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The coexistence or replacement of two subtypes of influenza

A pandemic subtype of influenza A sometimes replaces (e.g., in 1918, 1957, 1968) the previous seasonal subtype. However, the reintroduced subtype H1N1 in 1977 has been co-circulating with H3N2 since then. To understand these alternatives, we formulate a hybrid model for the dynamics of influenza A epidemics. Our model takes into account the cross-immunity between seasonal strains and the cross-immunity between seasonal and pandemic subtypes. A combination of theoretical and numerical analyses shows that for very strong cross-immunity between seasonal and pandemic subtypes, the pandemic cannot invade, whereas for strong and weak cross-immunity there is coexistence, and for intermediate levels of cross-immunity the pandemic may replace the seasonal subtype.