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► **To cite this version:**

Elisabeta Vergu, Sébastien Ballesteros, Anton Camacho, Caroline C. Bidot, Bernard Cazelles. Stochastic metapopulation modeling of multi-strain influenza dynamics. MODEMAVE, May 2012, Angers, France. 1p. hal-02811354

HAL Id: hal-02811354

<https://hal.inrae.fr/hal-02811354>

Submitted on 6 Jun 2020

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Workshop MODEMAVE
31 mai et 1^{er} juin 2012
LAREMA – Université d'Angers

31 mai, 14h15 – 15h15 : **Elisabeta Vergu**

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Stochastic metapopulation modeling of multi-strain influenza dynamics

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Here we aim at providing a general framework capturing the dynamics of co-circulating influenza subtypes and to characterize replacement and co-existence conditions. We propose a time-continuous metapopulation stochastic model for three co-circulating subtypes incorporating three key processes of influenza dynamics: antigenic drift, seasonal forcing in transmission and temporary full cross-immunity. The model realism is enhanced by considering three age-classes with specific contact rates based on data. The network underlying the metapopulation structure comprises major cities in the world coupled through real passengers flows. The impact of key determinants (basic reproductive ratio – R_0 , antigenic drift rate, and seasonality) was explored through computer-intensive simulations based on parameters consistent with recent estimations. For realistic mean antigenic drift rates, resident subtypes can be replaced even by a new virus with a smaller R_0 . When $R_0=1.5$ for all subtypes and assuming a strong seasonality, the probability of replacement tends to 1 for a rapidly evolving new subtype whatever the value of the antigenic drift rate for the resident subtypes. Co-existence of the three subtypes can be obtained for plausible ranges of parameter values. Besides the interpretation of the replacement or coexistence in terms of R_0 and antigenic drift rate, our approach highlights the need of additional hypotheses on mechanisms avoiding the extinction of a new strain introduced in a system with two strains at equilibrium.