

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.

57 Nowadays, the vast majority of health risk assessment
58 has been computerized.

59 2. Research areas

60 2.1. Health risk assessment in public health 61 emergencies

62 Public health emergencies refer to the sudden
63 occurrence of major infectious diseases, mass unex-
64 plained diseases, major food and occupational
65 poisoning and other events that seriously affect public
66 health, which cause or may cause serious damage to
67 public health. Risk assessment refers to the process of
68 risk identification, risk analysis and risk assessment
69 to assess the risk of public health emergencies and
70 public health risks of other emergencies, and put for-
71 ward risk management suggestions. Early detection,
72 identification and assessment of public health risks
73 are of great significance for effective prevention and
74 response to public health emergencies.

75 From 1914 to 2019, a total of 41 major public
76 health emergencies occurred in the world, and the
77 average outbreak interval has been shortened from
78 about 4.7 years before 2000 to about 0.87 years
79 after 2000. Public health emergencies have entered
80 a new stage of normalization, in which old diseases
81 recur and new diseases emerge. The outbreak of
82 2019-nCoV is a new infectious disease in the new
83 stage. Although governments at all levels have made
84 rapid response and achieved good control effect, the
85 problems caused by the lack of preparation of local
86 governments before the epidemic, such as the rapid
87 spread of the epidemic, the lack of medical resources,
88 the shortage of isolation places and so on cannot be
89 ignored. Therefore, it makes people realize the lack of
90 foresight in urban planning layout, medical resource
91 allocation and park green space construction. There-
92 fore, it is necessary to deeply integrate public health
93 discipline and urban planning discipline, put urban
94 planning construction at the front end of public health
95 safety and epidemic prevention and control, enhance
96 the safety and resilience of the city, and promote the
97 construction of a healthy city by strengthening the
98 emergency support capacity of urban space.

99 In the work of 2019-nCoV, the effectiveness of
100 comprehensive prevention and control measures bas-
101 ed on community prevention and control has been
102 confirmed. Through the implementation of grid and
103 carpet management, and the spatial control of the
104 input, spread and output of the epidemic, the

105 development of the epidemic has been gradually
106 suppressed. In the context of epidemic situation,
107 health risk assessment system has gradually attracted
108 people's attention. Through bioelectrical induc-
109 tion technology, human body electrical impedance
110 measurement technology and chronoamperometric
111 analysis method, the functional status of various
112 organs can be evaluated mainly from the perspective
113 of functional medicine. The functional status of vari-
114 ous organs of nine major systems of human body can
115 be evaluated in 5 minutes and 38 seconds. Through
116 the analysis and assessment of the immune defense
117 stage of each organ, the susceptibility of the body to
118 the new type of pneumonia is accurately judged, so
119 as to help quickly distinguish the susceptible pop-
120 ulation and prevent the spread of the epidemic. As
121 the organizational unit of residents' life and the basic
122 unit of social governance, community is not only the
123 forefront of urban disaster prevention and epidemic
124 prevention, but also the first "gate" of epidemic pre-
125 vention. Risk assessment is the scientific basis and
126 important foundation to effectively guide the con-
127 struction of resilient and healthy community.

128 2.2. Environmental health risk assessment

129 With the rapid development of economy and soci-
130 ety and the gradual improvement of residents' health
131 awareness, environmental health problems have be-
132 come increasingly prominent. Although some envi-
133 ronmental pollution problems have been improved
134 through governance, the current global environmen-
135 tal pollution situation is still not optimistic. Quan-
136 titative assessment of the population health risk in
137 environmental pollution and taking effective inter-
138 vention and protection measures, has become an
139 important problem to be solved in the field of pub-
140 lic health. In the 1970s, the Environmental Protection
141 Agency and the World Health Organization took the
142 lead in environmental health risk assessment, and
143 gradually formed a relatively complete assessment
144 system, which provided important support for the
145 formulation of relevant policies and regulations.

146 Analyzing, evaluating and predicting the health
147 effects of various factors can not only help people
148 to improve their awareness of health risk factors and
149 formulate health intervention measures, but also pro-
150 vide corresponding data support and guidance for
151 the formulation of some policies. With the increas-
152 ingly serious problem of air pollution, many countries
153 and regions have formulated air pollution concen-
154 tration standards and a series of countermeasures.

