

Conceptual Models and Coping Strategies of "Vaccine Hesitancy": A Review Study

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ABSTRACT

According to WHO (World Health Organization) estimates, vaccination can prevent 2.5 million deaths each year. The vaccination plan has played a significant role in reducing the mortality and morbidity of infectious diseases of great public health significance. The high vaccination rate not only provides direct protection for the vaccinated individuals, but also plays an indirect protective effect for the entire community. However, more and more people choose to postpone or refuse vaccination. People's hesitancy on vaccination has become an increasingly serious problem, leading to the resurgence of vaccine-preventable diseases. Vaccine hesitancy is affected by many factors. Countries need to carry out in-depth research to ensure vaccine coverage and minimize vaccine hesitancy, which has become an international priority. This article summarizes the research background of vaccine hesitancy, the definition of vaccine hesitancy, the influencing factors and conceptual models of vaccine hesitancy, and proposes coping strategies of vaccine hesitancy through a review of existing research and literature.

Keywords: *vaccine hesitancy, influencing factors, conceptual models, coping strategies*

I. INTRODUCTION

Vaccines save millions of lives and are one of the safest and most effective public health interventions, which can bring many social and economic benefits while maintaining the health of the population [1]. People can produce antibodies after being vaccinated, which can build defenses against some serious diseases, such as rabies, tetanus, typhoid, flu, measles, etc. Vaccines are also unique in that under high-level vaccination, individuals and communities can be protected. This phenomenon is often called "herd immunity" [2].

However, since the birth of vaccines, people have had doubts and worries about the possible adverse reactions of vaccines. In recent years, the public's confidence in vaccines has been declining, and the anti-vaccine movement is increasing. For example, a recent study of Canadian vaccine experts and first-line suppliers showed that they believe that hesitancy in vaccination is an important issue leading to the situation that the vaccination coverage lower than optimal vaccination coverage. The recent outbreaks of diseases that have been largely eradicated such as measles, mumps and diphtheria have been attributed to hesitancy in vaccination [3]. This hesitancy reduces herd immunity, making unvaccinated individuals and individuals with compromised immune systems vulnerable to infection.

II. DEFINITION OF "VACCINE HESITANCY"

"Vaccine hesitancy" is a term that appears in the literature and discourse on vaccine decision and the determinant of vaccine acceptance. It recognizes that in the vaccine field, individuals and groups do not either support or oppose vaccines. Depolarizing "vaccine acceptance" and "vaccine rejection", "vaccine hesitancy" reflects the continuity between acceptance and rejection. In March 2012, the WHO Strategic Advisory Expert Group on Immunization (SAGE) convened a working group meeting and define "vaccine hesitancy" as: "vaccination is delayed or refused despite the availability of vaccination services" [4]. People may refuse to receive certain vaccines, but agree to receive other vaccines; people may postpone vaccination according to the recommended schedule, but feel uncertain about whether their decision is "correct" [5], [6].

There are various driving factors for vaccine hesitancy, such as individual and social groups' concerns, and the risks of the vaccine itself [7]. Those who are hesitant but do not reject all vaccines are especially worthy of attention [7]. Vaccine hesitancy is complex, and its specific circumstances vary with time, place, and vaccine; it is affected by factors such as complacency, convenience, and confidence. Complacency refers to the belief that the risks of vaccines outweigh its benefits. Convenience refers to the availability of vaccines. Confidence refers to the

trust in the vaccine itself, the entire health care system, and the decision-makers who decide on immunization schedules [4].

In 2015, Patrick et al. believed that vaccine hesitancy was an all-encompassing category, not a real concept. They propose to base the concept of vaccine hesitancy in a clear theoretical framework that takes into account some of the main structural characteristics of contemporary society. Vaccine hesitancy is a decision-making process that depends on people's degree of commitment to healthism/risk culture and their confidence in health authorities and mainstream medicine [8].

