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Influence of the co-dynamics Ebola-COVID-19 in the population

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In this project, we investigate the influence of the co-circulation of Ebola virus and SARS-CoV-2 virus, which causes the COVID-19 pathology. Although no cases of co-infection of the two diseases have yet been reported, the observation of recent Ebola outbreaks shows that they have been of moderate incidence compared to those that preceded them, suggesting a possible influence of COVID-19 control on Ebola dynamics. We therefore propose a coupled Ebola-COVID-19 mathematical model. The models restricted to the COVID-19 pandemic and the Ebola epidemic, as well as the coupled model, are rigorously analysed. In each case, we show that the disease disappears when the basic reproduction number is less than one and that it is locally endemic when it is greater than one. For the coupled model in particular, we show the existence of several boundary equilibria, which can also be locally asymptotically stable under certain conditions, and of an interior equilibrium that can co-exist with the disease-free equilibrium point. Numerically, the restricted Ebola model is calibrated per phases for the outbreak in Democratic Republic of Congo (DRC) that took place between 2018 and 2020: (i) The first phase is the one were only the Ebola virus was circulating; (ii) The second phase is the one in which both viruses (Ebola and SARS-CoV-2 virus) were circulating. This calibration shows a significant variation of some parameters, which would be due to the implementation of measures addressed against COVID-19. An analysis of the reported data and the obtained parameters is proposed. Within the framework of the coupled model, we explore the impact of the increase or decrease of certain parameters of the dynamics of one disease on the dynamics of the other.

Keywords: Ebola, COVID-19, Frontier equilibria, Local asymptotic stability, Global asymptotic stability