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Assessment Framework and Application of the Long-Term Care Insurance System for Major Outbreaks of Infectious Diseases

-- A Case Study based on Germany, the United States and the United Kingdom

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Abstract

Summarizing and evaluating the latest progress of foreign LTC insurance system in a timely manner is of great significance for the establishment of LTC insurance system in China. Combined with the 4R crisis management theory, this paper applies the hierarchical analysis method and fuzzy comprehensive evaluation method to construct a multilevel contingency assessment framework for the LTC insurance system, which contains 4 first-level indicators, 15 second-level indicators and 30 third-level indicators, including infection risk reduction, nursing resource preparation, nursing resource supply, and system adjustment and change. The framework was applied to assess typical LTCI system models in Germany, the United States and the United Kingdom. The assessment results show that the German LTCI system performs better than the US and the UK in the event of a major infectious disease outbreak, while the LTCI systems of the three countries have a certain degree of vulnerability, and there is room for post-disaster "rebound". In view of the problems and challenges faced by the LTC insurance system in dealing with major outbreaks of infectious diseases, this paper suggests strengthening the top-level design of the LTC insurance system during the prevention and control of major outbreaks of infectious diseases, making every effort to minimize the risk of nursing infections, improving the availability of nursing human resources, and accelerating the implementation of digital solutions.

Keywords

Long-Term Care Insurance; Major Sudden-Onset Infectious Diseases; Assessment Framework; Case Studies.

1. Introduction

According to incomplete statistics, the proportion of deaths of elderly people infected with the new coronavirus is close to one-third of the total number of deaths, and the elderly and vulnerable groups with long-term chronic diseases have become a high-risk group of deaths due to viral infections. The long-term care insurance system, as a regular institutional design in some countries, has played an important role in maintaining the lives and health of the elderly and disabled groups in the emergency situation of the epidemic. However, under the catalyst of the epidemic, all kinds of political, economic and social problems are rapidly concentrated and magnified, which will easily cause the long-term care insurance system to fail. In addition, various unjust institutional designs in the construction of the LTCI system in various countries have also made the operation of the system deviate from its original purpose and fail to fulfill its expected functions.

Since the outbreak of the new coronary pneumonia epidemic, governments at all levels in China have decisively taken preventive and control measures and promptly adjusted their health

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insurance policies, clarifying the reimbursement policies for suspected and confirmed patients, which has strongly safeguarded the patients' right to life through fair access to medical care. However, the long-term care insurance system, which is an effective supplement to the health insurance system, is still in the pilot stage, and due to the lack of a unified top-level design, it has not yet played a practical role in the fight against the new coronary pneumonia epidemic. Therefore, in the process of building China's future LTC insurance system, we should not only fully summarize the practical achievements of the existing 49 pilot cities, but also face up to the crises and challenges of a risky society, draw on the experience and lessons learned from the LTC insurance systems of Europe and the United States in responding to the new coronary pneumonia outbreak, improve the emergency management capacity of China's LTC insurance system in responding to public health crises, and strive to reduce the system's internal pitfalls and friction of interests, and strengthen the system of combining peace and war. To strengthen the system's resilience in combining peace and war.

The current literature on the study of long-term care insurance system can be mainly divided into four stages. In the first stage, the system design of long-term care insurance in different countries and regions was introduced,and the feasibility of establishing a long-term care insurance system in China was initially explored in terms of financing channels, protection populations and commercial insurance development. [4-6] In the second stage, with the acceleration of population aging and the transformation of the disease spectrum of the population, various types of studies have emerged to address the needs of the long-term care insurance system, such as the use of Markov modeling and field research to measure the population needs, [7-9] revealing the differences in the needs of different groups between urban and rural areas. In the third stage, focusing on the operational status of the LTCI system in two batches of pilot cities in China, the effectiveness of the existing policy experiments was reviewed for typical pilots as well as comparisons of multiple pilots. [1] In the fourth stage, using the data accumulated over the years from the pilots, the operational status of the pilots was accurately assessed through case analysis, PMC index modeling, and big data algorithms such as BP networks, which provided a scientific basis for the design of the pricing mechanism of the LTCI system, and for the sustainable operation of the fund.

