

Simulation, prediction, and evaluation-clinical applications of a mathematical model in infectious diseases and cancer

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Human Papillomavirus (HPV) is one of the most common sexually transmitted infections. There are currently more than 200 genotypes. Some of them, classified as high oncogenic risk, are associated with certain types of cancer, such as cervical, head and neck, vulva, vagina, and anus, in addition to other diseases, such as genital warts.

In 2007, a vaccination program aimed at 12-year-old girls was implemented in Spain to prevent the infection and, therefore, the associated diseases. Vaccination coverage has evolved over the years, and currently, the vaccination program has also been extended to 12-year-old boys to eliminate HPV-associated diseases in both genders.

Predicting the evolution of sexually transmitted infections (STD) is complex since different factors can influence it - from aspects related to sexual habits (initiation of sexual relations, number of sexual partners, among others) to social aspects associated with vaccination coverage or population fluctuations associated, for example, with tourism.

In this sense, and given that in the case of HPV, from infection to the development of the cancers associated with it can take years or even decades, it is necessary to be able to predict the epidemiological evolution of this infection and its consequences; as well as to evaluate different vaccination strategies and also to evaluate the resilience of vaccination programs and how sensitive they are to possible external factors such as crises of confidence in vaccination, or the appearance of pandemics such as the recent SARS-COV2 pandemic.

The development of a network model that takes into account aspects related to all these factors - clinical, social, and demographic and that simulates the transmission of this infection in the population allows the evaluation of which vaccination strategy is the most appropriate, the impact of these strategies in the short, medium and long term, and how these programs will respond to future situations - this allows informed decision making, based on data that will influence generations and generations of young people and that will determine that in the future challenges as relevant as the elimination of certain types of cancers or infections can be achieved and that we can identify the critical factors to be taken into account so that we can reach them and when they will be achieved.