

We have defined the key determinants of vaccine hesitancy based on the Working Group Matrix on Determinants of Vaccine Hesitancy, as shown in Table 1. To better explain how the vaccine hesitancy Fuzzy Cognitive Map (FCM) is built in this paper using the factors in the table, the following explanation is made for the supplement to this paper.

1. The criteria of inviting experts

(1) To finalize the area of expertise.

In this research, the 24 influencing factors as defined in the Working Group Matrix on Determinants of Vaccine Hesitancy include Contextual factors, Individual and group factors, Vaccines or vaccinations factors, involving 3 dimensions. Among them, contextual factors include historical, sociocultural, environmental, institutional, economic or political factors in vaccine hesitancy. Depending on the experience and area of expertise required for the above factors, it is necessary to invite doctors, healthcare practitioners, vaccination-related decision-makers and sociologists. Individual and group factors, include the influence of individual, group, social, peer environment and other influencing factors on vaccine hesitancy. In this respect, the influencing factors in vaccine hesitancy often relate to individual or collective impact, involving sociologists, psychologists, doctors, nurses and vaccine administrators, etc. Experts in the above areas of knowledge that have a significant impact on the public during the course of vaccination should be considered for invitation. Vaccines or vaccinations factors, include influencing factors directly related to vaccines or directly related to vaccination. Doctors, nurses, vaccine administrators and healthcare practitioners shall be taken into consideration. Apart from that, since the model built in this study relates to the judgment on causal relationships, it is also necessary to consider those experts and scholars familiar with data science and experienced in the relevant research for invitation.

(2) To finalize the members of the panel.

According to the areas of expertise related to the influencing factors listed in the Matrix on Determinants of Vaccine Hesitancy, 8 experts are invited to participate in the scheme. Among them, two are government officials from the Chinese Center for Disease Control and Prevention for their extensive experience in administering the distribution of vaccines; four are medical staff working for public hospitals as they are 3A certified for the administration of vaccination and have the relevant specialist knowledge; and the remaining two are sociology and communication professors who lecture at two prominent public universities and have the research experience relating to data science.

2. Matrix on Determinants of Vaccine Hesitancy

After an exhaustive explanation of the concepts involved in the vaccine hesitancy matrix to the experts, the field experts are invited to complete the questionnaire we designed according to matrix on determinants of vaccine hesitancy, a similar matrix in black. The criteria are detailed as follows.

(1) Suggested objectives

To better promote COVID-19 vaccination among the public and clarify the reasons for "vaccine hesitancy" among the public, such as delayed vaccination or non-vaccination, we have sorted out the key variables affecting vaccine hesitancy and divided them into three categories according to the variable content, with a total of 24 variables. Now we sincerely invite experts to make a judgment on the relationship between variables and share your valuable opinions based on the variable description made by us.

(2) Expert needs

a. Provide an Excel spreadsheet of vaccine hesitancy and find the causal relationship: Please find the variables that have the causal relationship and fill in the following steps.

b. Mark positive and negative, strong and weak relationships: Mark the positive and negative relationships between "influencing variable" and "affected variable", for example, the increase in the state value of variable A will cause the increase in the state value of B, and there will be a positive causal relationship between A and B, as represented by "positive"; conversely, it is negative causality, which is expressed as "negative direction".

c. Mark strong and weak relationships: The strength of influence caused by causal relationship. Please fill in the following three options: strong influence, moderate influence and weak influence.

e. Mark "hesitancy": Considering your decision hesitancy factors in the process of discrimination, please mark your degree of hesitancy in the process of discrimination: certain, generally certain, not very certain.

f. In order to facilitate the archiving of the validity of the data after the judgment, please print this form and write down your name and time.

3. Supplementary materials: Concept Explanation

Table S1: Factors for vaccine hesitancy in the vaccine hesitancy determinants matrix

Factors
Contextual factors
C1 Communication and media environment: The abundance of vaccine-related information in the media
C2 Opinion leader: The level of acceptance of vaccines by influential people or groups in society
C3 Historical influences: Historical levels of support for vaccines, if there is an anti-vaccine movement and so on, are seen as not being supportive
C4 Religion/culture: Do religions and social cultures support vaccines?
C5 Age structure: Proportion of vulnerable groups (elderly and children as a proportion of total population)
C6 Gender structure: Male/female ratio
C7 Socio-economic: The local GDP level
C8 Politics/policies: The level of government support for vaccination and the level of policy improvement are represented by the level of popular science popularization
C9 Geographic barriers: The dispersion of the local population
C10 Perception of the pharmaceutical industry: The level of local support for the pharmaceutical industry
Individual and group factors
C11 Vaccine experience: Acceptance of vaccination by individuals, families or people close to them
C12 Healthy attitude: The level of importance that individuals, families or people around them place on health
C13 Education level: The level of education of an individual, family or those close to them
C14 Trust in the healthcare system: The level of trust that individuals, families, or people close to them have in the process of producing, storing, transporting, and administering vaccines
C15 Risk-reward ratio at the cognitive level: The risk-benefit ratio, or risk/benefit value, of what individuals, families, or people around them consider to be "vaccinated"
C16 Social Norms Perception: The extent to which individuals, families or people close to them feel that vaccination is a social norm
Vaccines or vaccinations factors
C17 Realistic level risk-return ratio: The risk-benefit ratio of vaccination based on epidemiological surveys and scientific evidence
C18 Popularity of vaccine science: The extent to which new vaccines are introduced, or the extent to which existing vaccines are recommended
C19 Mode of administration: Does the country or territory have an integrated, top-down vaccination system?
C20 Level of mobilization for vaccination: The number of designated vaccination units in a country or region, and the number of vaccination organizations
C21 Reliability of vaccination: Reliability of vaccines and/or vaccination equipment or sources of vaccine supply
C22 Vaccination planning: Does the country or territory have a priority group for vaccination?
C23 Vaccination costs: The price of the vaccine
C24 The strength of the medical staff's recommendation: The level of recommendation for vaccination by healthcare professionals