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Ethics of vaccination programs

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Ethical issues are present at each stage in the vaccine product life cycle, the period extending from the earliest stages of research through the eventual design and implementation of global vaccination programs. Recent developments highlight fundamental principles of vaccine ethics and raise unique issues for ongoing vaccination activities worldwide. These include the 2009–10 H1N1 pandemic influenza vaccination campaign, renewed attention to the potential global eradication of polio, and the ongoing evaluation of vaccine risk controversies, most notably the alleged link between childhood vaccines and autism. These cases present ethical challenges for public health policy-makers, scientists, physicians, and other stakeholders in their efforts to improve the health of individuals, communities, and nations through vaccination.

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Introduction

Ethical considerations are increasingly visible in discussions regarding the design and implementation of vaccination programs. A number of recent developments in vaccine science and policy have brought heightened attention to longstanding ethical questions and have also raised new concerns. Common among these varied debates are questions regarding the proper role of governments in developing, promoting, and monitoring vaccines; the identification and evaluation of vaccine risks and benefits; and the appropriate place of vaccination in comprehensive public health programs.

Major topics in vaccination and public health since 2009—pandemic influenza, polio eradication activities, and vaccine safety debates—highlight fundamental themes of vaccine ethics. They also raise unique issues

in which ethical considerations are relevant to policy-making regarding the role of vaccines in ongoing efforts to promote global health.

Vaccine ethics: an overview

Ethical issues are present at each stage in the vaccine product life cycle, the period extending from the earliest stages of research through the eventual design and implementation of global vaccination programs [1,2]. The prioritization of disease targets for research [3], the design and execution of research involving human subjects [4,5], the evaluation of safety and efficacy data by regulatory bodies [6,7], and the creation of programs to ensure long-term access, affordability, and safety [8–10] are some of the major issues within the vaccine product life cycle in which ethical concerns coincide with questions of science, medicine, and public health.

A general goal of vaccination programs is to maximize the benefits of vaccines in preventing morbidity and mortality in all populations, while minimizing exposure to severe vaccine-related adverse events and infringement on the decision-making prerogatives of individuals (or parents, for vaccines administered to children) [1]. Like any medical intervention, vaccines can never be risk-free [11]. A primary ethical and public health responsibility for policy-makers is to identify and confirm vaccine-related risks and then to evaluate whether the prevalence or severity of those risks outweighs potential benefits [12].

The use of mandatory vaccination requirements for select populations has proven to be an indispensable tool in building and maintaining high vaccination rates, particularly in the United States [13,14]. While most analysts believe that mandatory vaccination requirements can be justified ethically, there is a broad consensus that those policies should be implemented only in limited circumstances [15,16]. Effective decision-making regarding vaccine risks and the potential use of mandates requires ongoing deliberation informed by evidence about individual vaccines, the diseases they prevent, and the role of vaccines as part of overall disease prevention strategies.

Further complicating debates of vaccine ethics and policy are several intrinsic characteristics of vaccines and vaccination programs. As preventive interventions, the acceptability of vaccine-associated risk is less than what would probably be tolerated for treatments in individuals with disease. The historical achievements of vaccination programs in reducing and eliminating diseases in many countries mean that many vaccine-preventable diseases

are neither observed nor remembered by many citizens and an increasing number of health care providers [17]. An unintended consequence of those achievements is the potential for an inaccurate perception of the relative risks and benefits of vaccines [11[•],17]. Moreover, most routinely administered vaccines are recommended for children [18–20]. Tolerance of vaccine-related risk for this population is even more limited.

The most significant factor complicating discussions of vaccine ethics is herd immunity, generally defined as the additional protection against disease that is a result of high vaccination rates within a community [21[•]]. Maintaining vaccination rates at a level sufficient to preserve herd immunity is among the foremost concerns of vaccination advocates. Because of herd immunity, the decision by an individual to receive or decline a vaccine not only affects their personal protection against vaccine-preventable disease, but it also has consequences for their community. Determining how to weigh the duty to help others against individual rights regarding vaccination status is central to discussions of vaccine policy.

Vaccines and pandemic influenza

Planning for a possible influenza pandemic had been a priority of governments, the public health community, and other stakeholders for much of the past decade. This planning was largely developed in response to concerns regarding a potential H5N1 (avian) influenza pandemic [22–24], but it provided a valuable foundation for responses to the 2009–10 pandemic caused by a novel strain of influenza A (H1N1).

