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Modeling the impact of introducing the pertussis' vaccine booster for adolescent and adult in São Paulo City, Brazil.

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Report:
As we had planned, it was possible to improve the first model that we had proposed in the Research plan to Small Grant Program, and we have interesting conclusions. The work was concluded in August 2008.
The results was presented as poster on the XVIII World Congress of Epidemiology / VII Brazilian Congress of Epidemiology, in Porto Alegre - Brazil, during September 20-24, 2008.
We had either submitted an abstract to the 13th International Congress on Infectious Diseases (Kuala Lumpur – Malaysia, 2008) with the title "The impact of pertussis' vaccine booster for adolescents at São Paulo city – Brazil". It was approved to poster presentation but unfortunately I could not able to attend the congress.
Now we are trying to publish the paper in a peer-reviewed journal. It was already submitted on the European Journal of Epidemiology and we are waiting for their decision.

Abstract:

Assessment Of Pertussis Boosters For Adolescents And Young Adults In São Paulo, Brazil

Background:
Whooping cough incidence is on the rise throughout the world and acellular pertussis booster immunisations are being adopted for adolescents and adults in different countries. Different strategies are used according to different epidemiological profiles, whose proper recognition is imperative for a successful intervention. Meagre health budgets prevent developing countries of conducting epidemiologic surveillance as those regularly conducted in wealthier societies. Thus, epidemiologists are expected to draw from available data as to produce recommendations to public health authorities and the present study endeavours to put forward a model able to appraise different booster strategies for São Paulo city.

Methods:
A stationary compartmental age-dependent dynamic model accounting for immunity waning was conceived. Additionally to the current vaccination scheme, different strategies were tested and those referring to (i) 35% or (ii) 70% coverage at age 12 and (iii) both 35% at 12 and 70% at 20 are reported since they epitomise possible outcomes.

Results:
Scenario (i) produces a 59% total reduction of disease occurrence and a 53% reduction for infants; scenario (ii) yields a 76% total reduction and a 63% infant reduction; scenario (iii) reduces 62% of disease occurrence altogether and 54% of occurrences among infants. Conclusion: a single vaccine booster at age 12 comes out as the best option since it provides the best overall reduction and best impact over infants who are more liable to adverse outcomes. If this is the age group at stake, then young adult vaccination may be a spendthrift strategy.

Modeling the impact of introducing the pertussis' vaccine booster for adolescent and adult in São Paulo City, Brazil. *by Angela Carvalho Freitas, M.D., MPH continued*

The Model

The following differential equations describe the pertussis' model, and we can see it on the flow diagram below.

$$(1)\frac{dSp}{da} = -\lambda(a) * Sp - pv1(a) * Sp - \mu(a) * Sp$$

$$(2)\frac{dI}{da} = \lambda(a) * Sp + \lambda(a) * Ss - \gamma(a) * I - \mu(a) * I - \mu d(a) * I$$

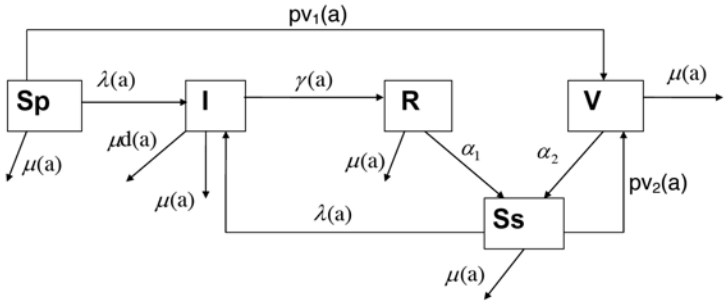
$$(3)\frac{dR}{da} = \gamma(a) * I - \alpha 1 * R - \mu(a) * R$$

$$(4)\frac{dV}{da} = pv1(a) * Sp + pv2(a) * Ss - \alpha 2 * V - \mu(a) * V$$

$$(5)\frac{dSs}{da} = -\lambda(a) * Ss + \alpha 1 * R + \alpha 2 * V - pv2(a) * Ss - \mu(a) * Ss$$

Where

$$(6)\lambda(a) = \lambda_i = \sum_j \beta_{ij} * I_j$$



Whooping cough age-dependent compartmental model.

Legend:

Sp: primary susceptible; Ss: secondary susceptible; I: infected; R: recovered from and immune to disease;V: immune after vaccine; (a): age-dependent transmission rate; (a): age-dependent recovery rate; 21 and : immunity waning rates; pv1(a) and pv2(a): age-dependent immunization rates; (a): age-dependent mortality rate; d(a): age-dependent disease-mortality rate.