Contact tracing in asymptomatic diseases under elimination

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OBJECTIVE

This study analyzes the critical tracing fraction (f_c) to eliminate diseases like rubella when both asymptomatic and symptomatic cases are considered.

BACKGROUND

Contact tracing, potentially identifies new cases of a disease from an index case and therefore prevents the spread of infection. This strategy is particularly useful to control minor outbreaks during elimination of diseases when the incidence of disease is low. In asymptomatic cases, contact tracing allows recognizing undiagnosed people who may possibly transmit the infection [1]. The critical tracing fraction (f_c) has been previously used [1] from estimation of the basic reproductive rate (R_0), the expected number of secondary cases generated by a single infectious individual in a partially susceptible population [2]. R_0 is deduced, as a ratio between the infection rate (β) and recovery rate(γ), including symptomatic and asymptomatic cases, to $R_0 < 1$ namely to eliminate a disease. This is applied to rubella, whose cases are asymptomatic of 20-40%. The goal is to eliminate rubella and congenital rubella syndrome in Latin America and the Caribbean in 2010[3].

METHODS

The critical tracing fraction is estimated from R_0 ($f_c=1-1/R_0$). R_0 is deduced with a standard local analysis of stability from two models: a SIR (Susceptible-symptomatic Infected-Recovered) model and a SIIR (Susceptible-asymptomatic Infected - symptomatic Infected-Recovered) model [4]. f_c is simulated for different a number of contacts per individual and probability of disease transmission ($w = \beta/\gamma+\beta$). Parameters values are chosen according to the epidemiological profile of rubella in Latin America and the Caribbean: a mortality rate (2000-2005) of 6.0 x1000, a loss of immunity of $1x10^{-8}$, a recovery rate for symptomatic infected of $1x10^{-3}$ and for asymptomatic infected of $5x10^{-4}$. An immunization rate of 95% is assumed [3]. Sensitivity analyses to changing parameter values were examined.

RESULTS

In symptomatic cases, fifty five contacts should be traced if f_c=90% and a transmisión probability of 0, 2 (90% of 60 contacts per individual) to sustain rubella elimination with an immunization rate of 95%. If f_c= 50%, five contacts should be traced (50% of 10 contacts per individual) (Figure 1a). In asymptomatic cases, with a f_c= 90% and a transmisión probability of 0, 2, ninety cases should be traced (90% of 100 contacts per individual) and ten contacts should be traced (50% of 20 contacts per individual) with a f_c= 50% and a transmisión probability of 0,2, (Figure 1b).

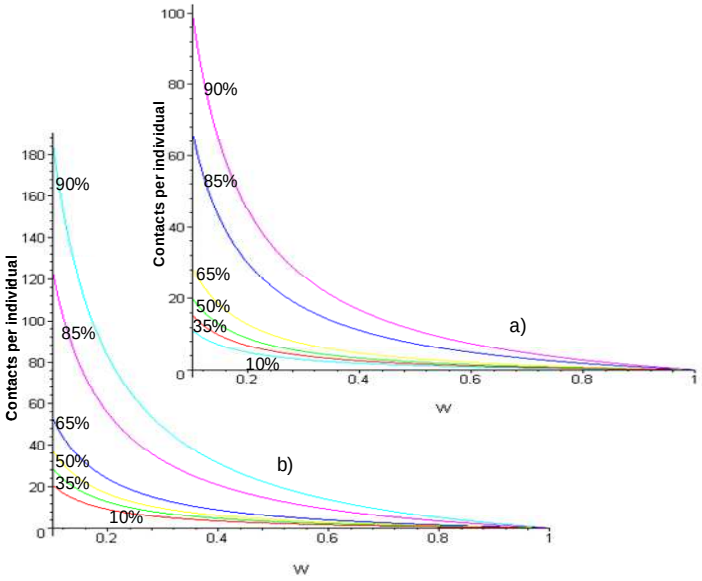

Figure 1 – Critical tracing fractions by contacts per individual and probability of disease transmission (w) when there are a)only symptomatic cases b) asymptomatic cases.

CONCLUSIONS

An increased number of contacts should be traced to sustain elimination of a disease with asymptomatic cases such as rubella when analysing critical fraction by contacts, a number of contacts by individuals, and a low probability of diseases transmission. A coordinated-integrated surveillance and vaccination systems are required, including monitoring of key parameters of the model.

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