Several ethical issues emerged in the development and implementation of the global H1N1 influenza vaccination program. The time required to produce the initial doses of the vaccine generally matched the six-month timetable that had been predicted, underscoring the crucial need for investment in faster production technologies [25]. The accelerated development of safe and effective vaccines in response to pandemics is both a paramount public health objective and an ethical priority.

Improving production techniques is one of several steps required to provide broad, equitable access to vaccines. A successful program begins prior to vaccine development, with the global sharing of virus samples. This ensures that eventual vaccines and other responses are designed based on the most complete information regarding the characteristics of the virus. The threat of avian influenza several years ago revealed challenges in securing full global cooperation in virus sharing [26,27]. A 2011 agreement organized by the World Health Organization (WHO) promises to address these moral concerns by linking the prompt sharing of samples with programs to promote accelerated delivery of vaccines and other interventions to all nations at risk [28].

Ensuring equitable global access to pandemic vaccines—particularly for those countries where the burden of disease is greatest—is an ethical imperative. The 2009–10 pandemic revealed significant deficiencies in this area, as some countries eventually destroyed millions of unused vaccine doses while others had inadequate supply to meet demand [29]. With the vast majority of global vaccine supply coming from a limited number of multinational manufacturers, it remains unclear in what order vaccine purchases from various nations were filled or how they should be filled in the future. International bodies should provide greater clarity and guidance on this issue as part of ongoing preparedness activities.

Even in countries such as the United States that eventually had adequate vaccine supply to meet demand, limitations in the early stages of the vaccination program required priority groups to be identified by public health policy-makers [30]. The allocation of limited vaccine doses had long been a focus of pandemic planning activities in the United States and internationally [31,32]. Prioritization schemes were based on those prior efforts as well as the groups most likely to be harmed by the H1N1 pandemic strain.

The successful implementation of allocation strategies and other pandemic responses depends on trust established through effective communication between the public health community and citizens. Results in this area were decidedly mixed during the recently concluded pandemic. While the United States, United Kingdom, Mexico, and other countries developed robust outreach and education programs to provide the public with the latest information about the threat and possible responses [33[•]], considerable criticism was directed at WHO's efforts in this area. Some critics raised objections about conflicts of interest influencing WHO recommendations and decision-making during the pandemic [34]. Of particular concern was its pandemic phase classification system, a scale that failed to communicate effectively the distinction between the geographical spread of the virus and its severity. Numerous reviews, including one commissioned by WHO itself, have already developed recommendations aimed at addressing these concerns for the future [35].

Reevaluating eradication campaigns

Vaccination programs are frequently implemented to address long-standing infectious disease threats, particularly those common in childhood. The contributions of vaccines to the reductions in the morbidity and mortality of many diseases have been well documented, none more so than the successful global eradication of smallpox certified by WHO in 1980 [36]. Eradication has been a goal of public health advocates since the earliest days of vaccination; confirmation that it could be achieved only added to the enthusiasm for similar eradication cam-

paigms, particularly against polio [37], malaria [38[•]], and measles [39]. This enthusiasm continues today.

Despite significant efforts aimed at duplicating the successful eradication of smallpox for other vaccine-preventable diseases, the past thirty years have revealed considerable challenges that as yet remain insurmountable. Polio has been the most alluring target for proponents of eradication. Vaccination programs have brought the annual number of wild poliovirus cases below 2000 for several years, and the disease remains endemic in only a few countries [37]. While eradication seemingly appears within reach, achieving further reductions in polio incidence has proven exceedingly difficult, partly owing to the unique characters of the virus and polio infection.

Philanthropies such as the Bill and Melinda Gates Foundation and Rotary International have remained steadfast in their commitment to polio eradication, vowing in 2010 to continue to devote considerable financial resources to eradication activities [40]. Polio eradication is one of the foremost priorities of the Gates Foundation, perhaps the most influential organization in global health priority-setting. Observers have questioned whether continued investment in this area is an appropriate use of global health resources, revisiting a debate that had long been simmering among the vaccination science, policy, and ethics communities [41]. A vigorous discussion has ensued, with the Gates Foundation and other advocates emphasizing their belief that the benefits of eradication are so great that continued pursuit of eradication is well worth the continued investment [42[•]]. Others argue that maintaining the current level of control is a more appropriate goal, with the additional resources that would go toward eradication efforts redirected to the many other pressing global health needs [43]. This ongoing, important public dialogue should continue, aiming for consensus regarding future responses to polio and overall efforts involving eradication as a public health objective.