On the basis of the established literature, this paper will study the latest foreign progress of long-term care insurance policies to cope with the new coronary pneumonia epidemic, and the main contributions include the following three points: first, it constructs a multilevel emergency assessment framework for the LTC insurance system to cope with major outbreaks of infectious diseases, which includes four first-level indicators for the shrinking of the risk of infection, the preparation of nursing care resources, the supply of nursing care resources, and the system's adjustments and changes, 15 second-level indicators Second, combining a large amount of textual data, the assessment framework constructed in this paper is applied to assess and compare the LTCI systems of Germany, the United States and the United Kingdom in three typical modes, and explore the effectiveness and shortcomings of the systems of the three countries; third, in order to establish and improve the LTCI system nationwide, the assessment is conducted in terms of the top-level design of emergency management, the reduction of infection risk, the supply of human resources, the adjustment and change of the system, and so on. Thirdly, it puts forward policy recommendations on how to establish and improve the LTCI system in China in terms of the top-level design of emergency management, the reduction of infection risk, the availability of human resources, and the acceleration of the implementation of digital solutions for the reference of relevant government departments.

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2. Multi-tiered Emergency Assessment Framework for the LTCI System

2.1. Basic Idea

The LTCI system plays an important role in reducing the overall risk of the society, meeting the basic life care needs of the elderly, and rallying the overall strength of the society in the process of responding to the epidemic of new coronary pneumonia in western countries. Based on the large amount of literature on LTCI, the evaluation framework focuses on the "downsizing power", "readiness", "responsiveness" and "resilience" as proposed by Robert Heath. The assessment framework is based on the 4R crisis management theory proposed by Robert Heath, which consists of four phases: "Reduction", "Readiness", "Reaction" and "Resilience", and is designed through four major steps: individual exploration, group discussion, expert evaluation and indicator refinement. In this paper, we will develop and analyze the assessment framework based on the four first-level indicators: Reduction of infection risk, Readiness of nursing resources, Response of nursing service provision, and Recovery of system adjustment and change.

2.2. Assessment Indicators

Each of the four level 1 indicators examines four aspects of system resilience: the "infection risk reduction" dimension assesses the role of the LTCI system in the front-end of infection risk management; the "nursing resource reserve" assesses whether the nursing resource reserve can effectively meet the surge in nursing needs of infected persons and the basic nursing needs of uninfected persons during the "wartime state" of a major public health crisis event; the "nursing resource reserve" assesses whether the nursing resource reserve can effectively meet the surge in nursing needs of infected persons and the basic nursing needs of uninfected persons. The "Nursing Resource Reserve" assesses whether the nursing resource reserve can effectively meet the surging nursing needs of the infected and the basic nursing needs of the uninfected during the "wartime state" of a major public health emergency and crisis; the "Nursing Service Supply" examines whether various types of nursing service resources, including at-home, institutionalized, and hospitalized nursing services can meet the needs of the infected during the epidemic. The "nursing service supply" examines whether various nursing service resources, including home, institutions, hospitals, etc., can be delivered in a demand-centered "quality and quantity" manner under the blockade of the epidemic; institutional adjustment and change is the greatest manifestation of institutional resilience, which is reflected in the ability to quickly and flexibly adjust the "usual" laws, policies, and institutional norms to adapt to the epidemic. Institutional adjustment and change is the greatest manifestation of institutional resilience, which is reflected in the ability to quickly and flexibly adjust the "usual" laws, policies and institutional norms to adapt to the emergency situation under the epidemic. In summary, the system effectiveness assessed by the four dimensions of Level 1 (4), Level 2 (15), and Level 3 (30) indicators can provide a more systematic and complete reflection of whether the design of LTCI systems in different countries and regions is able to achieve the ultimate goal of "dual use in times of peace" (see Table 1 below). (See Table 1 below.)

2.3. Evaluation Methods

Fuzzy comprehensive evaluation (FCE) is a quantitative method based on the theory of fuzzy mathematical affiliation, which can systematically evaluate fuzzy and difficult-to-quantify problems, with clear results, and is suitable for solving a variety of non-deterministic problems. [18] In this paper, it is difficult to use traditional quantitative methods to scientifically construct quantitative indicators for rational evaluation of the long-term care insurance system, so this paper adopts the fuzzy comprehensive evaluation combined with hierarchical analysis to determine the indicator weights and performs the defuzzification operation on the assessment

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matrix. The determination of indicator weights specifically through the Delphi method, a total of 10 experts were selected (7 college teachers of social security, emergency management and chronic disease management of Chengdu Medical College of Southwest Jiaotong University, 2 deputy chief physicians of the Western Theater General Hospital, and 1 person in charge of the recreation board of China Quality Certification Center), and a total of three rounds of expert consultation, issuance and recycling of questionnaires were conducted in the early stage of the indicator identification and scoring, and finally realized the Summary of findings.

