Transactions on Materials, Biotechnology and Life Sciences
ISSN: 2960-1932, eISSN: 2960-2319 | Volume 7
MISBP 2024

Imaginations of Feasibility, Method of Production and Benefits of Oral MMR Vaccine

Haoyang Tang

1Suzhou International Academy, Suzhou, 215200, China

rentanshen@ldy.edu.rs

Abstract. Measles, mumps and rubella are acute infectious diseases caused by viral infections in children and caused great harm before the use of vaccines. The Measles, Mumps and Rubella (MMR) oral vaccine indicates a breakthrough in the fight against three infectious diseases which are measles, mumps and rubella. Unlike the traditional injectable MMR vaccine. This oral vaccine does not require an injection, and it can improve patient acceptance. The purpose of this paper is to provide a comprehensive study of the development, efficacy and safety of the oral MMR vaccine and compare it with the traditional injectable vaccine. It will emphasize the benefits of oral vaccines, such as reduced needle-related fears and increased accessibility, which are particularly beneficial in resource-limited settings where needle vaccination may be impractical. In addition, this paper will discuss the challenges of maintaining vaccine stability, dosage accuracy, vaccine efficacy and safety. Through these analyses, this paper seeks to determine whether oral MMR vaccine can be a viable alternative to global immunization efforts.

Keywords: MMR Vaccine; oral; benefit.

1. Introduction

Measles is virus that causes symptoms such as fever, rash, cough, and runny nose. It can lead to serious complications like pneumonia and encephalitis. Mumps is a virus that causes swelling of the salivary glands, fever, and headache. Complications can include orchitis (swelling of the testicles) and, in rare cases, meningitis. Rubella is also known as German measles, this virus can cause rash, fever, and joint pain. Rubella infection during pregnancy can lead to congenital rubella syndrome, which can cause severe birth defects. Some studies show that the number of deaths caused by MMR and show that it is necessary to be vaccinated (figure1 to 3). Otherwise, the risk of dead is really high after getting infected. The MMR (measles, mumps and rubella) vaccine significantly reduces the incidence of these diseases and contributes to herd immunity, protecting those who cannot be vaccinated [1].

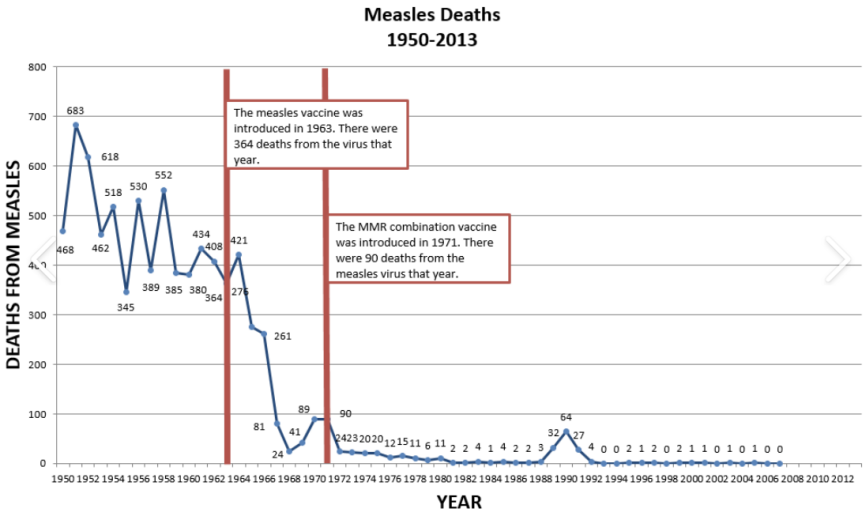

Figure 1. The changes of death caused by measles from 1960 to 2013 [3]

Content from this work may be used under the terms of CC BY-NC 4.0 licence (https://creativecommons.org/licenses/by-nc/4.0/).
Published by Warwick Evans Publishing.

