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الطبيب / حسام حمودة محمد دراز

تحت إشراف

أ.د/فؤاد علي البحيري

أستاذ طب الأطفال

كلية الطب - جامعة الأزهر

د/محمد مصطفى أحمد

أستاذ مساعد طب الأطفال

كلية الطب - جامعة الأزهر

كلية الطب - جامعة الأزهر

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Advances In Immunization Strategies

An Essay

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By

**Housam Hamoda Deraz
M.B, B.ch.**

Under Supervision of

Prof. Dr. Fouad Ali Al-Behairy

*Professor of Pediatrics
Faculty of Medicine - Al Azhar University*

Dr. Mohammed Mustafa Ahmed

*Assistant Professor of Pediatrics
Faculty of Medicine - Al Azhar University*

*Faculty of Medicine - Al Azhar University
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INTRODUCTION

Immunization is the process of inducing immunity against a specific disease. Immunity can be induced either passively through administration of antibody-containing preparations or actively by administering a vaccine or toxoid to stimulate the immune system to produce a prolonged humoral and /or cellular immune response (*Walter and Larry, 2008*).

Vaccines are substances that are made of the pathogens that cause the disease and designed as a prophylactic measure to induce a lasting immune response so that prevent acquiring the diseases on subsequent exposure to the particular infectious agent (*Gordon Ada, 2005*).

The best way to reduce vaccine-preventable diseases is to have a highly immune population. Universal vaccination is a critical part of quality health care and should be accomplished through routine and intensive vaccination programs implemented in physicians' offices and in public health clinics. Programs should be established and maintained in all communities to ensure vaccination of all children at the recommended age. In addition, appropriate vaccinations should be available for all adolescents and adults (*Kroger et al., 2006*).

The idea of progress in vaccination strategies is to achieve multicomponent vaccines that are more potent, less reactogenic, somewhat inexpensive and delivered by non



parenteral route. The final goal of immunization is not only to minimize the occurrence of infectious diseases but to eradicate them, the example of that is small pox and measles (***Fouad Al-Behairy, 2009***).



AIM OF THE WORK

The aim of this essay is to present an updated review of the Literature on the advances in immunization strategies being one of the most beneficial and cost-effective disease prevention measures.

This is to help better understanding of the subject, to reduce the incidence of vaccine preventable diseases and finally eradicate them for the benefit of the child and the community in general.



HISTORY OF VACCINATION

The history of vaccination extended for more than 200 years as described in the following table

Table (1): Milestones in the history of vaccination.

Year	Event
400	Hippocrates describes diphtheria, epidemic jaundice, and other conditions
1100	Variolation for smallpox first reported in china
1721	Variolation introduced Into great Britain
1796	Edward jenner inoculates james Phipps with cowpox, and calls the procedure vaccination (vacca is latin for cow)
1870	Louis Pasteur creates the first live attenuated bacterial vaccine (chicken cholera)
1884	Pasteur creates the first live attenuated viral vaccine (rabies)
1885	Pasteur first uses rabies vaccine in a human
1887	Institute Pasteur established
1900	Paul Ehrlich formulates receptor theory of immunity
1901	First Nobel prize in medicine to von behring for diphtheria antitoxin
1909	Theobald smith discovers a method for inactivating diphtheria toxin
1919	Calmette and gurin create BCG the first live attenuated bacterial vaccine for humans
1923	First whole-cell pertussis vaccine vaccine tested gaston ramon develops diphtheria toxoid
1926	Ramon and Christian zoeller develop tetanus toxoid
1927	Yellow fever virus isolated
1931	Goodpasture describes a technique for viral culture in hens eggs
1936	Thomas francis and Thomas Magill develop the first inactivated influenza vaccine
1948	John enders and colleagues isolate lansing type ll poliovirus in human cell line
1954	Enders and peedbles isolate measles virus francis field trial of inactivated polio vaccine
1955	Inactivated polio vaccine licensed
1961	Human diploid cell line developed
1963	Measles vaccine licensed trivalent oral polio vaccine licensed
1965	Bifurcated needle for smallpox vaccine licensed
1966	World health assembly calls for global smallpox eradication
1967	Maurice hilleman develops jeryl lynn strain of mumps virus

1969	Stanley plotkin develops RA27/3 strain of rubella vaccine virus
1971	MMR vaccine licensed
1977	last indigenous case of smallpox (Somalia)
1979	Last wild poliovirus transmission in the U.S.
1981	First hepatitis B Vaccine licensed
1983	Smallpox vaccine Withdrawn from civilian market
1986	First recombinant vaccine licensed (hepatitis B) national childhood vaccine injury act
1989	Two – does measles vaccine recommendation
1990	First polysaccharide conjugate vaccine licensed (haemophilus influenza type b)
1994	Polio elimination certified in the Americas vaccine for children program begins
1995	Varicella vaccine licensed hepatitis A vaccine licensed first harmonized childhood immunization schedule published
1996	Acellular pertussis vaccine licensed for infant
1997	Sequential polio vaccination Recommended
1998	First rotavirus vaccine licensed
1999	Exclusive use of inactivated polio vaccine recommended rotavirus vaccine withdrawn
2000	Pneumococcal conjugate vaccine licensed for infants
2003	Live attenuated influenza vaccine licensed
2004	Inactivated influenza vaccine recommended for all children 6-23 months of age
2004	Indigenous transmission of rubella virus interrupted
2005	Acellular pertussis vaccines licensed for adolescents and adults
2005	MMR – varicella (MMRV) licensed
2006	Second generation rotavirus vaccine licensed
2006	First human papillomavirus vaccine licensed
2006	First herpes zoster vaccine licensed