III. OVERVIEW OF THE INFLUENCING FACTORS AND CONCEPTUAL MODEL OF "VACCINE HESITANCY"

The individual and community behavior of "vaccine hesitancy" is complex, and its determinants are highly variable, which means that different factors can influence the process of vaccination decisions. In order to better solve this problem, experts or organizations from various countries have classified and summarized the influencing factors of "vaccine hesitancy", and successively proposed conceptual models of the influencing factors of vaccination suitable for their country or region.

The Health Belief Model was originally developed in the 1950s to study the barriers for parents to vaccinate against polio. In 2011, Smith and his collaborators evaluated the relationship between parents' beliefs about vaccines, their decision to postpone or refuse to vaccinate their children, and the vaccination coverage of children at 24 months of age, and came up with four socio-psychological domains of health belief model: the perceived susceptibility and severity of vaccine-preventable diseases (VPD), the perceived efficacy of vaccines, and concerns and effects that promote or hinder vaccination. It can be used to measure beliefs related to hesitancy of vaccination, and can be used to predict parents' decision to postpone or refuse to vaccinate their children [9].

In 2011, Douglas Opel, James Taylor and others conducted a survey on the attitudes of parents who were hesitant to vaccination towards children's vaccination (PACV) to determine which parents were hesitant to vaccinate children and thus may lead to weakened immunity of their children. This is the first batch to develop and validate an investigation tool for vaccine hesitancy. PACV includes 18 projects in 4 content areas (immunization behavior [6 items], belief in vaccine safety and effectiveness [8 items], attitude towards vaccine authorization and exemption [1 item], and trust [3 items]), and the results show that PAPV effectively

measures the underlying factors of vaccine hesitancy [10].

In the same year, the WHO Strategic Advisory Group of Experts on Immunization (SAGE) proposed the "3Cs" model of vaccine hesitation. In this model, Confidence is defined as belief, that is, 1) the effectiveness and safety of the vaccine; 2) the system that provides the vaccine, including the reliability and competence of health services and health professionals; 3) the motivations of decision makers who determine the vaccines needed. Complacency is defined as self-satisfaction. When the perceived risk of vaccine-preventable diseases is low, or when vaccination is not regarded as a necessary means, it can lead to complacency. The success of the immunization program may also lead to complacency and ultimately indecision, as individuals weigh the risks of vaccines against the risks of diseases that are no longer common. Convenience is defined as being convenient. The convenience of vaccines is measured according to the actual availability, affordability and willingness to pay, geographic accessibility, understanding (language and health literacy), and the attractiveness of immunization services. The quality of service and the degree of vaccination service provided in time and place and in a convenient and comfortable cultural background will also affect the vaccination decision, and may lead to hesitancy in vaccination [4].

In addition, SAGE has developed a more comprehensive matrix of determinants of vaccine hesitancy. The determinants are divided into three categories: environmental factors (influence due to historical, cultural, environmental, health system/institution, economic or political factors), individual/ social influence factors (such as the influence of personal views on vaccines or the influence of society/companion environment) and vaccine/vaccination specific problem factors (such as new vaccine or new formula, vaccination plan/method, vaccination schedule, etc.) [4].

In 2013, WHO's European immunization strategy consultants provided a model TIP to solve the problem of vaccine hesitancy, that is, the Tailoring Immunization Program, which is used to subdivide the population, diagnose the root causes of vaccine hesitancy in subgroups of hesitation, and adjust interventions for these fundamental factors. The program combines the theory of healthy behavior with social determinants, and divides the influencing factors of vaccination into four categories: environmental and mechanism factors, social support factors, personal motivation factors, and health workers' influence. These factors vary from place to place, to different subgroups in the population, and can also vary from time to time and vaccines, and affect the parents' decision to vaccinate their children. The model provides an

effective strategy to solve the problem of hesitancy. It divides the population into sub-groups with higher levels of hesitancy, diagnoses the main underlying factors, then tailors interventions for these factors, and then evaluates the results [4].

