Introduction to the special issue on health risk assessment

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Abstract. The main purpose of health risk assessment and prediction is to explore the potential risk factors and to assess and predict the possible risks of people and individuals. It can not only intervene the high-risk groups in advance, but also improve the medical process, which has great practical significance. Health risk assessment is mainly for regulatory purposes, which usually emphasizes specific health endpoints and specific exposure routes or pathways of hypothetical population. However, in real life, people are often affected by a variety of stressors, resulting in more and more health risk factors. The traditional narrow sense of risk assessment has been unable to adapt. This special issue will focus on new methods, models and theories that have been applied or are being developed to assess the cumulative health risks of various hazards exposed to the environment. Research theses, analytical reviews, case studies, conceptual framework and policy related articles will be collected.

Keywords: Health management system, health risk assessment, public health events, environment, chronic diseases

1. Introduction

From the global perspective, the user demand of health management is very large. With the aging and the westernization of living habits, the number of people with chronic diseases grows rapidly at geometric level. In short, the purpose of health risk assessment is to transform health data into health information. Specifically, the main purpose of health risk assessment are as follows: 1) helping individuals to comprehensively understand health risk factors; 2) encouraging and helping people to correct unhealthy behaviors; 3) formulating personalized health interventions; 4) evaluating the effectiveness of interventions; 5) classifying health management groups.

The application fields of health risk assessment include hospitals, physical examination centers, community health service centers and other medical and health service institutions, as well as enterprises and health insurance industry. Through health risk assessment, medical units or institutions can extend the existing service content, carry out individualized health education and health promotion and targeted disease management services, and effectively stabilize and expand the service population; enterprises and other workplaces can introduce their own health management projects, improve the occupational safety coefficient of the enterprise population, reduce the health risk of employees, and reap comprehensive rewards such as employee health, enterprise medical expenses saving, cohesion improvement and competitiveness enhancement; the health insurance industry can determine a more reasonable insurance premium, quantify the health and medical cost risk of the insured population, and help reduce its own business risk. Moreover, health insurance companies can also cooperate with relevant institutions to carry out professional health management services and create professional service content and business model. Health risk assessment includes three basic modules: questionnaire, risk calculation and assessment report.
Nowadays, the vast majority of health risk assessment has been computerized.

2. Research areas

2.1. Health risk assessment in public health emergencies

Public health emergencies refer to the sudden occurrence of major infectious diseases, mass unexplained diseases, major food and occupational poisoning and other events that seriously affect public health, which cause or may cause serious damage to public health. Risk assessment refers to the process of risk identification, risk analysis and risk assessment to assess the risk of public health emergencies and public health risks of other emergencies, and put forward risk management suggestions. Early detection, identification and assessment of public health risks are of great significance for effective prevention and response to public health emergencies.

From 1914 to 2019, a total of 41 major public health emergencies occurred in the world, and the average outbreak interval has been shortened from about 4.7 years before 2000 to about 0.87 years after 2000. Public health emergencies have entered a new stage of normalization, in which old diseases recur and new diseases emerge. The outbreak of 2019-nCoV is a new infectious disease in the new stage. Although governments at all levels have made rapid response and achieved good control effect, the problems caused by the lack of preparation of local governments before the epidemic, such as the rapid spread of the epidemic, the lack of medical resources, the shortage of isolation places and so on cannot be ignored. Therefore, it makes people realize the lack of foresight in urban planning layout, medical resource allocation and park green space construction. Therefore, it is necessary to deeply integrate public health discipline and urban planning discipline, put urban planning construction at the front end of public health safety and epidemic prevention and control, enhance the safety and resilience of the city, and promote the construction of a healthy city by strengthening the emergency support capacity of urban space.

In the work of 2019-nCoV, the effectiveness of comprehensive prevention and control measures based on community prevention and control has been confirmed. Through the implementation of grid and carpet management, and the spatial control of the input, spread and output of the epidemic, the development of the epidemic has been gradually suppressed. In the context of epidemic situation, health risk assessment system has gradually attracted people’s attention. Through bioelectrical induction technology, human body electrical impedance measurement technology and chronoamperometric analysis method, the functional status of various organs can be evaluated mainly from the perspective of functional medicine. The functional status of various organs of nine major systems of human body can be evaluated in 5 minutes and 38 seconds. Through the analysis and assessment of the immune defense stage of each organ, the susceptibility of the body to the new type of pneumonia is accurately judged, so as to help quickly distinguish the susceptible population and prevent the spread of the epidemic. As the organizational unit of residents’ life and the basic unit of social governance, community is not only the forefront of urban disaster prevention and epidemic prevention, but also the first “gate” of epidemic prevention. Risk assessment is the scientific basis and important foundation to effectively guide the construction of resilient and healthy community.

