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REVIEW ARTICLE

Adult Vaccination and Preventive Immunization in High-Risk Populations: An Updated Clinical Review

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Abstract

Vaccination remains one of the most effective public health interventions for preventing infectious diseases and reducing morbidity and mortality. Adult immunization is particularly important in older adults, individuals with chronic diseases, residents of long-term care facilities, and immunocompromised populations, who are at increased risk of severe infections. This narrative review summarizes current recommendations from major public health organizations, including the WHO, ECDC, and CDC, with emphasis on adult and high-risk populations. Key vaccine platforms are discussed, including influenza, pneumococcal, mRNA-based COVID-19, RSV, herpes zoster, and hepatitis B vaccines. The review also highlights the role of immunosenescence in reduced vaccine responsiveness and discusses emerging applications of mRNA technology in oncology. Overall, targeted immunization strategies remain essential for reducing disease burden and improving health outcomes.

Keywords: Adult Vaccination, Immunization, High-Risk Populations, Immunosenescence, Influenza Vaccine, Pneumococcal Vaccine, mRNA Vaccines.

1. Introduction

Vaccination is a cornerstone of preventive medicine and represents one of the most cost-effective interventions in healthcare, significantly reducing morbidity, mortality, and healthcare system burden worldwide[1,2]. International health authorities, including the World Health Organization (WHO) and the European Centre for Disease Prevention and Control (ECDC), emphasize routine immunization as a key strategy for population health.[1,2]

High-risk groups include older adults, patients with chronic cardiopulmonary or metabolic diseases, individuals with renal disease or immunodeficiency, and residents of long-term care facilities [2-4]Age-related immune decline, known as immunosenescence, together with chronic low-grade inflammation ("inflammaging"), contributes to reduced vaccine effectiveness in older populations.[3]

2. Vaccine Delivery Methods and Immunologic Basis

Vaccines may be administered via different routes, each influencing immune activation [5]

Intramuscular administration induces strong systemic antibody responses, while subcutaneous delivery allows slower antigen release. Intradermal injection enhances antigen presentation due to high dendritic cell density. Oral vaccines stimulate mucosal immunity through IgA production.[5]

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3. Cold Chain Management

Maintaining vaccine potency requires strict cold chain conditions. Vaccines must be stored at 2-8°C, protected from freezing, and continuously monitored during transport [6]Failure to maintain these conditions can reduce immunogenicity and vaccine efficacy.[6]

4. Influenza Vaccination

Seasonal influenza causes significant morbidity and mortality, particularly among elderly and high-risk individuals. Vaccines are updated annually to match circulating strains, including influenza A(H1N1), A(H3N2), and influenza B lineages.[7]

Protective immunity develops within 10–14 days, primarily through neutralizing antibodies targeting hemagglutinin and neuraminidase. Vaccine effectiveness ranges from 40–60% depending on strain and population.[7-8]

5. Pneumococcal Vaccination

Streptococcus pneumoniae is a leading cause of pneumonia, sepsis, and meningitis. Conjugate vaccines (PCV13/15/20) induce T-cell–dependent immune memory, while polysaccharide vaccines (PPSV23) provide broader serotype coverage but weaker immune memory.[9]

Vaccination is recommended for adults ≥65 years and high-risk individuals aged 18–64 years with chronic diseases.[9-10]

6. Covid-19 Vaccines and mRNA Technology

mRNA vaccines deliver genetic material encoding the SARS-CoV-2 spike protein via lipid nanoparticles, leading to antigen expression and activation of both humoral and cellular immunity.[11]

These vaccines demonstrate strong immunogenicity and rapid development timelines but reduced effectiveness in older adults due to immunosenescence.[11-12]

7. RSV Vaccination

Respiratory syncytial virus (RSV) causes severe lower respiratory tract disease in infants and older adults. Recombinant prefusion F protein vaccines (RSVpreF, RSVpreF3) induce neutralizing antibodies.[13]

Efficacy in older adults exceeds 80% in the first season.[13]

8. Herpes Zoster Vaccination

Herpes zoster results from reactivation of latent varicella-zoster virus due to declining cellular immunity. The recombinant glycoprotein E vaccine provides approximately 90% protection and remains effective in older adults.[14]

9. Hepatitis B Vaccination

Hepatitis B virus infection can lead to cirrhosis and hepatocellular carcinoma. Recombinant surface antigen vaccines induce long-lasting immune memory after a three-dose schedule (0, 1, 6 months).[15]

High-risk groups include healthcare workers, dialysis patients, and individuals with high-risk behaviors.[15]

10. Emerging Applications of mRNA Vaccines in Oncology

mRNA vaccine platforms are being investigated in cancer immunotherapy. These vaccines encode tumor-associated antigens and stimulate cytotoxic T-cell responses [16]. Early clinical trials in melanoma and other solid tumors show promising results, especially when combined with immune checkpoint inhibitors.[16]

11. Conclusion

Vaccination remains a fundamental pillar of preventive medicine. Advances in immunization strategies, particularly mRNA-based technologies, are expanding vaccine applications beyond infectious diseases into oncology. Targeted vaccination of high-risk populations is essential for reducing disease burden and improving public health outcomes.

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