In 2014, Gustavo and others at Hacarmel University in Haifa, Israel studied the H1N1 pandemic from 2009 to 2010 and proposed a model of social and political determinants of vaccine hesitation, and came to the following conclusions: 1) Trust: Trust in the national government's ability to respond to epidemic outbreaks and the execution capabilities of local community health care organizations is a hesitant factor in vaccination; 2) Political party prejudice: Trust in the government's ability to handle the H1N1 epidemic is largely based on political party attitudes towards the appropriate role of the government. Party members who support social health care programs are more willing to be vaccinated than others; 3) Vulnerability: Age, family composition and ethnicity also affect the willingness to vaccinate. The vulnerability factors considered by many people may play a role in the decision to seek vaccination; 4) Fear of infection: Regardless of other factors, the fear of flu infection is very important in the willingness to vaccinate, and those who fear are more willing to vaccinate [11].

In 2015, under the guidance of the definition and determinant matrix of vaccine hesitancy, Larson and colleagues of the SAGE vaccine hesitancy problem working group developed survey tools, standardized the measurement of vaccine hesitancy, and developed the Vaccine Hesitancy Scale (VHS). The research team conducted a systematic review of existing research, reviewed the questions used in the WHO-UNICEF joint report form, and through expert consultation, compiled three different types of questionnaires, including core closed-ended questions, Likert scale questions, and a set of open questions. Although Larson constructed the scale and encouraged future verification of the scale, the scale was not verified by psychometrics in this study [12].

In 2017, Philipp Schmid et al. through a systematic review of the hesitancy of influenza vaccination from 2005 to 2016, proposed a "micro-determinant model of vaccine hesitancy following the theory of planned behavior". This model is based on the SAGE model and refers to the theory of health decision-making behavior, integrates the concepts of risk perception, past behavior, knowledge and experience into the model, analyzes vaccine hesitancy from both macro and micro levels, and uses this model as a comprehensive theoretical framework to identify and cluster barriers in influenza vaccination [13].

In 2018, Shapiro et al. believed that a standardized and effective vaccine hesitancy measurement tool can help advance research and immunization policies. This

tool can be widely used to understand the relevance of vaccine hesitation, the relationship between vaccine hesitancy and vaccine coverage, to compare vaccine hesitancy among countries, and to evaluate the changes in vaccine hesitancy over time [3]. They measured the psychological characteristics of Larson et al.'s 2015 scale question, assessed the scale's structure and internal consistency, structure and validity of the scale, and sociodemographic differences in parents' vaccination hesitancy. It turns out that VHS contains two potential factors: "lack of confidence" and "risk". The subscale was related to vaccine attitudes, and important differences were found in the vaccine hesitancy of parents in the HPV vaccine decision-making stage. The vaccine hesitancy scale is related to vaccine rejection. In addition, it was also found that in terms of vaccination hesitancy (for example, between gender and income), sociodemographic differences are small but significant.

IV. COPING STRATEGIES FOR "VACCINE HESITANCY"

The determinants of vaccine hesitancy are complex and specific, varying with time and place. The behaviors of individuals or communities who hesitate to vaccinate are complex, and the determinants of hesitancy are highly variable [5]. Therefore, strategies to deal with vaccine hesitancy require extensive methods, interventions, and system reforms in the country, public health system, health service providers, communication media, and vaccine industry.