2.2. Environmental health risk assessment

With the rapid development of economy and society and the gradual improvement of residents’ health awareness, environmental health problems have become increasingly prominent. Although some environmental pollution problems have been improved through governance, the current global environmental pollution situation is still not optimistic. Quantitative assessment of the population health risk in environmental pollution and taking effective intervention and protection measures, has become an important problem to be solved in the field of public health. In the 1970s, the Environmental Protection Agency and the World Health Organization took the lead in environmental health risk assessment, and gradually formed a relatively complete assessment system, which provided important support for the formulation of relevant policies and regulations.

Analyzing, evaluating and predicting the health effects of various factors can not only help people to improve their awareness of health risk factors and formulate health intervention measures, but also provide corresponding data support and guidance for the formulation of some policies. With the increasingly serious problem of air pollution, many countries and regions have formulated air pollution concentration standards and a series of countermeasures.
According to the air quality standard issued by the World Health Organization, the daily average concentration of PM2.5 should not exceed 25 μg/m³, while the annual average concentration should not exceed 10 μg/m³. According to the standard, about 87% of the world’s people live in areas with excessive PM2.5 concentrations. In 2013, the global burden of disease study ranked PM2.5 exposure as the seventh leading cause of death, and PM2.5 exposure led to about 2.9 million premature deaths worldwide. In addition, due to the high population density and rapid economic development in big cities, compared with other cities, the air pollution and disease burden caused by pollution in big cities are more serious.

The environment pollution situation is severe, which presents the characteristics of water, soil, air and other multi-environmental media, and it is difficult to eliminate in a short time. Therefore, how to accurately evaluate the impact of environmental pollution on the health of the population and take effective intervention measures to reduce the damage of environmental pollution on the health of the population has become the focus of the whole society. The system of environment and health monitoring, investigation and risk assessment has been gradually established and improved. The environment and health monitoring of drinking water, air and soil, which are closely related to residents’ health, has been strengthened. The research on the relationship between environmental pollution and disease, health risk assessment, early warning and intervention protection has been carried out. By integrating the existing environmental data and health data resources and improving the technical ability of environmental health risk assessment, the working mechanism of environmental health risk assessment is established, and the environmental health risk assessment is gradually institutionalized and normalized. On this basis, it is necessary to establish a scientific data sharing mechanism, reasonably strengthen the coordination and cooperation between departments, enhance public awareness of environmental health risks, promote the policy transformation of risk assessment results, and finally achieve the goal of risk assessment to support government decision-making and serve the society and the public. The uncertainty and universality of risks lead to the diversity and complexity of environmental health problems. Effective risk management is a powerful measure to prevent and control environmental health problems. Through scientific and reasonable risk assessment, when the risk uncertainty is reduced, the occurrence of environmental health problems is reduced to protect public health.

2.3. **Health management and risk assessment of the elderly**

The mode of health management and combination of medical care and nursing care for the elderly is still being tried. The ability of community health service center to provide daily care, chronic disease management, rehabilitation, health education and consultation, Chinese medicine health care and other services for the elderly needs to be improved. In the survey, a community health service center extends the nursing service to the residents’ families, and also cooperates with the nursing home to provide care, regular diagnosis and treatment and other services for the patients, trying to carry out health management for the elderly in the mode of combination of medical care and nursing care. Among them, a health service center also launches a rehabilitation treatment consulting room to provide help for the rehabilitation of stroke patients after treatment in a 3A hospital. However, day care, full care, half care and other forms of care services for the elderly still need to be gradually enriched and improved. Although family sickbed service has been carried out in most community health service centers, due to resource constraints, the number is small, and the types of services provided are single, which cannot meet the demand.

The coverage rate of electronic health records of community residents, especially the contracted patients, is very high, and the filing rate is 70% ~ 90%. However, the frequency difference of file updating is quite different. In addition to the unified physical examination of the elderly, the update of electronic health records can only rely on clinical treatment. Moreover, these community health service centers do not use health records to carry out health risk assessment for individuals or groups, and lack the ability to carry out health risk assessment. Most of the elderly are accompanied with one or more chronic diseases at the same time, and there are great security risks after discharge. Fall, medication errors, lost, aspiration, asphyxia, scald and other abnormal nursing accidents related to patient safety are all nursing adverse events. These high-risk hidden dangers seriously threaten the safety of the elderly, reduce the quality of life of the elderly, and concern the whole family. Whether the elderly can get continuous and effective long-term care after discharge is the key to improve their daily life ability and
quality of life, and the key to a harmonious family. The comprehensive health assessment of the elderly is a multi-dimensional assessment method to measure the overall health level of the elderly from the aspects of physical health, mental health, functional status, social adaptability and environmental conditions.

