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MODELLING BEHAVIOURAL CHANGES AND VACCINATION IN THE TRANSMISSION OF RESPIRATORY VIRUSES WITH CO–INFECTION

Emanuela Penitente*
joint work with Bruno Buonomo

Department of Mathematics and Applications, University of Naples Federico II, Naples (Italy)
*emanuela.penitente@unina.it

ABSTRACT

Co-infection of two respiratory viruses occurs when an individual's respiratory system is simultaneously infected by two genetically different viral diseases. In the recent literature, several models can be found that provide useful insights into the co-infection dynamics [2, 3]. However, a crucial aspect remains neglected: the influence of information-driven changes in human behaviour. Indeed, it is well known that human behaviour plays a pivotal role in determining the course of an epidemic and the effectiveness of any containment measures. We propose a behavioural co-infection compartmental model to investigate the effects of the behavioural changes induced by the information about the epidemic status [1]. First, we consider the case where the containment measures are purely non-pharmaceutical and model the contact rate as a decreasing function of the information index, defined as a distributed delay that quantifies the level of information and rumours about the disease status [4, 5]. We perform a qualitative analysis of the model through stability and bifurcation theory, in order to analyse the existence and stability of both endemic and co–endemic equilibria. Second, we extend the model to incorporate vaccination. The vaccination rates are assumed to increase with information about the prevalence of the diseases, and the contact rate to increase with the number of vaccinated individuals. Three information indexes are employed to quantify the information about the disease prevalence and vaccinated individuals. Among the main results, we show that behavioural changes may have a stabilising effect when only non-pharmaceutical measures are considered. In this case, sustained oscillations may turn into damped oscillations converging towards a steady state in which co-infection is endemic. Conversely, when both vaccination and non-pharmaceutical measures are considered, the effect of behavioural changes in contact patterns may have a destabilising effect.

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