The first round of expert consultation first analyzed the "LTC responses to COVID-19" series of thematic reports issued by the International Long-term care Policy Network. "LTC responses to COVID-19 published by the International Long-term care Policy Network (ILCPN) were analyzed and validated, and the indicators with a high degree of recognition by experts were entered into the second round of consultation, while the controversial indicators were eliminated and revised in various ways. According to the feedback from the experts, 3 of the secondary indicators were deleted and merged, and 8 were revised.

The second round of expert consultation determined the final weights of the primary and secondary indicators and the evaluation scores of the case content through a seven-level Likert scale. Specifically, according to the experts' own experience in theoretical research and practical work, the importance of level 1 and level 2 indicators was assigned, averaged according to the classification of the indicators, and then normalized, and the corresponding weight scores were finally calculated.W represents the weight score of each indicator, and A represents the average value of the experts' scores on the indicators. The third-level indicators are weighted by equalization, which simplifies the statistical calculation process, makes the assessment results more intuitive, and fully embodies the characteristics of the assessment elements that are complementary to each other.

Normalization of the mean value of the first-level indicators:

Example: W1=A1/(A1+A2+A3+A4)=0.4026

Normalization of the mean values of the secondary indicators:

Example: W11=A11/(A11+A12+A13+A14)=0.49

According to this method, the weights of the indicators at each level can be calculated sequentially:

Infection risk reduction W1=[0.49 0.13 0.31 0.007]

Nursing resource preparation W2=[0.205 0.025 0.33 0.44]

Nursing service supply W3=[0.52 0.12 0.04 0.32]

System Adjustment and Change W4=[0.20 0.44 0.36]

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Table 1. Multi-tiered emergency assessment framework for the LTC insurance system

Level 1 indicators	Level 2 indicators	Level 3 indicators
1.Infection risk reduction (0.4026)	(1)Nucleic acid testing is adequate and accessible(0.49)	Adequate: all available tests Accessible: free or affordable
	(2)Well-coordinated care(0.13)	Transfers: good linkages between different hospitals Discharge: safe return to home, institution and community
	(3)Keeping track of caregivers(0.31)	Timely: real-time reporting of cases of infected workers to authorities Accurate: ability to trace the movement of infected workers
	(4) Closed homes, institutions and communities (0.007)	Closed status: with or without explicit visitor ban Visitor management: appointment, registration and protection of visitors
2. Nursing Resource Preparedness (0.1814)	(1) Capacity to control sources of infection (0.205)	Isolation space: whether there is a separate space for isolation Protective conditions: whether adequate protective gear is available
	(2) Issuance of advanced immunization guidelines (0.025)	Harmonization level: whether the central and local authorities have issued advanced vaccination guidelines Degree of updating: whether the guidelines are regularly updated with advanced vaccination guidelines
	(3) Availability and well-being of formal caregivers (0.33)	Compensation and benefits: higher wages, additional subsidies Social support: provision of studies, guidance, childcare services
	(4) Unpaid (informal) caregivers (0.441)	Remuneration package: reimbursement of expenses for kinship care services Social support: support for home care for relatives
3.Nursing service supply (0.1381)	(1) Maintaining home care during a pandemic (0.52)	Specialized services: specialized personnel and specialized protective equipment Remote management: remote care services and reimbursement of expenses
	(2) Maintaining institutional care during the pandemic (0.12)	Specialized services: professional staff and specialized protective equipment Remote Management: Provision of Telecare Services and Reimbursement of Expenses
	(3) Maintaining community-based care during a pandemic (0.04)	Professional Services: Professional staff and specialized protective equipment Remote management: provision and reimbursement of telecare services
	(4) Maintaining care for people with dementia (0.32)	Professional Services: Professional staff and specialized protective equipment Remote management: provision and reimbursement of telecare services
4.System Adjustment and Change (0.278)	(1) Introducing long term care related relief bill (0.20)	Financial support: support for nursing homes and caregivers Vulnerable groups protection: dedicated financial support for ethnic minorities
	(2) Adjusting the existing norms of the long term care system (0.44)	Deregulation: suspension of routine inspections and reduction of staff mobility Enhanced support: better information sharing, relaxation of telemedicine restrictions
	(3) Legislation on new initiatives has been enacted at all levels of government (0.36)	Level of legislation: central or local government Speed of response: time taken to legislate

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3. Assessment of Cases in Germany, the United States and the United Kingdom

3.1. Overview of the Pilot Cases in the Three Countries

The LTC insurance system and its related policies are an important institutional arrangement for China to implement the national strategy of actively coping with population aging, and also a public system with strong regularity for countries to cope with the challenges of population aging, to control medical expenses and to maintain the safety of health insurance funds. In this paper, three typical countries (Germany, the United States and the United Kingdom) are selected to represent three different models of LTC insurance system for specific analysis.

