Have you herd? Indirect flu vaccine effects are critically important

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Seasonal epidemics of influenza virus infection occur frequently. These viruses infect the respiratory tract and typically cause fever, cough, and muscle and joint pain. In some individuals, particularly infants and elderly people, influenza infection can lead to severe illness or death.[1] Seasonal influenza also places a strain on economic productivity due to employee absenteeism and exhaustion of health-care resources due to increased hospital admissions.[2] Seasonal immunisation programmes are an important component of influenza prevention strategies, but several factors combine to make seasonal vaccination programmes less impactful than might be expected.

First, viral mutation (also known as drift) is an ongoing process, resulting in vaccine mismatch with circulating strains in some years and therefore decreased vaccine efficacy. Furthermore, influenza epidemiology is unfortunately characterised by dissociation between populations most likely to have severe disease (infants and elderly people), and populations most likely to benefit from vaccination (older children and adolescents—ie, those aged 2–16 years).[3] Older children and adolescents seem to be important for the early propagation of influenza in populations, and the efficacy of influenza vaccines is greater in these populations than in elderly people, but they are generally not prioritised for immunisation because of their lower risk of morbidity and mortality from this infection.[3] This paradoxical state of affairs has led some researchers to suggest that the best way to minimise the burden of seasonal influenza would be to focus immunisation programmes on children, adolescents, and young adults, with benefit accrued by elderly people and infants as a result of herd immunity.[3] Herd immunity is the additional protection provided to both unvaccinated and vaccinated individuals in a population, and results from the inability of successfully vaccinated individuals to propagate disease. Such an approach would be supported by both observational data,[4] and more recent randomised trials[5,6] suggesting that protection of all age groups results when children and adolescents are immunised against influenza. Such an approach might raise ethical questions: individuals who bear the discomfort and risk of immunisation provide the benefit of herd immunity to others at the extremes of age, who are less likely to benefit from direct immunisation. Although such an approach would be consistent with a utilitarian optimum, and with a communitarian approach to health and medicine, it might be a difficult sell in a health context that embraces an individualistic focus on health-care decision making.[3]

In *The Lancet Public Health*, David Hodgson and colleagues[7] provide a model-based cost-effectiveness analysis of emerging live-attenuated influenza virus (LAIV)-based seasonal influenza programmes targeting people aged 2–16 years. Although the efficacy of LAIV had been the subject of controversy, the most recent randomised trial[6] showed efficacy equivalent to that seen with a more traditional trivalent subunit vaccine, providing the same herd effects. Intranasal administration of LAIV has the benefit of making parenteral injection unnecessary, a benefit that can be readily appreciated by parents of young children.

Importantly, and in accordance with best practices,[8] Hodgson and colleagues use a well calibrated dynamic mathematical model that allows them to evaluate the cost-effectiveness of vaccinating one group in the population (aged 2–16 years) on disease risk in another (elderly people).[7] They project that LAIV programmes focused on young individuals are in themselves highly cost-effective health interventions. However, their analysis highlights the importance of herd effects for decision makers: a rapidly implemented LAIV programme focused on children aged 2–16 years is actually more effective at preventing disease in elderly people than a more slowly implemented programme that includes both LAIV and direct immunisation of elderly people themselves. This finding is because a rapid, early focus on young individuals, in whom the vaccine is more effective, stops the influenza epidemic in its tracks. Furthermore, when young individuals are vaccinated, seasonal vaccination programmes targeted at low-risk elderly individuals might cease to be cost-effective (depending on the notoriously murky definition of cost-effectiveness threshold) because herd effects already effectively reduce risk for these individuals.

The Article by Hodgson and colleagues,[7] although focusing on influenza, has implications for other emerging vaccines. For example, conjugate pneumococcal vaccines administered to children have important effects on mortality in older individuals.[9] The existence of these herd effects could erode the cost-effectiveness of direct immunisation of older individuals. If health-care providers are to use the increasingly wide array of vaccines optimally, they need to acknowledge that epidemics are implicitly processes that involve populations rather than individuals. A degree of fluency with disease dynamics and health economics as applied to communicable diseases is increasingly a key component of the public health practitioner's skill set.

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