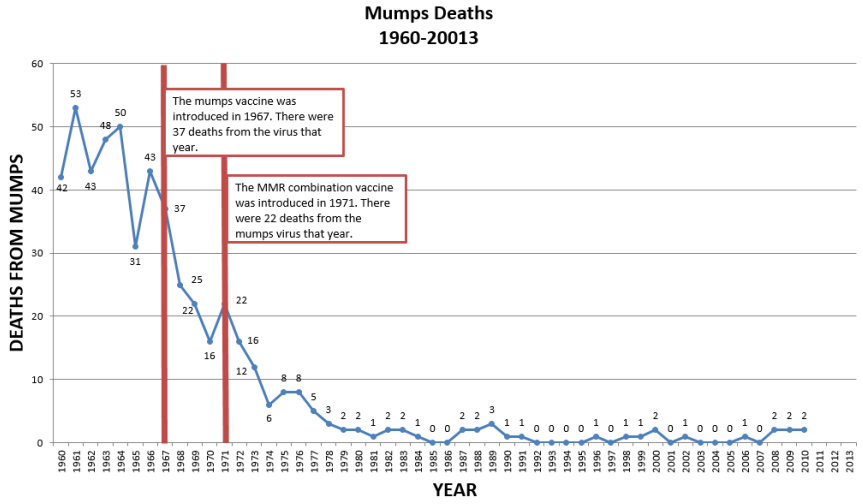

Figure 2. The changes of death caused by Mumps from 1960 to 2013 [3]

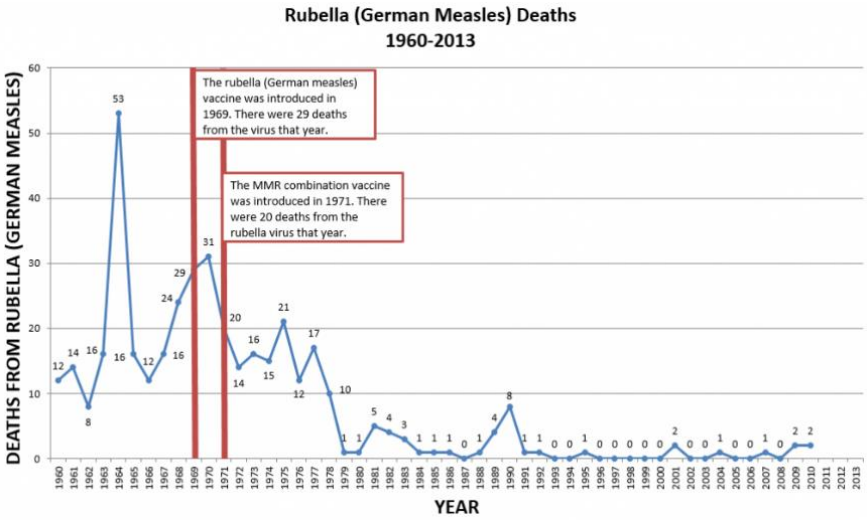

Figure 3. The changes of death caused by Rubella from 1960 to 2013 [3]

The MMR vaccine, known for its protection against measles, has traditionally been administered through the injection. However, research into oral vaccine delivery systems has opened new avenues for vaccination strategies. The development of an oral MMR vaccine could potentially offer significant benefits in terms of ease of administration and vaccine coverage. This paper explores the advances in oral MMR vaccines, their efficacy, safety, and the challenges they face compared to the injectable version.

2. History

The idea of an oral vaccine is not new, and vaccines like the oral polio vaccine (OPV) have proved the success of it. The success of the OPV highlights many advantages of oral immunization, such as ease of use and reduced reliance on sterile equipment. Inspired by these advantages, researchers have been studying oral versions of other vaccines, including the MMR vaccine. Introduced in the early 1970s, the MMR vaccine has been highly effective but has faced a number of challenges. These include needle phobia, logistical hurdles and the need for vaccination by trained professionals. According to the CDC, mumps is a contagious viral infection that begins with symptoms like fever, headache, muscle aches, fatigue, and loss of appetite, eventually leading to the swelling of salivary glands. The mumps virus was first identified in 1945 In 1948, researchers developed an inactivated vaccine, but it offered only temporary protection and was phased out by the 1970s. On March 30, 1967, the FDA approved Mumpsvax, a groundbreaking mumps vaccine created by Maurice Hilleman using a strain of the virus that had affected his five-year-old daughter, Jeryl Lynn. This live attenuated

vaccine, known as the Jeryl Lynn strain, remains in use even as of July 22, 2014 [2]. The term "German measles," or "Rötheln" in German, was first clinically described by the German physician Friedrich Hoffmann in 1740. During an outbreak at a school in India in 1841, the condition was called "rubella," which means "little red." By 1866, English surgeon Henry Veale suggested adopting the name "Rubella" to replace "Rötheln." In 1938, Japanese scientists S. Tasaka and Y. Hiro managed to transmit rubella from infected to healthy children, though they were unable to identify the specific cause of the disease. It wasn't until 1960 that the rubella virus was successfully isolated by Thomas Weller, a researcher at Harvard School of Public Health, who obtained the virus from his 10-year-old son.

