

Lifelong vaccination as a key disease-prevention strategy

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Abstract

Vaccination is traditionally considered as a measure addressed to infants and children. Indeed, in natural conditions, vaccine-preventable infections are mainly spread at a young age. The implementation of routine and mass vaccination programmes has led to the eradication of smallpox and to the elimination of poliomyelitis in many regions of the world, together with the control of once life-threatening diseases like diphtheria and tetanus. In more recent times, the development of new generation vaccines and the changing epidemiological profile of many vaccine-preventable diseases have greatly changed the objectives and the target of today's immunization strategies. The objective of this article is to highlight and discuss the evolution of vaccination strategies from measures aimed at protecting children to a practice that is needed throughout life. Adolescents and adults need immunization for several reasons: they may not have received the vaccines usually administered in childhood; new vaccines tailored for adolescents and adults have become available; immunity acquired thanks to immunization in childhood can fade; and older adults or those who are chronically ill are more susceptible to vaccine-preventable diseases and to their complications. The changing demographic profile of both industrialized countries and of countries in transition towards an 'aging' population, and the shift of several infectious diseases towards adulthood make it imperative that new infrastructures to deliver vaccines and new investments in immunization are investigated. Such a change of perspective is needed both to preserve health and to guarantee the sustainability of health systems.

Keywords: Lifelong vaccination, strategy, sustainability, adolescents, adults, changing demographics

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Background

Vaccination is traditionally considered as a measure that is addressed to infants and children. In natural conditions, vaccine-preventable infections are mainly spread at a young age. The start of attendance at day-care centres, nurseries and primary schools is usually the typical age of acquisition of highly contagious infections transmitted directly or indirectly through airborne droplets or by the faecal–oral route.

The implementation of routine and mass vaccination programmes has led to the eradication of smallpox and to the elimination of poliomyelitis in many regions of the world, together with the control of once life-threatening diseases like diphtheria and tetanus.

In the last three decades, the development of new technologies (like recombinant DNA and conjugation of polysaccharides) to produce vaccines that were impossible to obtain using the conventional cultural techniques, has allowed the introduction of immunization programmes against hepatitis B, *Haemophilus influenzae* b, and pneumococcal and meningococcal diseases in many countries of the world. The efforts of countries and international agencies to increase vaccination coverage have produced notable results [1]. In some cases, the positive effects on mortality are not limited to the vaccine-preventable disease itself, but expand to fatalities caused by other agents whose pathogenic effects, in natural conditions, are increased by the vaccine-preventable infectious disease. For instance, a 13% increase of global coverage against measles obtained between 2000 and 2010 has translated into a

c.74% reduction of measles mortality [2] and an indirect effect on casualties due to pneumonia and diarrhoeal diseases.

In more recent times, the development of the latest generation of vaccines and the new epidemiological profile of many vaccine-preventable diseases have greatly changed the objectives and the target of today's immunization strategies.

For instance, the availability of human papillomavirus (HPV) vaccines prompted health authorities to plan and organize universal immunization programmes aimed at a non-traditional target for previous vaccination strategies, that of adolescents.

We also have innovative tools, like new pneumococcal and herpes zoster vaccines, that we can use to preserve health and quality of life in the elderly population, an increasingly numerous target where preventive activities can substantially contribute to the sustainability of healthcare systems.

On the other hand, the most affected age groups for traditional vaccine-preventable diseases (i.e. measles) have changed because of suboptimal coverage in children. Measles has become mainly a disease of adolescents and adults in many industrialized countries.

The objective of this article is to highlight and discuss the evolution of vaccination strategies from measures aimed at protecting children to a practice that is needed throughout life.

Priority Setting on Vaccination Programmes and New Ways to Measure Immunization Impact

In the past, the drivers behind the decision to introduce a vaccination programme were mainly the number of deaths and serious disease cases. Relatively few vaccines were available, and pharmaco-economic evaluations were not needed, because the advantage of vaccination was self-evident and there was a preference for vaccination early in life. Parents accepted vaccination almost invariably, and the costs connected with vaccination programmes were low.

Since the beginning of the 21st century, the world of vaccination has started to change: many new vaccines are in line and the approach to their introduction is focused on evidence-based prevention. However, the communication landscape has changed dramatically, and, as a consequence of the reduction of incidence of once threatening diseases thanks to widespread vaccination, parents are more concerned by the adverse reactions of vaccines than by the disease itself. Vaccines have a higher technological content and higher costs, at least in the first years following their availability.

Also, the concept of vaccine-preventable diseases has changed. Traditionally, the effect of vaccination was measured as the reduction (usually in the short term) of deaths, serious

sequelae, complications and number of cases for well-characterized acute diseases. Measurement of effects is performed using standard surveillance methods (incidence, hospitalizations, mortality rates, etc.), and the end objective of vaccination programmes is frequently elimination or even eradication of an infectious agent.

With the newly developed vaccines, the impact of vaccination strategies is less frequently only a direct effect, it is often prolonged (vaccines like HPV, for instance, extend their effects for many decades to come), and it is not only 'medical' and not easily measurable, given the frequent impact on economics, on social settings or quality of life [3]. As a consequence, methods to measure the effects of an immunization programme need to be adapted to the new scenario. For instance, for influenza, the reduction of hospitalizations and of work absenteeism might be more relevant than the simple decrease of disease cases; for rotavirus diarrhoea, the impact on family disruption is among the most relevant expected outcomes; for herpes zoster, vaccination is expected to impact especially on quality of life and on social disruption. In addition, there is a need for surrogates of protection when the maximum expected benefit is delayed (as for HPV). In brief, we need to shift from the concept of prevention of disease to that of prevention of illness (also including consequences on social disruption, resource use, protection of high-risk groups, family and community members, and impact on work absenteeism).

The characteristics of our evaluation tools are also changing: for surveillance purposes, it is advisable to introduce and validate the most modern tests for the surveillance of infections (nucleic acids testing, genotyping, sequencing, etc.).

On the other hand, a complete evaluation of the most relevant aspects of the introduction of a new vaccine (from an epidemiological, economic, ethical, organizational and communicational point of view) is needed today and is included in the broad concept of Health Technology Assessment (HTA) [4]. In this new landscape, it is necessary to implement the evaluation techniques of evidence-based prevention, not only through meta-analysis and systematic revision of efficacy and safety of vaccines, but also by expanding a multidisciplinary approach (together with mathematicians, demographers and economists) to develop dynamic models on the epidemiology of disease and on the impact of new vaccination strategies. Since HTA also includes considerations of acceptability and ethical and economic issues, we need to explore new methods for the surveillance of social wellness, quality of life and impact on productivity. Last but not least, in a scenario of more attention given to adverse events following vaccination than to the diseases prevented by vaccines, we need to learn and experience relevant communication skills.

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