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Toward the development of universal influenza vaccines and vaccination regimens

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Influenza virus continues to evolve due to its genetic nature and the emergence of novel strains is inevitable. Predicting when and where the next pandemic strain will arise is almost impossible even in the 21st century. This poses a number of problems in designing timely preventive measures and necessitates the development of vaccines with greater efficacy and protection against diverse influenza viruses. The experimental universal vaccines/vaccine formulations have been primarily tested in mouse model. To our knowledge, this is the first time the protective efficacy of broadly reactive vaccine (aka "universal vaccine") has been extensively evaluated in farm animals in comparison with the rodent model. Our extensive comparative study has shown clear differences in immunogenicity and protective efficacy of M2e-based or other conserved epitope based vaccine in chickens and swine compared to mouse, which justifies the need for species-specific design of the universal influenza vaccine and vaccination approach. Our study also provides direct evidence showing that the mouse model may not reflect vaccine efficacy in humans, and the swine can be a better model for human flu vaccine development. Specifically, data obtained from our pig study has confirmed the utility of a pig model for evaluation of intranasal particulate flu vaccine delivery platform to potentially control flu in humans. In addition, we have tested an array of novel vaccines/vaccine formulations (recombinant and live vaccines, adjuvants, etc.) in different animal models. This wealth of knowledge will be used to optimize and define the best vaccine combinations and vaccination approaches for each species that can provide broadly reactive protective immunity against emerging and re-emerging influenza viruses.

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