The first mumps vaccination was created by Maurice Hilleman and released in 1969. The vaccination known as MMRV (measles, mumps, rubella, varicella) was licensed in 2005, succeeding the 1971 licensing of the combination MMR (measles, mumps, rubella).

The first dose of the MMR vaccine should be given to children between the ages of 12 and 15 months, according to the CDC.

The traditional injectable MMR vaccine is utilized in over 90 countries around the globe, including more than 50 European nations, as well as the USA, Canada, Australia, and New Zealand [3, 4]. It is also a key component of the World Health Organization's "Expanded Program on Immunization." Consequently, the global incidence of measles has significantly decreased over the past 35 years.

3. Contraindication

But the Institute of Medicine (IOM) discovered strong evidence for a cause-and-effect relationship between vaccination and syncope—a condition that can happen during any medical treatment using a needle, including blood draws [5]. 15% of young women who received the quadrivalent human papillomavirus vaccine suffered presyncope or syncope following the first dose [6]. Injuries, including brain damage, can result from post-vaccination syncope. For example, minutes after receiving a hepatitis B vaccination, a death from blunt head trauma following a fall linked to vasovagal syncope was reported in a VAERS report [7]. An observation period of 15 minutes following immunization is advised by the Advisory Committee on Immunization Practices, especially for teenagers, as syncope typically occurs within 15 minutes of vaccination [8, 9].

Furthermore, there's a legitimate worry that the increasing number of vaccines advised for children will wear people out. Three more injections would be required to administer this inactivated vaccination. It may be difficult to persuade parents that measles is not a normal part of childhood growth, despite the notion that this is sometimes held [10].

MMR vaccination is contraindicated in individuals with hypersensitivity to neomycin, gelatin, or any other vaccine component; those who are pregnant or attempting pregnancy; individuals with primary or acquired immunodeficiency diseases or a family history that excludes them from immunization, unless they are confirmed to be immune-competent; those with hematological disorders, leukemias, lymphomas, or other malignancies; and those undergoing systemic immunosuppressive therapies, including oral immunosuppressive treatments [11].

4. Method

In addition, the efforts have been made to develop an oral MMR vaccine. The function of the oral vaccine is to introduce antigens into the mucosal immune system. This elicits a robust immune response comparable to that of an injected vaccine. Several approaches have been explored to develop an oral MMR vaccine. One approach is the use of virus-like particles (VLP), which mimic the structure of viral proteins. It does not contain the genetic material of the virus and elicits a strong immune response, making it ideal for oral administration. Another approach is to use live attenuated vaccines, such as the traditional injectable MMR vaccine. These viruses are less harmful but still produce an immune response when taken orally. Ensuring that vaccines are properly encapsulated is

key to maintaining their effectiveness. To prevent vaccine degradation, researchers have devised a variety of encapsulation techniques. These methods ensure that the MMR vaccine enters the small intestine and reacts with the immune system.

4.1. Virus Cultivation

First, samples of MMR virus are obtained, that are optimized for efficient growth in cell cultures. Then, these attenuated viruses are cultured in a suitable environment such as human diploid cells or chicken embryos. This step allows the virus to replicate efficiently.

4.2. Virus Harvesting and Purification

Once the virus has multiplied to a sufficient number of the virus, it can be extracted. However, this usually requires collecting virus-containing cultures. The harvested virus particles are then purified by removing cellular waste and other impurities. Finally, pure virus particles are isolated by centrifugation and filtration.

4.3. Formulation

Viruses for oral vaccines must be attenuated or inactivated to prevent diseases while still causing an immune response. This needs to control the attenuation process. The purified, attenuated virus is then formulated into a liquid which is suitable for oral administration. This includes additives such as buffers to ensure that the vaccine remains effective and safe during storage and use.

4.4. Quality Control

Extensive quality control measures ensures that vaccines satisfied safety and efficacy requirements. These tests verify viral attenuation, absence of contaminants, and vaccine stability. Efficacy is a critical part of vaccine development. Oral MMR vaccines must be shown to have the same efficacy as injected vaccines. Animal models demonstrate that oral MMR vaccines are effective in stimulating immune responses.

4.5. Packaging and Distribution

Containers to prevent contamination and maintain their stability. This packaging process is carried out under strict aseptic conditions. The vaccines are then distributed to hospitals and vaccination centers. The vaccines must be stored under precise conditions to maintain their effectiveness until the vaccination.