155 According to the air quality standard issued by the
156 World Health Organization, the daily average concen-
157 tration of PM_{2.5} should not exceed 25 $\mu\text{g}/\text{m}^3$, while
158 the annual average concentration should not exceed
159 10 $\mu\text{g}/\text{m}^3$. According to the standard, about 87% of
160 the world's people live in areas with excessive PM_{2.5}
161 concentrations. In 2013, the global burden of disease
162 study ranked PM_{2.5} exposure as the seventh lead-
163 ing cause of death, and PM_{2.5} exposure led to about
164 2.9 million premature deaths worldwide. In addition,
165 due to the high population density and rapid eco-
166 nomic development in big cities, compared with other
167 cities, the air pollution and disease burden caused by
168 pollution in big cities are more serious.

169 The environment pollution situation is severe,
170 which presents the characteristics of water, soil, air
171 and other multi-environmental media, and it is dif-
172 ficult to eliminate in a short time. Therefore, how
173 to accurately evaluate the impact of environmental
174 pollution on the health of the population and take
175 effective intervention measures to reduce the damage
176 of environmental pollution on the health of the pop-
177 ulation has become the focus of the whole society.
178 The system of environment and health monitoring,
179 investigation and risk assessment has been gradu-
180 ally established and improved. The environment and
181 health monitoring of drinking water, air and soil,
182 which are closely related to residents' health, has
183 been strengthened. The research on the relationship
184 between environmental pollution and disease, health
185 risk assessment, early warning and intervention pro-
186 tection has been carried out. By integrating the
187 existing environmental data and health data resources
188 and improving the technical ability of environmental
189 health risk assessment, the working mechanism of
190 environmental health risk assessment is established,
191 and the environmental health risk assessment is gradu-
192 ally institutionalized and normalized. On this basis,
193 it is necessary to establish a scientific data sharing
194 mechanism, reasonably strengthen the coordination
195 and cooperation between departments, enhance pub-
196 lic awareness of environmental health risks, promote
197 the policy transformation of risk assessment results,
198 and finally achieve the goal of risk assessment to
199 support government decision-making and serve the
200 society and the public. The uncertainty and univer-
201 sality of risks lead to the diversity and complexity of
202 environmental health problems. Effective risk man-
203 agement is a powerful measure to prevent and control
204 environmental health problems. Through scientific
205 and reasonable risk assessment, when the risk uncer-
206 tainty is reduced, the occurrence of environmental

207 health problems is reduced to protect public
208 health.

2.3. Health management and risk assessment of the elderly

209 The mode of health management and combination
210 of medical care and nursing care for the elderly is
211 still being tried. The ability of community health
212 service center to provide daily care, chronic dis-
213 ease management, rehabilitation, health education
214 and consultation, Chinese medicine health care and
215 other services for the elderly needs to be improved. In
216 the survey, a community health service center extends
217 the nursing service to the residents' families, and also
218 cooperates with the nursing home to provide care,
219 regular diagnosis and treatment and other services for
220 the patients, trying to carry out health management
221 for the elderly in the mode of combination of medical
222 care and nursing care. Among them, a health service
223 center also launches a rehabilitation treatment con-
224 sulting room to provide help for the rehabilitation of
225 stroke patients after treatment in a 3A hospital. How-
226 ever, day care, full care, half care and other forms of
227 care services for the elderly still need to be gradually
228 enriched and improved. Although family sickbed ser-
229 vice has been carried out in most community health
230 service centers, due to resource constraints, the num-
231 ber is small, and the types of services provided are
232 single, which cannot meet the demand.

233 The coverage rate of electronic health records
234 of community residents, especially the contracted
235 patients, is very high, and the filing rate is 70 %
236 ~ 90 %. However, the frequency difference of file
237 updating is quite different. In addition to the uni-
238 fied physical examination of the elderly, the update
239 of electronic health records can only rely on clinical
240 treatment. Moreover, these community health ser-
241 vice centers do not use health records to carry out
242 health risk assessment for individuals or groups, and
243 lack the ability to carry out health risk assessment.
244 Most of the elderly are accompanied with one or
245 more chronic diseases at the same time, and there
246 are great security risks after discharge. Fall, med-
247 ication errors, lost, aspiration, asphyxia, scald and
248 other abnormal nursing accidents related to patient
249 safety are all nursing adverse events. These high-risk
250 hidden dangers seriously threaten the safety of the
251 elderly, reduce the quality of life of the elderly, and
252 concern the whole family. Whether the elderly can
253 get continuous and effective long-term care after dis-
254 charge is the key to improve their daily life ability and
255

257 quality of life, and the key to a harmonious family.
 258 The comprehensive health assessment of the elderly
 259 is a multi-dimensional assessment method to measure
 260 the overall health level of the elderly from the aspects
 261 of physical health, mental health, functional status,
 262 social adaptability and environmental conditions.