The continental model represented by Germany is characterized by fair and orderly competition, high operational quality and huge operational costs. Germany enacted the Long-Term Care Insurance Act (LTCIA) in 1994, becoming the first country in the world to implement special legislation for long-term care insurance. Long-term care insurance system has also become the “fifth pillar” of the German health insurance, pension insurance, accident insurance and unemployment insurance. [The German long-term care insurance system is famous for its “mandatory income-related” feature, and the law clearly stipulates the principle that the long-term care insurance system follows the health insurance system. As a mandatory compulsory insurance, Germany's long-term care insurance has reached 96% in 2013, and the rest of the population is mostly state employees.

The hybrid model represented by the United States is characterized by a market-driven approach, low quality of operation and a wide gap in the level of coverage. The LTC insurance system in the United States consists of a combination of the social security system and commercial insurance, which mainly covers the costs incurred by the insured for any personal care. In practice, most of the long-term care services in the U.S. are supported by the Medicare and Medicaid systems of the social security system, with the Long-Term Care Cooperative Program (LTCPP) playing a meager role. But the Social Security system has limited coverage and is under financial pressure. Meanwhile commercial insurance, with its high contribution rates and stringent scrutiny, leaves less than 10 percent of the U.S. population over the age of 50 with commercial insurance.

The Nordic model, represented by the UK, is characterized by limited access to financing, high utilization thresholds and low coverage. The LTC insurance system in the United Kingdom provides services mainly in the form of community care, and the state implements social security policies to provide long-term care benefits to citizens through tax financing. In terms of the financing mechanism, public finance can only cover part of the cost of long-term care, and most of the cost has to be borne by the cared-for person and his/her family. The threshold for receiving State-provided long-term care services is high, and only individuals whose assets fall below a certain threshold are eligible to receive government support. Citizens who do not meet the conditions are fully responsible for all long-term care costs; in terms of service content, the British long-term care insurance system focuses on providing low-income elderly people aged 65 and over and disabled groups with relief-type allowances such as the Disability Living Allowance, the Elderly Nursing Allowance Community Nursing Supplement Allowance, and Informal Nursing Care Providers Income Supplement;in terms of the operation and management mechanism, the government is directly responsible for the management of long-term care In terms of operation and management mechanisms, the government is directly responsible for managing long-term care service organizations, investigating the qualifications and incomes of both supply and demand, and supervising service quality.

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3.2. Specific Assessments

Table 2. summarizes in detail the key practices of the LTCI systems in the three countries in response to the new CRP epidemic.[29]

	Germany	United States	United Kingdom
Infection risk reduction	Nursing facilities and local health departments collaborate on regular testing of at-risk populations, with ongoing tracking of institutional status. [2] Patients discharged from hospitals must first be isolated for 14 days in nursing homes.	Lack of extensive testing is the biggest problem in nursing homes;[3] there have been news reports of residents being evicted from nursing homes; there is a lack of integration between the acute care and long-term care sectors.	In the second wave of the epidemic, nucleic acid testing was gradually extended to social care workers,[4] and in order to clear hospital beds to cope with the surge in the proportion of confirmed diagnoses, elderly patients were being discharged from hospitals and transferred to care homes without being tested. [5]
	Every confirmed case of a suspected or infected caregiver must be reported to the local health department;[6] 3 categories of exposure are classified according to the degree of contact with the confirmed case, and different tracking and testing measures are arranged;	There are no statistics on infection rates among caregivers and no uniform measures are in place; [7] homes and communities are not closed; most care facilities are not allowed visitation and family members are not informed. [8]	Personal Protective Equipment (PPE) is not provided in sufficient quantities and of appropriate specifications to protect staff providing care services." [5] While there is no formal prohibition on visiting nursing homes, visits are not allowed except in end-of-life situations;
Preparation of nursing resources	Suspected infected patients and close contacts are immediately moved into single rooms reserved for isolation; when there is a confirmed case in the facility, the space and staff are immediately divided into three zones to isolate the healthy population, suspected infected patients, and confirmed patients; and, in accordance with regulations issued by state governments across the Commonwealth, the nursing home administrators and the local Department of Health work together to develop a plan for prevention of epidemics.	Nursing homes are under-equipped; residents who test positive need to be moved to a new location for quarantine. [9] The National Center for Disease Control and Prevention has issued preparedness guidelines and continues to update them. [7]	Central government guidance issued for care homes focuses only on symptomatic people, and the potential for transmission from latent or asymptomatic patients has been officially ignored; local authorities have a responsibility to utilize the £1.3 billion of hospital discharge funding to provide alternative accommodation for people in isolation. [10] During the pandemic, there were several updates to the guidance on infection prevention and control in care homes. [11]
	The German government has continued to raise the minimum wage for nursing assistants and all nursing employees will be	At the state level, there are programs to convene retired and inactive health care providers; to call on health care providers in other sectors to support long-term	Mentoring, learning resources, discounts and other support for caregivers; an infection control fund has been