First of all, from a national perspective, the reasons for vaccine hesitancy in different countries are different. The first step in formulating an effective strategy is to fully understand the reasons and background that led to the hesitancy and rejection of vaccination. Therefore, it is necessary to strengthen the national investigation of vaccine hesitancy, clarify the factors related to the local area, and develop adaptive strategies to deal with these factors [14]. For example, it can use the standardized measurement tools recommended by SAGE to quantify and measure the hesitancy problem to measure the degree of geographic aggregation of vaccine hesitancy. In addition, through the understanding of immunization concerns and other potential obstacles, it is necessary to formulate a national immunization plan adapted to the country, and impose mandatory vaccination measures for certain vaccines or penalties for non-vaccination. Government agencies and professional organizations need to conduct regular research to understand the public's knowledge, beliefs, understanding and concerns about vaccines and vaccine-preventable diseases, and maintain the public's trust of vaccines by providing timely, reliable and proactive vaccine decisions and vaccine information [15]. In addition, the country needs to have the notification capacity and

financial resources to deal with vaccine risks, especially in the current situation where more and more new vaccines and vaccine combinations are being developed, to monitor emerging hesitancy and formulate appropriate strategies [4].

Second, from the perspective of the public health system, it is necessary to build public trust in the public health system to obtain or restore a high vaccination rate against common and preventable diseases. A sound vaccine safety system, responding to public concerns, and raising public awareness of the scope of vaccine safety monitoring will help resolve the hesitancy of vaccination and increase public confidence in vaccines. For example, public health organizations conducted a rapid, independent and transparent review of the 2009-2010 H1N1 influenza vaccine safety data and released it to the public, providing a model for maintaining public confidence [11]. Improving the transparency of vaccination policies and/or the decision-making process of incorporating vaccination into school education plans can also effectively reduce parents' hesitancy about children's vaccination [5]. In terms of vaccine information communication and dissemination, it is necessary to use new technologies and new scientific methods and effective communication to adjust public health information to target groups, such as strengthening those who fully receive vaccines, such as strengthening those who completely receive the vaccine, dealing with those who are hesitant, and taking a completely different approach to those who completely reject all vaccines [16]. Parents with vaccine problems need to take interventions at the individual level. For example, women who are pregnant for the first time are the ideal target group, because the first pregnancy is the best "educational moment". However, parents with more than one child may have entrenched methods of vaccination, and personalized information transmission is particularly important [17]. In terms of strategic public health communication, it is necessary to consider demographic factors, such as the education level of the target population, racial/ethnic differences, and launch a communication campaign for receivers divided by social class, race/ethnicity and belief [18].

Third, at the level of health service providers, they play a key role in maintaining confidence in vaccination. They recommend vaccination and how to provide vaccination is one of the main predictors of people's acceptance of vaccines. For example, the results of a large study in the United States showed that parents who changed their minds to postpone or prevent their children from being vaccinated listed "information or guarantees from healthcare providers" as the main reason [19]. Allison Kennedy et al. passed a study on American parents' confidence in vaccines in 2011 and affirmed the importance of health service providers in building confidence in the safety and value of vaccines. Jocelyn Raude et al. found in the 2014 vaccine

hesitancy survey of French general practitioners that health professionals, especially general practitioners, have a considerable influence on individual vaccination decisions [20]. Therefore, for health service providers, they need to fully understand the value of vaccines, have the ability to advise, guide, disseminate vaccines, and be able to deliver clear information to patients. And they also need to adjust the information according to the target group, geographic location and popular social and cultural influence factors [15].

Fourth, at the level of communications media, especially online and social media, negative and false information about vaccination is an important reason for vaccine hesitancy. Many studies have shown that the widespread anti-vaccine content on the Internet has led to an increase in vaccine hesitancy [21]. The dissemination of misleading scientific information by non-professional media has weakened people's confidence in science, especially confidence in vaccines, and needs to be quickly and forcefully refuted [22]. The media is a way to disseminate misinformation, but it can also become an effective channel for positive information. In 2012, the Global Vaccine Action Plan proposed that social media platforms not only provide opportunities for the anti-vaccine movement, but also provide opportunities for public health [5]. It is necessary to make full use of the potential of social media, develop an appropriate online communication strategy, provide information that supports vaccines, resolve misinformation posted online, and meet the needs and interests of vaccine audiences [21]. It can also use strategies similar to anti-vaccine lobbying behavior — using public figures, anecdotal columns, or personal statements to spread positive information about vaccination. In addition, although the media dissemination of vaccine information should generally be positive, it also needs to be realistically added to a "fear factor" to remind the public of the terrible damage caused by infectious diseases that vaccines prevent. At the same time, the rigor of the peer review process for scientific journals needs to be improved to avoid publishing incorrect and misleading scientific data, and to play a role by disseminating positive information about vaccines [22].