263 2.4. Health risk assessment of patients with 264 chronic diseases

265 Health is the most precious wealth in life. With the
 266 improvement of people's living standards, the aware-
 267 ness of health risk assessment has been paid more and
 268 more attention. In recent years, with the change of
 269 disease spectrum and the increase of tumor patients,
 270 people need to take effective measures in time. Rel-
 271 ative to individual health, the factors that affect the
 272 admission of patients are not only the environmen-
 273 tal factors, but also the patient's own condition, the
 274 treatment in hospital and so on. Many diseases, such
 275 as chronic diseases, need long treatment cycle and
 276 even lifelong treatment, so patients often need to be
 277 hospitalized repeatedly in the process of treatment.
 278 Unplanned readmission refers to the situation that
 279 patients are readmitted for the same disease or related
 280 diseases in a short time without hospital arrangement
 281 after discharge. It is a negative index commonly used
 282 to evaluate the medical quality of hospitals. High
 283 readmission rate will increase the economic burden
 284 of patients and cause the waste of medical and health
 285 resources. Early warning of chronic diseases is a new
 286 research topic in the field of global health care, and it
 287 is also an important means to improve the health care
 288 situation of low and middle income countries.

289 Chronic diseases such as cancer, hypertension,
 290 hyperlipidemia, diabetes and respiratory diseases
 291 have become the main causes of death and disability
 292 in the whole society. Lots of studies have confirmed
 293 that unreasonable diet, working environment, smok-
 294 ing and excessive drinking are the main factors
 295 leading to the occurrence of most chronic diseases.
 296 Nowadays, the phenomenon of aging population
 297 is increasing, and the incidence rate of cardiovas-
 298 cular diseases in the elderly is also rising, which
 299 has become the number one disease threatening
 300 human life. The main risk events of cardiovascular
 301 disease are smoking, hypertension, hyperlipidemia,
 302 unhealthy diet and lack of physical activity. Compre-
 303 hensive risk assessment and giving control strategies
 304 are effective ways to intervene the risk.

305 Through the big database platform, the health /
 306 disease spectrum of the population is analyzed, and

307 the risk factors closely related to health / disease
 308 are extracted. Based on the theory of competitive
 309 risk regression, the risk prediction model is popu-
 310 larized and applied in practice through the research
 311 and design, evaluation of disease definition and its
 312 queue construction, prediction factor screening and
 313 coding, prediction model construction, model param-
 314 eter estimation, model accuracy and prediction ability
 315 evaluation, external group validation of the model,
 316 and the visualization of the prediction results. More-
 317 over, the model is optimized continuously in practice.

318 2.5. Health risk assessment based on machine 319 learning

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

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

354 In operation, health risk assessment usually
 355 uses information technology support technology to

356 collect and track various information reflecting personal
357 health status through software or various
358 information system platforms, and provide individual
359 health information list, personal disease risk
360 assessment report, personal health management pre-
361 scription and personal health improvement action
362 guide on how to reduce and control risk factors. In
363 addition, in the dataset of health correlation analy-
364 sis, most of them are data without time nodes, the
365 change of time is not considered, and the physical
366 sign data also changes with the change, which leads to
367 the dynamic change of health. In the field of medical
368 treatment, data mining technology plays an impor-
369 tant role in disease prediction, diagnosis and so on.
370 With the explosive growth of massive data, traditional
371 data mining algorithms cannot meet the increasing
372 demand. How to use deep learning technology to
373 deal with massive data efficiently and provide tools
374 for decision-making and comprehensive analysis to
375 reduce the pressure of medical system, has become
376 an important direction of current research.

3. Conclusion

377
378 Health risk assessment is an important part of
379 health management with high technical requirements.
380 Scientific and accurate assessment is the only way
381 to carry out health management, and the key to
382 improve the efficiency of health management. Group
383 and individual health risk assessment is of great
384 significance to improve people's health awareness,
385 optimize hospital resource management and improve
386 the medical process. Nowadays, with the develop-
387 ment of medical information, many medical assistant
388 systems emerge as the times require. Data mining,
389 machine learning and other related technical means
390 are used and combined with massive and rich medi-
391 cal data to build a health risk assessment system for
392 people and individuals. It can help the hospital to
393 be more forward-looking in the operation process,
394 and patients can also know more about their health
395 through this system and take protective measures in
396 advance.