4.6. Post-Marketing Surveillance

Once a vaccine is ready for widespread use it must be monitored on an ongoing basis. This is to detect any long-term adverse reactions or problems related to the efficacy of the vaccine. This ongoing monitoring ensures the long-term safety and efficacy of the vaccine. Human clinical trials are critical to assessing vaccine efficacy. Early findings suggest that oral MMR vaccine produces immunity to measles, mumps and rubella. However, results may vary, and further studies are necessary to confirm the long-term effectiveness of the vaccine and to compare it with injectable vaccines. Immunogenicity studies are also needed to evaluate and compare the immune response induced by oral measles, mumps and rubella vaccine with that induced by injected vaccine. Several studies have shown that oral vaccines induce a strong mucosal immune response that favors protection of mucosal surfaces. The safety of oral MMR vaccines is a crucial consideration. Injectable MMR vaccines have an excellent safety record, and any new vaccine must meet similar safety standards.

5. Side Effect

A transient febrile reaction may occur within one to two weeks after vaccination. Most of them are mild febrile reactions, which can be relieved on their own after 1~2 days. However, secondary

infections should be prevented. For moderate febrile reactions or fever lasting more than 48 hours, physical methods or medications can be used to treat the symptoms

People with serious immune system problems who receive this vaccine may develop life-threatening infections. People with severe immune system problems should not receive MMR vaccine.

6. Appliance

Oral vaccines reduce some of the risks associated with needle injections such as redness and swelling at the point of injection. Despite these advantages of oral MMR vaccines, it remains difficult to make them a viable alternative to injectable vaccines.

In addition, acceptance of oral vaccines depends on public awareness and education. While oral vaccines may be more acceptable to some, others may concern about their effectiveness or safety. Ensuring the accessibility of vaccines in different settings is also critical, especially in areas where injectable vaccines are already used.

A new vaccine needs to undergo serious tests and evaluations to gain government's approval. Oral MMR vaccines must meet the same regulatory standards as injectable vaccines, including extensive clinical trials and post-market surveillance. Unfortunately, there is a lack of data from relevant studies, but this oral vaccine should have the same effect due to the effects of similar drugs [2].

7. Conclusion

The oral MMR vaccine represents a significant advancement in vaccine technology, offering potential benefits such as easier administration and improved vaccine coverage. While research has demonstrated promising results regarding efficacy and safety, several challenges remain. Ongoing studies and development efforts will determine whether oral MMR vaccines can complement or replace injectable vaccines in routine immunization programs.

Addressing the challenges of stability, manufacturing, public acceptance, and regulatory approval is crucial for the successful implementation of oral MMR vaccines. As research progresses, oral vaccines could play a pivotal role in enhancing global vaccination efforts and improving public health outcomes.

References

[1] The FDA approved M-M-R II in 1971 for use in people 12 months of age and older.

[2] Measles, Mumps, and Rubella (German Measles). 2020.https://www.fhs.gov.hk/english/health_info/child/486.html

[3] "Rubella – Fact Sheet for Parents," cdc.gov.

[4] Wang H P, Wang Z G, Liu S L. Current status and future trends of vaccine development against viral infection and disease [J]. New Journal of Chemistry, 2021, 45 (17): 7437-7449.

[5] Stratton K, Ford A, Rusch E, Clayton EW, editors. Institute of Medicine. Adverse Effects of Vaccines: Evidence and Causality. Washington DC: National Academies Press; 2011. [PubMed] [Google Scholar]

[6] Naleway AL, Gold R, Drew L, Riedlinger K, Henninger ML, Gee J. Reported adverse events in young women following quadrivalent human papillomavirus vaccination. J Womens Health (Larchmt) 2012; 21 (4): 425–32.

[7] Woo EJ, Ball R, Braun MM. Fatal syncope-related fall after immunization. Arch Pediatr Adolesc Med. 2005; 159 (11): 1083.

[8] Braun MM, Patriarca PA, Ellenberg SS. Syncope after immunization. Arch Pediatr Adolesc Med. 1997; 151 (3): 255–9.

[9] Kroger AT, Sumaya CV, Pickering LK, Atkinson WL. General recommendations on immunization: Recommendations of the Advisory Committee on Immunization Practices. MMWR. 2011; 60 (RR02): 1–60.

[10] "Editorial: Inactivated Measles Virus Vaccine," British Medical Journal 1, no. 5294 (1962): 1746–1747. [PMC free article] [PubMed].

[11] Kowalzik F, Faber J, Knuf M. MMR and MMRV vaccines. Vaccine. 2018 Aug 28; 36 (36): 5402-5407.