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	entitled to additional paid leave beyond the statutory holidays;[12] the Bavarian Minister of Health and Nursing and the Minister of Finance have announced a financial subsidy of 6.5€ per day for all regular nursing employees;[13] the federal states and organizations have developed the "Nursing Reserve "website, which allows anyone with a nursing qualification to register. [14]	care; to relax practice regulation restrictions for nursing practitioners; to assess the competence of unpaid caregivers and use telehealth to guide unpaid caregivers; to reimburse family and friends for the cost of caring for patients and making telehealth appointments; and to encourage the inclusion of more people in nursing programs. [15]	established and all quarantined caregivers will continue to be paid their full wages; social care workers have been designated as "key workers" to enable them to continue to have access to childcare after school closures;[16]
Supply of care resources	There is a specialized staff that is sensitive to the health status of the residents. [2] The Ministry of Health will directly compensate care facilities for additional costs or loss of income due to the outbreak; in Lower Saxony, 14,500 nursing homes received tablet computers for regular medical consultations via videophone.	Expanded access to telehealth services for seniors through Medicare. Telemedicine services are provided in the home/facility/community in response to acute care needs for serious confirmed cases. Licensed clinical social workers, clinical psychologists, occupational therapists, and speech-language pathologists are allowed to participate in virtual exams and remote assessments.	Shift more in-home care to online/telephone platforms, but are small and under-resourced; reimbursement of costs for making telehealth appointments. [17] Allow nursing homes and shelters to reopen under certain circumstances, actively supporting institutionalized patients through individualized care and planning, as appropriate. [18]
	Day care centers have been closed throughout Germany; emergency care is available in day care centers in the Länder. [24] Germany's Alzheimer's Association has developed materials (documents, podcasts, and videos) to support people with dementia and their family caregivers, and also offers a telephone helpline. [19]	The cost of remotely monitored patients can be approved for reimbursement; 3. The National Association for Home Care and Hospice is acting as a clearinghouse to minimize the spread of the virus in community care settings. [20]	Safe care using telemonitoring technology; [21] The Department of Health and Social Welfare, together with local government, provides innovative digital solutions; 2. The government provides guidance for carers supporting adults with intellectual disabilities and adults with autism. [17]
Institutional adjustments and changes	A second law was introduced to protect the population by committing to tax-free bonuses for all types of home and institutional caregivers (formal, informal and volunteer).[22] [Suspension of quality of care assessments in all regions by the Ministry of Health; adjustment of the Caregiver's Leave Act and the Family Caregiver's Leave Act in order to	Of the funds earmarked for health care providers in the CARE Act, $30 billion is now being paid to hospitals and long-term care providers, including home health care;[23] the Family First Coronavirus Response Act earmarked $10 million for meal support for Native Americans, and the stimulus bill earmarked $40 million for health care services for people of Indian descent. [24] Regulatory Deregulation: routine inspections of nursing homes were suspended. However, facilities that had previously been found to be out	The Social Care Action Plan will invest £2.9 billion in funding "to enhance care for vulnerable people;[26] a £600 million Infection Control Fund has been established to support the normal functioning of care homes;[27] there is a national moratorium on routine inspections of care services, subject to the regular sharing of key information and action to safeguard the safety of

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	respond more flexibly to the current situation of long-term care in the context of the epidemic. Extended the statutory leave period from 10 to 20 days for family members who have a caregiving emergency under normal circumstances. The Ministry of Health suspended the quality of care assessment across the country.	of compliance would continue to be inspected. [25]	people being cared for and the protection of their human rights;[28] and The Coronavirus Act allows for delayed assessments to enable rapid discharge of patients in the event of labor shortages or increased demand.

First, the evaluation set V=(v1,v2,v3,v4,v5) is established to indicate (strongly agree, relatively agree, generally, relatively disagree, completely disagree); the policy identity evaluation indicator set U, contains four guideline layers of infection risk reduction, nursing resource preparation, nursing service provision, and system adjustment and change, so U=(Ui) (i=1,2,3,4), where Ui is additionally composed of secondary indicator Uj (j=1,2,3,4).