(Atkinson et al., 2009)

WHY VACCINATE?

The ability to develop protection against infection without adverse effects or the necessity to experience the infection would provide substantial benefits. That is particularly true when it comes to pathogens that give rise to serious disabling diseases and death, or that can cause major epidemics. A number of such vaccines have been discovered and widely introduced. Generally speaking, the vaccines also give rise to memory cells, ensuring long-term protection. That kind of approach has completely eradicated smallpox. Polio has almost been eradicated worldwide. Diphtheria, tetanus, measles, mumps and rubella have been largely eliminated in countries with high vaccination rates (*Ada, 2001*).

Children have the ability to develop an effective immune response to various antigens, including vaccines, at an early stage. Even preterm infants who weigh less than 1 000 grams at birth have protective antibody levels against these pathogens 7 years after receiving customary combination vaccines (*Kirmani et al., 2002*).

What criteria should a vaccine meet?

Above all, a vaccine should fully protect the child against infection for a long time. The immunity that is built up during and after infection is often long-lasting, sometimes for life. Vaccines can have a similar effect, but some may require multiple doses, live viruses or stimulating adjuvants. The vaccine should contain the purified pathogenic components that are required to activate the adaptive immune system (*Siegrist, 2001*).

Age at which induction of the most effective, long-term protection is possible

Children should ideally be vaccinated at an early age in order to prevent the maximum number of infections. But that concern must be weighed against the possibility that the immune system may be relatively undeveloped during the first year of life.

Vaccination practice has evolved quickly in line with immune system research. Better and better vaccines have been discovered, but much remains to be done (*Lambert et al., 2005*).

Measuring vaccine response

Vaccine response must measure how well the person is protected against infection. Establishing how long protection lasts and the possible effect of additional doses is also important. Good yardsticks are often available, for instance the level of serum antibodies against diphtheria and tetanus. Such data enable an assessment of whether additional doses are needed to ensure optimal protection. Neutralizing serum antibodies against some viruses, such as polio, provide information about how well the body may be protected against the particular disease. In some cases, such as when protection may also depend on secretory IgA antibodies that protect the mucous membranes, the number of antibodies may be less informative.

For some vaccines, the level of antibodies is not the only measure of protection. The avidity, or functional binding

strength, of the antibodies is also revealing. The type of antibodies that have been induced also provides informative data – IgG antibodies dominate when protection is longlasting. IgG normally bind most effectively, while IgM (which appear first in the immune response) bind more weakly because of their lower specificity. Their lower specificity at that point enables them to bind, and possibly protect, more broadly (*Ortqvist et al., 2010*).



TYPES OF VACCINES

There are mainly of four types of vaccines in use today (Table 2):

- (1) Live attenuated microorganisms;
- (2) Inactivated, whole microorganisms;
- (3) Subunit vaccines (subunit, polysaccharides, polysaccharide/protein conjugates);
- (4) Toxoids.

Table (2): Types of vaccines

	Viral	Bacterial
Live, attenuated	Vaccinia (smallpox) Polio (OPV) Measles Mumps Rubella Adeno Varicella-Zoster Ca Influenza Yellow fever	BCG <i>Salmonella typhi</i> (Ty21a) <i>Vibrio cholerae</i>
Inactivated, whole organism	Influenza Polio (IPV) Rabies Japanese encephalitis Hepatitis A	<i>Bacillus anthracis</i> <i>Bordetella pertussis</i> <i>Coxiella burnetii</i>
Subunit	Influenza Hepatitis B (HepB)	<i>Salmonella typhi</i> Vi <i>Bordetella pertussis</i> (acellular)
Polysaccharide		<i>Neisseria meningitidis</i> (A,C,Y,W135) <i>Streptococcus pneumoniae</i> , 23 valent
Conjugate		<i>Haemophilus influenzae</i> , type b (Hib) <i>Streptococcus pneumoniae</i> , heptavalent <i>Neisseria meningitidis</i>
Toxoids		<i>Corynebacterium diphtheriae</i> <i>Clostridium tetani</i>
Combinations	Measles, mumps, rubella (MMR)	Diphtheria, tetanus, pertussis, whole organism (DTPw), acellular (DTPa) DTPa, Hib, HepB

(Gordon Ada 2005)

A. Live, Attenuated Microorganisms