In addition to improve vaccine efficacy, a modification of vaccination strategies for elderly persons has been supported by the results of several vaccination trials. A decreased response and a shortened duration of protective immunity following booster immunization is a characteristic feature of old age (13). In Austria, for example, health authorities have therefore recommended five-year vaccination intervals for tetanus, diphtheria, pertussis, and pneumonia. Increased public awareness of regular booster vaccinations in adults should be enforced, as these immunization regimes may be essential to maintain the ability to respond to recall antigens in old age. Recent results also indicate that not only long-lasting protection but also a good booster effect can be expected even a long time after the last vaccination, when a live-attenuated vaccine (e.g., polio vaccine) is used for primary immunization in early life (9). New delivery systems that make use of tiny microneedles or noninjectable application devices may further increase vaccination acceptance, especially in the case of influenza, as this vaccination has to be repeated annually.

In the distant future, strategies to reverse or delay immunosenescence may also become apparent. Because thymic involution is a key event for the age-related deterioration of immune function, therapies aiming at promoting thymic regrowth, and increasing thymopoiesis are currently under investigation. The administration of IL-7 or growth hormone and insulin-like growth factor 1 have been proven promising in animal models. Furthermore, the eradication of chronic bacterial or viral infections may further delay immunosenescence. In animal models, a 30% reduction of caloric intake has also been found to slow multiple aspects of aging, such as the age-related loss of naive T cells and the decreased proliferative capacity after antigenic stimulation (39). Whether caloric restriction has similar effects in humans has not been proven yet.

CONCLUDING REMARKS

By virtue of the demographic development taking place in developed countries, infectious diseases in elderly persons have gained increasing importance. Thus, the development of more immunogenic vaccines for the elderly is relevant to the protection of public health. The improvement of specific vaccine types regarding immunogenicity and tolerability, the addition of adjuvants, the design of new delivery systems as well as specific immunization regimes should all contribute to enhanced efficacy of vaccines in elderly persons. For the short term, improvements could be achieved by raising people's awareness regarding recommended booster vaccination intervals throughout life and by adjusting vaccination intervals in old age. The enhanced efficacy of vaccines and the introduction of needle-free injection devices are likely to increase vaccine acceptance and vaccination coverage among elderly persons.

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