Due to the length of the derivation for three countries, it is demonstrated here using Germany as an example:

$$R_1=\begin{bmatrix}0.7 & 0.2 & 0.1 & 0 & 0\\ 0.6 & 0.4 & 0 & 0 & 0\\ 0.6 & 0.3 & 0.1 & 0 & 0\\ 0.6 & 0.2 & 0.1 & 0.1 & 0\end{bmatrix} \quad R_2=\begin{bmatrix}0.5 & 0.3 & 0.1 & 0.1 & 0\\ 0.4 & 0.5 & 0.1 & 0 & 0\\ 0.3 & 0.6 & 0.1 & 0 & 0\\ 0.3 & 0.4 & 0.2 & 0.1 & 0\end{bmatrix}$$

$$R_3=\begin{bmatrix}0.1 & 0.2 & 0.2 & 0.3 & 0.2\\ 0.2 & 0.3 & 0.2 & 0.2 & 0.1\\ 0.1 & 0.6 & 0.2 & 0.1 & 0\\ 0 & 0.3 & 0.4 & 0.1 & 0.2\end{bmatrix} \quad R_4=\begin{bmatrix}0.3 & 0.3 & 0.3 & 0.1 & 0\\ 0.4 & 0.2 & 0.3 & 0.1 & 0\\ 0 & 0 & 0 & 0.3 & 0.7\end{bmatrix}$$

3.2.1. Establishment of a Fuzzy Comprehensive Evaluation Model

Find the fuzzy comprehensive evaluation set B through the comprehensive evaluation matrix R above:

$$B=W*Ri(i=1, 2, 3, 4) \quad (1)$$

Then, the composite evaluation score is calculated, i.e., the composite evaluation score E of the evaluation object is calculated using the fuzzy composite evaluation set B and the measurement scale H, where H is a specific assignment for the evaluation set V:

$$E=B*H \quad (2)$$

Where H = (strongly agree, relatively agree, generally, relatively disagree, completely disagree) = (5,4,3,2,1).

According to formula (1) and the weight values assigned to each indicator, the second level of fuzzy comprehensive evaluation set is derived:

$B_1=W_1*R_1=[0.6112\ \ 0.2444\ \ 0.0807\ \ 0.0007\ \ 0]$

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$B_2=W_2*R_2=[0.3435\ \ 0.448\ \ 0.144\ \ 0.0645\ \ 0]$

$B_3=W_3*R_3=[0.08\ \ 0.26\ \ 0.264\ \ 0.216\ \ 0.18]$

$B_4=W_4*R_4=[0.236\ \ 0.148\ \ 0.192\ \ 0.172\ \ 0.252]$

According to formula (2), the defuzzification operation was performed sequentially on the guideline level evaluation set to obtain the evaluation value of policy identity for each guideline level of infection risk reduction, nursing resource preparation, nursing service provision, and system adjustment and change, respectively.

$E_1=H*B_1=5*0.6112+4*0.2444+3*0.0807+2*0.0007+1*0=4.2771$

$E_2=H*B_2=5*0.3435+4*0.448+3*0.144+2*0.0645+1*0=4.0705$

$E_3=H*B_3=5*0.08+4*0.26+3*0.264+2*0.216+1*0.18=2.844$

$E_4=H*B_4=5*0.236+4*0.148+3*0.192+2*0.172+1*0.252=2.94$

3.2.2. Calculation of the Comprehensive Evaluation Results

Based on the weights of the four first-level indicators and the values of B1, B2, B3 and B4, the overall evaluation set E can be derived:

$$E=H*Ei=0.4026*4.2771+0.1814*4.0705+0.1381*2.844+0.278*2.94=3.67,\ (i=1,\ 2,\ 3,\ 4)$$

As a result, the fuzzy composite values of the indicators for each level of the German, US, and UK LTC insurance systems in response to the new Crown pneumonia outbreak are derived.