2.4. Health risk assessment of patients with chronic diseases

Health is the most precious wealth in life. With the improvement of people’s living standards, the awareness of health risk assessment has been paid more and more attention. In recent years, with the change of disease spectrum and the increase of tumor patients, people need to take effective measures in time. Relative to individual health, the factors that affect the admission of patients are not only the environmental factors, but also the patient’s own condition, the treatment in hospital and so on. Many diseases, such as chronic diseases, need long treatment cycle and even lifelong treatment, so patients often need to be hospitalized repeatedly in the process of treatment. Unplanned readmission refers to the situation that patients are readmitted for the same disease or related diseases in a short time without hospital arrangement after discharge. It is a negative index commonly used to evaluate the medical quality of hospitals. High readmission rate will increase the economic burden of patients and cause the waste of medical and health resources. Early warning of chronic diseases is a new research topic in the field of global health care, and it is also an important means to improve the health care situation of low and middle income countries.

Chronic diseases such as cancer, hypertension, hyperlipidemia, diabetes and respiratory diseases have become the main causes of death and disability in the whole society. Lots of studies have confirmed that unreasonable diet, working environment, smoking and excessive drinking are the main factors leading to the occurrence of most chronic diseases. Nowadays, the phenomenon of aging population is increasing, and the incidence rate of cardiovascular diseases in the elderly is also rising, which has become the number one disease threatening human life. The main risk events of cardiovascular disease are smoking, hypertension, hyperlipidemia, unhealthy diet and lack of physical activity. Comprehensive risk assessment and giving control strategies are effective ways to intervene the risk.

Through the big database platform, the health / disease spectrum of the population is analyzed, and the risk factors closely related to health / disease are extracted. Based on the theory of competitive risk regression, the risk prediction model is popularized and applied in practice through the research and design, evaluation of disease definition and its queue construction, prediction factor screening and coding, prediction model construction, model parameter estimation, model accuracy and prediction ability evaluation, external group validation of the model, and the visualization of the prediction results. Moreover, the model is optimized continuously in practice.

2.5. Health risk assessment based on machine learning

In recent years, under the background of rapid development of artificial intelligence, it has become more and more important to study machine learning and put it in different fields. Among them, the research of machine learning in the field of risk assessment has been paid more and more attention by the state and all walks of life. The user data includes massive data such as personal information, living habits, and health records. It has exceeded the feasibility of direct calculation. In order to extract information efficiently and carry out health analysis and risk assessment, special learning algorithms are needed, which is the role of machine learning. It is very important to develop the health risk assessment model of big data by using modern machine learning technology.

For individual health, the factors that affect the admission of patients are not only the environmental factors, but also the patient’s own condition, the treatment in hospital and so on. Many diseases, such as chronic diseases, need long treatment cycle and even lifelong treatment, so patients often need to be hospitalized repeatedly in the process of treatment. Readmission rate is an important index to evaluate the quality of medical service. If the hospital can predict the readmission population with high risk in advance, and take follow-up and other intervention measures for patients, it can effectively reduce the readmission rate. It is difficult for doctors to directly assess the risk of readmission due to the complexity of factors affecting the readmission of patients. It is of great significance for early readmission intervention to use the readmission recognition model based on machine learning and data mining.

In operation, health risk assessment usually uses information technology support technology to
collect and track various information reflecting personal health status through software or various information system platforms, and provide individual health information list, personal disease risk assessment report, personal health management prescription and personal health improvement action guide on how to reduce and control risk factors. In addition, in the dataset of health correlation analysis, most of them are data without time nodes, the change of time is not considered, and the physical sign data also changes with the change, which leads to the dynamic change of health. In the field of medical treatment, data mining technology plays an important role in disease prediction, diagnosis and so on. With the explosive growth of massive data, traditional data mining algorithms cannot meet the increasing demand. How to use deep learning technology to deal with massive data efficiently and provide tools for decision-making and comprehensive analysis to reduce the pressure of medical system, has become an important direction of current research.

3. Conclusion

Health risk assessment is an important part of health management with high technical requirements. Scientific and accurate assessment is the only way to carry out health management, and the key to improve the efficiency of health management. Group and individual health risk assessment is of great significance to improve people’s health awareness, optimize hospital resource management and improve the medical process. Nowadays, with the development of medical information, many medical assistant systems emerge as the times require. Data mining, machine learning and other related technical means are used and combined with massive and rich medical data to build a health risk assessment system for people and individuals. It can help the hospital to be more forward-looking in the operation process, and patients can also know more about their health through this system and take protective measures in advance.