Vaccine safety and risk controversies

The debate over the continued pursuit of polio eradication exists largely among strong believers in vaccination as a crucial component of global health programs. More prominent and contentious exchanges have occurred in recent years regarding vaccine safety. Critics, usually in developed nations, allege that various individual vaccines and the overall vaccination series are associated with risks that are not recognized or addressed appropriately by the public health community [44]. Many critics of contemporary vaccine policy are parents whose children have conditions they believe were caused by the routine administration of childhood vaccines. While these risk controversies have a long, global history, they have been most recently visible since the late 1990s in the United States, Japan, and the United Kingdom [45,46^{••}].

Among the most prominent causes of public concern regarding vaccine safety was the now-retracted paper published by the British researcher Andrew Wakefield and colleagues in *The Lancet* in 1998 that alleged an association between the measles–mumps–rubella (MMR) vaccine and autism spectrum disorder [47]. The paper and its conclusions were quickly and repeatedly challenged by medical and public organizations [44,48]. A 2010 investigation by the U.K. General Medical Council found Wakefield guilty of research misconduct in the conduct of this study [49]. The group subsequently banned him from practicing medicine in the United Kingdom. In the United States, Wakefield remains a champion among those who reject the consensus of the mainstream medical and public health communities, believing instead that vaccines are the cause of observed recent increases in autism incidence.

Wakefield's research is part of a constellation of theories alleging links between vaccines and autism or related conditions. In the late 1990s, scrutiny was directed at the potential harmful effects of thimerosal, the mercury-containing preservative common at the time in multi-dose vials of many childhood vaccines [50]. The decision by U.S. public health officials to remove thimerosal from vaccines in 1999 only added to the confusion and controversy over its alleged risks [51]. More recently, several hypotheses related to MMR vaccine, thimerosal, and autism rates were investigated as part of the Omnibus Autism Proceeding, a multi-year effort conducted as part of the U.S. Vaccine Injury Compensation Program [52]. A series of test cases were chosen to represent the over 5000 claims seeking compensation for autism-related injuries alleged to have been caused by vaccines. The rulings of the Special Masters assigned to hear the cases, released in 2009 and 2010, unambiguously rejected each of the theories linking vaccines with autism [53].

Despite these developments and many other studies and expert reports attesting to the safety of vaccines, vaccine risk controversies persist. New hypotheses—such as alleged risks associated with different vaccine components or the timing of the recommended vaccination schedule—routinely replace those that are refuted.

Concerns over vaccine safety have led to uncertainty and fears among an increasing number of parents. Negative perceptions are reflected in surveys of parental attitudes [54^{••}] as well as recent increases in the number of parents seeking non-medical exemptions from U.S. state vaccination requirements for their children [13^{••}]. Public confidence in the safety and value of vaccines is essential to the success of vaccination programs [55,56], and attention to these concerns are central to the National Vaccine Plan released in 2010 by the U.S. National Vaccine Program Office [57]. Enhanced vaccine safety systems and improved communication strategies are two of the five

principal priorities identified for the next decade. Finding an appropriate balance among the public good, protection of the vulnerable, and deference to individual rights remains a key challenge for vaccine policy, particularly as vaccine safety fears persist and vaccination programs continue to expand in developing nations.

Conclusions

While ethical considerations may often be less visible than scientific, political, legal, or financial concerns, they are present and directly relevant to the decision-making processes that shape the design and implementation of vaccination programs. The evaluation of these questions demands inclusive dialogue about ethics among all relevant stakeholders, informed by the best available evidence and analysis. Policy-makers should likewise engage in meaningful international collaboration in such deliberations whenever possible, reflecting the global nature of infectious disease prevention and the value of insights and expertise from the broadest possible range of perspectives.

Expanding efforts in recent years have aimed to deliver the benefits of existing vaccines to all who could benefit from them and to develop new vaccines against a growing array of disease targets. The relevance of ethical considerations to these activities has been increasingly recognized, and attention to these issues will be essential to the continued success of global vaccination programs in advancing the public good and promoting public health.

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