Table 3. Summary of policy identity questionnaire rating data

Evaluation Objectives	Primary Indicators	Secondary Indicators	Germany	United States	United Kingdom
System Adjustment and Change LTCI System Resilience Score 3.67/2.54/2.92	W_1(0.4026) 4.27/1.16/2.12	W_{11}(0.49)	4.6	1.2	3.1
		W_{12}(0.13)	4.6	1.5	1.6
		W_{13}(0.31)	4.5	1.2	1.2
		W_{14}(0.007)	4.3	1.2	2.6
	W_2(0.1814) 4.07/3.60/3.85	W_{21}(0.204)	4.2	2.1	2.6
		W_{22}(0.025)	4.3	2.8	3.1
		W_{23}(0.33)	4.2	3.8	4.2
		W_{24}(0.441)	3.9	4.2	4.2
	W_3(0.1381) 2.84/4.0/3.56	W_{31}(0.52)	2.7	4.4	3.7
		W_{32}(0.12)	3.3	4.4	2.9
		W_{33}(0.04)	3.7	4.4	1.9
		W_{34}(0.32)	2.4	3.1	3.8
	W_4(0.278) 2.94/3.13/3.17	W_{41}(0.20)	3.8	3.9	4.1
		W_{42}(0.44)	3.9	4.2	4.2
		W_{43}(0.36)	1.3	1.3	1.4

Note: The numbers under Evaluation Objectives and Level 1 Indicators indicate, from left to right, the ratings for Germany, the United States and the United Kingdom, respectively.

3.2.3. Summary of the Assessment

According to Table 3 and Figure 1, the LTC insurance systems in Germany, the United States and the United Kingdom all have a certain degree of institutional vulnerability, there is room for “rebound” after a disaster, and there is a lower average score, especially in the module of institutional adjustment and change. The LTCI system in the German continental model had a resilience score of 3.67 in response to the C.N.C.P. outbreak, which was at the average to relatively satisfactory level, with the highest scores in the modules of infection risk reduction

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and care resource preparation. The resilience score of the US mixed-model LTC insurance system was 2.54, at the relatively unsatisfactory to fair level, with the highest scores in the care service provision module and weaker scores in the infection risk reduction and care resource preparation modules; the resilience score of the UK Nordic-model LTC insurance system was 2.92, at the relatively unsatisfactory to fair level, with lower scores in the infection risk reduction level module, and lower scores in the higher scores on the modules of care resource preparation and care service provision.

4. Conclusion

By transforming a large amount of qualitative information into quantitative indicators for analysis through the fuzzy comprehensive evaluation method, the evaluated values of four first-level indicators, namely, infection risk reduction, care resource preparation, care service provision, and system adjustment and change dimensions of long-term care insurance in Germany, the United States, and the United Kingdom, during the response to the New Crown Pneumonia outbreak have been calculated as the basis for evaluating the system resilience of the three models in response to the New Crown Pneumonia outbreak. (a) German LTCI system.

4.1. German LTCI System

Germany's LTCI system has strong overall effectiveness, with a particular focus on curtailing the risk of infection for those being cared for, and is ahead of the U.S. and the U.K. in nucleic acid testing (4.6), which is critical in terms of its adequacy and accessibility, with a weighting of 19.72% in the overall indicator system. Strict classification criteria and segregation measures during referral coordination between hospitals, nursing homes, and homes, and tracking of staff in institutions and in-home care providers minimize the problem of cross-aggregation of infections in the long-term care system. The German federal government has issued strong decrees and provided financial support to help the Länder keep their long-term care systems functioning well, and mandatory long-term care insurance compensates care facilities for the additional costs and loss of revenue associated with the new coronavirus outbreak. On the other hand, the German government has continuously increased the wages of caregivers, paid all bonuses in one lump sum, and provided support to unpaid caregivers such as family members and friends. However, there are significant weaknesses in the German LTC insurance system in terms of the supply of care services (2.84), especially the lack of attention and information collection for vulnerable groups such as people with dementia.

4.2. LTC Insurance System in the United States

The U.S. federal system ensures that states and the federal government have shared and overlapping responsibilities in responding to the outbreak of C.N.C. pneumonia. However, the lack of uniform administrative directives from the US federal government during the response process has led to confusion and even confrontation among the states in their response. The U.S. currently leads the world in the number of confirmed cases of the C. neoformans outbreak, and the lack of widespread nucleic acid testing (1.2) has been the primary problem. There are significant regional differences in the impact of the C. neoformans epidemic on health and social systems in the United States, including long-term care insurance. Although the U.S. model performs poorly on infection risk reduction and care resource preparation, it has a high care provision score (4.0) by virtue of a strong health care base, particularly in the use of advanced medical technologies and medicines, the recruitment of retired health care workers, and the role of private nonprofit organizations. As for system adjustment and change (3.13), due to the greater independence of local autonomy in the United States, localities were able to quickly adjust the LTCI system and respond more flexibly to the shock to the healthcare system caused by the new Crown pneumonia epidemic.