Fifth, at the level of the vaccine industry, it plays an important role in disseminating correct information and solving sensitive issues in public trust. The public needs to know the strictness of the requirements for the approval of vaccines, the high cost of developing and producing vaccines, and the high attention paid to safety during the development and evaluation of new vaccines. The vaccine industry needs to strengthen the transparency of data disclosure and access, publish post-vaccination follow-up research results in a language that the public can understand (for example, in open access literature), and provide the public with data on risks and benefits. While increasing the public's

trust in the safety and effectiveness of vaccines, it is also better to educate the public on how to make appropriate risk-benefit decisions for themselves, their children and the communities in which they live [22].

V. CONCLUSION

With the development of medical technology, more and more vaccines and vaccine combinations have become available, and the global transmission model has become more common, rapid and non-hierarchical, which has made the discussion around vaccination more and more complicated. In recent years, more and more people have noticed that they are hesitant to vaccination, which has reduced their concerns about the previous "acceptance" and "rejection". Although the definition of "vaccine hesitancy" is still controversial, whether it is an attitude, behavior or decision-making process, there are different opinions in the industry. However, the continuous research on vaccine hesitancy is very valuable. It is not only important for successful public health intervention strategies to control preventable diseases, but also for emergency preparedness in the event of a pandemic.

Vaccine hesitancy is complex, and many different determinants change with environment, vaccine, and time. This understanding shows that no single strategy can effectively solve all the determinants of vaccine hesitancy [23]. There is an urgent need to take active actions and establish effective communication, dialogue and participation among all vaccine stakeholders — vaccine experts, scientists, industry, national and international health organization decision makers, politicians, health professionals, media and the public. The problem of vaccine hesitancy is serious. Countries need to take action to increase public confidence in vaccines and reduce the hesitancy of vaccination. Otherwise, it may lead to the recurrence of past infectious disease disasters, and may also cause policymakers and politicians to make inappropriate decisions about future life-threatening pandemics.

