Final Abstract Number: 48.003
Session: Vaccines & Vaccine Development
Date: Friday, June 15, 2012
Time: 12:45-14:15
Room: Poster & Exhibition Area

A mathematical model for the control of dengue using vaccines

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Background: Before the widespread deployment of a new dengue vaccine, we need to consider how best to use limited supplies of vaccine, given the complex dengue transmission dynamics and the immunological interaction among the four dengue serotypes.

Methods: We developed an individual-level simulation model for dengue transmission in Ratchaburi Province in central Thailand, the site of the first double-blinded, dengue vaccine randomized control efficacy trial. The model includes human mobility, a seasonal vector population, and the co-circulation of four dengue serotypes in a population that matches the age and household structure of Ratchaburi. We used the model to investigate the best use of vaccine to reduce the number of cases and dengue-related hospitalizations.

Results: Simulation results indicate that vaccinating children reduces both the number of dengue cases and hospitalizations more than vaccinating the same number of adults, but local dengue transmission can only be stopped if approximately 50-70% of children and adults are vaccinated. We also simulated multi-year catch-up campaigns to estimate their effectiveness.

Conclusion: Our model provides a coherent framework that integrates the natural history and epidemiology of dengue in semi-rural Thailand. The model can be used to plan mass vaccination campaigns, and it will be extended to evaluate coordinated mass vaccination and vector control.

http://dx.doi.org/10.1016/j.ijid.2012.05.985

Type: Poster Presentation

Final Abstract Number: 48.004
Session: Vaccines & Vaccine Development
Date: Friday, June 15, 2012
Time: 12:45-14:15
Room: Poster & Exhibition Area

Vaccination against viral hepatitis A and B in adults aged over 40 Years – antibody persistence and immune memory

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Background: Primary vaccination with combined vaccine against viral hepatitis A (VHA) and viral hepatitis B (VHB) induces higher anti-hepatitis B surface (anti-HBs) antibody responses and similar anti-hepatitis A virus (anti-HAV) antibody responses in adults aged over 40 years in comparison with concomitant monovalent vaccines against VHA and VHB. The objectives were to assess, vaccination and antibody response following a booster dose of the vaccine.

Methods: Five hundred and ninety-six subjects aged > 40 years were vaccinated with three doses of the combined VHA/VHB vaccine at Months 0, 1, 6 (HAB group) or with concomitant VHA and VHB vaccines at Months 0, 6 and 0, 1, 6 (ENG + HAV and HBVX + VAQ, respectively). Blood samples were collected one month following primary vaccination (Month 7) and then at one-year intervals for four years after the booster dose with the same vaccine as used for the primary vaccination. The anti-HBs and anti-HAV antibody levels were determined prior to the booster dose and at days 14 and 30 after the booster dose.

Results: At Month 7, > 97% of study subjects were seropositive for anti-HAV antibodies in all groups analyzed. Four years after primary vaccination, anti-HAV antibody seropositivity persisted in > 93% of study subjects, increasing to > 99% after the booster dose. At Month 7, the highest proportion of study subjects with anti-HBs antibody levels > 10 mIU/ml was found in the HAB group (91.7% versus 79.7% in the ENG + HAV group versus 71.0% in the HBVX + VAQ group). Four years after vaccination, anti-HBs antibody levels of 10 mIU/ml persisted in 57.1% of the HAB study subjects in comparison with 40.1% and 26.6% of the study subjects in the ENG + HAV and HBVX + VAQ groups, respectively.

Conclusion: In the adults aged over 40 years, an adequate anti-HAV antibody response persisted for at least four years after vaccination and was higher and more sustained in those who received the combined HAB vaccine.

http://dx.doi.org/10.1016/j.ijid.2012.05.986

Type: Poster Presentation

Final Abstract Number: 48.005
Session: Vaccines & Vaccine Development
Date: Friday, June 15, 2012
Time: 12:45-14:15
Room: Poster & Exhibition Area

Clinical impact and economic evaluation of organized HPV vaccination program in Hong Kong

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Background: To model the impact of prophylactic HPV vaccines against persistent HPV 16/18 infections on the age-specific incidence of cervical cancer and to assess the associated incremental cost-effectiveness of HPV vaccination compared to cytology screening only.

Methods: We developed a mathematical model to assess the impact of adding a mass HPV vaccination program under the current cervical screening program. Our model comprised deterministic population-level dynamic and stochastic individual-level components for the development of cervical cancer over the lifetime of individuals. We performed cost-effectiveness analysis (CEA) of organized HPV vaccination for age 12 girls at 45% coverage with lifelong protection and 95% efficacy against HPV types 16/18 persistent infections in a 50-year time horizon. Sensitivity analyses on vaccine effectiveness, vaccination coverage and inclusion of catch-up programs were also performed.

Results: When 12-year girls were annually vaccinated at 45% coverage, the age-specific cancer incidence started to drop substantially (40%-60%) after organized vaccination had begun