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4.3. LTC Insurance System in the UK

The initial policy response to the CKP epidemic in the UK did not fully take into account the social care sector. Lack of and delays in nucleic acid testing and personal protective equipment (PPE) contributed to a high mortality rate of cared-for people infected with the new coronavirus in the first wave of the outbreak, and the situation did not abate until the second wave of the outbreak. The biggest highlights of the work of the UK's long term care sector have been the full development of programs in consultation with unpaid caregivers and the active enactment of a bill focusing on allocating funds to focus on the care needs of vulnerable populations. In the case of Resource Preparation for Care (3.85), the UK government not only established an Infection Support Fund and incentivized the provision of full wages during the quarantine period, but also provided continuity of care for the family's children during the school closure period, as “key workers”. In addition, due to the lack of epidemic prevention materials, the British long-term care system has been forced to vigorously expand online services, actively explore a set of digital solutions, and use long-term care insurance funds to reimburse online care, counseling and other services, so that the score in the care service supply sector is high (3.56).

5. Policy Recommendations

Combining the construction of the indicator system and the policy practices of Germany, the United States and the United Kingdom, the assessment results from the four levels of infection risk reduction, nursing resource preparation, nursing service supply and system adjustment and change, respectively, to establish and improve the “dual-use” long term care insurance system in China to make corresponding recommendations:

Strengthen the top-level system design for the prevention and control of major infectious disease outbreaks. At present, the horizontal policy diffusion process triggered by the multi-location pilots of China's long-term care insurance system has seen the emergence of two diffusion mechanisms, namely learning and imitation, and has initially revealed the characteristics of convergence and blindness coexisting. According to the policy texts of the existing pilots, no city has yet taken into account the response program for major infectious disease outbreaks. In view of the messy situation in the U.S. and the U.K., where the LTC insurance system has gone its own way at the local level in response to the new Crown pneumonia epidemic, China, in the process of summarizing the gains and losses of the existing pilot experiences, will also have to clarify important issues such as the central and local responsibilities, sources of funding, scope of coverage, and human resources of the LTC insurance system, so as to form a set of systematic and mechanistic contingency plans.

The front-end hurdle of infection risk reduction is the top priority of the emergency program. This is an inevitable choice determined by the number of elderly people in China and the limited medical resources per capita. China lacks the strong healthcare base and per capita wealth income of Europe and the United States, and must minimize the risk of infection in the elderly, the disabled and other vulnerable populations by ensuring adequate and universal access to viral testing, and the flow of patients between hospitals, institutions and homes must be managed in a refined manner to cut off all possible chains of transmission of viral cross-infection. In addition, it is worth noting that the practical experience of Germany, the United States and the United Kingdom has proven that a blanket embargo is not effective, but rather a disregard for the human rights of those being cared for.

Enhancing the availability of human resources is as important in “peacetime” as it is in “pandemic times”. The shortage of nursing staff and professional nursing service capacity is an important constraint to the benign development of China's elderly care services and the long-term care insurance system in pilot cities. We should take advantage of the valuable

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opportunity to carry out pilot work to first establish a mechanism for occupational access, vocational training and assessment and management, to promote the development and utilization of human resources in the elderly care industry, to comprehensively improve their working conditions and social status, and to guarantee the social insurance coverage of nursing staff. coverage. In addition to strengthening the tracking and nucleic acid of all nursing staff during the epidemic prevention and control period, it is also necessary to timely implement the insurance payment and full treatment compensation for work-related infectious diseases.

Digital solutions are imperative. At the micro level, data for vulnerable groups such as dementia patients and the physically challenged should be accurately recorded on a digitized integrated management platform to effectively monitor the normal vital signs of those being cared for, and to safeguard the continuity and stability of care services. Mesoscopically, digital technology is used to assist and empower the traditional service model, providing more transparent and convenient intelligent services and management tools for stakeholders such as long-term care insurance recipients, care workers, designated institutions and the government, and realizing the digital operation of the links from enrollment and management, treatment payment, auditing and assessment, expense reimbursement, etc., but in a foolproof way, with “one-stop” operation. One-stop” operation. At the same time, the data barriers of multiple departments such as health insurance, human resources and social security, the Health and Wellness Commission and the Elderly Commission should be bridged, so as to establish a credit system for long-term care insurance services from top to bottom. At the macro level, the long-term care insurance system should be deeply integrated with the construction of “digital China” and “smart cities”, and should be promoted together with the supply-side reform of elderly care services, supervision and the deepening of the reform of the medical system.

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[29] Table 2 focuses on typical practices in the three countries and therefore does not follow the content of each indicator in Table 1.