References

- [1] Sachiko Ozawa, Meghan L Stack. Public Trust and Vaccine Acceptance-International Perspectives, *Human Vaccines & Immunotherapeutics*, 2013,9:8, 1774-1778, DOI: 10.4161/hv.24961
- [2] Orenstein WA, Gellin BG, Beigi RH, et al. Assessing the State of Vaccine Confidence in the United States: Recommendations from the National Vaccine Advisory Committee. *Public Health Rep* 2015;130(6):573–95.
- [3] Shapiro GK, Tatar O, Dube E, et al. The Vaccine Hesitancy Scale: Psychometric Properties and Validation. *Vaccine* 2018;36(5):660–7.
- [4] WHO. SAGE Working Group Dealing with Vaccine Hesitancy Terms of Reference. Webpage accessed 4 Nov 2014.
- [5] Larson HJ, Jarrett C, Eckersberger E, Smith DMD, Paterson P. Understanding Vaccine Hesitancy Around Vaccines and Vaccination from a Global Perspective: a Systematic Review of Published Literature, 2007–2012. *Vaccine* 2014;32 (19):2150–9.
- [6] Gust D, Darling N, Kennedy A, Schwartz B. Parents with Doubts About Vaccines: Which Vaccines and Reasons Why. *Pediatrics*. 2008; 122(4): 718–25. doi: 10.1542/peds.2007-0538 PMID: 18829793
- [7] Ramanadhan S, Galarce E, Xuan Z, Alexander-Molloy J, Viswanath K. Addressing the Vaccine Hesitancy Continuum: an Audience Segmentation Analysis of American Adults Who Did Not Receive the 2009 H1N1 Vaccine. *Vaccines* 2015;3(3):556–78.
- [8] Peretti-Watel P, Larson HJ, Ward JK, Schulz WS, Verger P. Vaccine Hesitancy: Clarifying a Theoretical Framework for an Ambiguous Notion. *PLOS Curr: Outbreaks* 2015. Edition 1.
- [9] Dube E, Laberge C, Guay M, Bramadat P, Roy R, Bettinger J. Vaccine hesitancy:an overview. *Hum Vaccin Immunother* 2013;9(8):1763–73.
- [10] Opel DJ, Mangione-Smith R, Taylor JA, Korfiatis C, Wiese C, Catz S, et al. Development of a Survey to Identify Vaccine-hesitant Parents: the Parent Attitudes About Childhood Vaccines Survey. *Hum Vaccin* 2011;7(4):419–25.
- [11] Gustavo S. Mesch, Kent P. Schwirian. Social and political determinants of vaccine hesitancy: Lessons Learned from the H1N1 Pandemic of 2009-2010. *American Journal of Infection Control* 43 (2015) 1161-5
- [12] Larson HJ, Jarrett C, Schulz WS, et al. Measuring vaccine hesitancy: the development of a survey tool. *Vaccine* 2015;33(34):4165–75.
- [13] Schmid P, Rauber D, Betsch C, Lidolt G, Denker ML. Barriers of Influenza Vaccination Intention and Behavior—a Systematic Review Of Influenza Vaccine Hesitancy, 2005–2016. *PLoS one*. 2017 Jan 26;12(1):e0170550.
- [14] Dube E, Gagnon D, Nickels E, Jeram S, Schuster M. Mapping Vaccine Hesitancy – Country-specific Characteristics of a Global Phenomenon. *Vaccine*2014;32(49):6649–54
- [15] Kennedy A, LaVail K, Nowak G, Basket M, Landry S. Confidence About Vaccines in the United States: Understanding Parents' Perceptions. *Health Aff* 2011;30 (6):1151–9.
- [16] Siddiqui M, Salmon DA, Omer SB. Epidemiology of Vaccine Hesitancy in the United States. *Hum Vaccin Immunother* 2013;9:2643-8.
- [17] Salmon DA, Dudley MZ, Glanz JM, Omer SB. Vaccine Hesitancy: Causes, Consequences, and a Call to Action. *Vaccine*. 2015;33:D66-71.
- [18] Galarce EM, Minsky S, Viswanath K. Socioeconomic Status, Demographics, Beliefs and A(H1N1) Vaccine Uptake in the United States. *Vaccine* 2011; 29:5284±9.
- [19] Dub é E, Vivion M, MacDonald NE. Vaccine Hesitancy, Vaccine Refusal and The Anti-vaccine Movement: Influence, Impact and Implications. *Expert Rev Vaccines* 2015;14:99–117
- [20] Raude, J., Fressard, L., Gautier, A., Pulcini, C., Peretti-Watel, P., Verger, P., 2016. Opening the 'Vaccine Hesitancy' Black Box: Howtrust in Institutions Affects French Gps' Vaccination Practices. *Expert Rev. Vaccines* 21, 1–12
- [21] Dube E, Gagnon D, Ouakki M, Bettinger JA, Guay M, Halperin S, et al. Understanding Vaccine Hesitancy in Canada: Results of a Consultation Study by the Canadian Immunization Research Network. *PLoS ONE* 2016;11:e0156118.
- [22] Black S, Rappuoli R. A crisis of Public Confidence in Vaccines. *Sci Transl Med*2010;2(61):61mr1.
- [23] Schuster M, Eskola J, Duclos P. Review of Vaccine Hesitancy: Rationale, Remit and Methods. *Vaccine* 2015.