Abstract for: 17th Conference of the International Society of Travel Medicine (CISTM17)

Venue: online event

Date: 19-22 May 2021

Words: of 400

Tables: 0 of 3

Images: 2 of 4

Topic: 11d: GLOBAL IMPACT OF TRAVEL: MASS GATHERINGS

Title: Infectious Disease Transmission and Vaccination Strategies in Mass Gatherings: What Lessons Have We Learned from Meningococcal Transmission in Hajj?

Authors: Amine Amiche1**, Laurent Coudeville*2, Ashrafur Rahman*3, Julien Arino4, Biao Tang5, Ombeline Jollivet2, Alp Dogu1, Edward Thommes6, Jianhong Wu5

*: equal first author

**: corresponding author

1. Sanofi Pasteur, United Arab Emirates
2. Sanofi Pasteur, Lyon, France
3. Oakland University, Rochester, United States of America
4. University of Manitoba, Winnipeg, Canada
5. York University, Toronto, Canada
6. Sanofi Pasteur, Toronto, Canada

Introduction: Mass gatherings (MGs) have the potential to facilitate global spread of infectious pathogens. Hajj is one of the largest MG events, where over two million pilgrims from all over the world gather for a 5-day ritual in a high-density area in Saudi Arabia. An invasive meningococcal disease (IMD) outbreak in 2001 urged the Saudi authorities to mandate vaccination for all pilgrims. We developed a mathematical model to assess the variation of population density effect in Hajj on IMD transmission and evaluate the impact of vaccination among pilgrims.

Methods: A meta-population mathematical model was developed to simulate the transmission and predict the risk of IMD outbreaks by integrating the effect of population density during Hajj pilgrimage. The impact was estimated for the pilgrims at the Hajj site, and for 5 clusters of population: Mecca city, KSA outside of Mecca, and pilgrims' origin based on meningococcal endemicity (low, moderate, and high). We simulated the impact of several vaccination coverage

Abstract for: 17th Conference of the International Society of Travel Medicine (CISTM17)

Venue: online event

Date: 19-22 May 2021

and vaccine efficacies (VEs) of quadrivalent conjugated ACWY vaccines on the risk of transmission and outbreaks of IMD.

Results: The effect of increased density of contacts during Hajj was estimated to generate a 78-fold increase in disease transmission that impacts not only pilgrims but also the local population. Reduction of meningococcal vaccination coverage among pilgrims has the highest likelihood of outbreak among pilgrims, followed by non-pilgrims in Mecca, and then non pilgrims in the rest of KSA (Figure 1). Even with a 75% vaccine coverage, the risk of a meningitis outbreak of more than 30 cases among pilgrims remain significant (25%). High vaccine efficacy was mostly important to protect pilgrims at the hajj site from disease risk (Figure 2). The likelihood of ≥30 cases was 47% for 50% VE; 26% for 70% VE, and <1% for 93% VE (expected VE of conjugated meningococcal disease).

Conclusion: We learned from Hajj that MGs can be a significant catalyzer for infectious disease spread and that vaccination coverage and efficacies can have an impact on attendants and other clusters to whom the participants belong. Our mathematical framework may be used to study the spread of other respiratory infections (e.g. Influenza and COVID-19.) during regular MG events. This will inform public health preparedness and interventions (e.g. attendance control and vaccination strategies).

Abstract for: 17th Conference of the International Society of Travel Medicine (CISTM17)

Venue: online event

Date: 19-22 May 2021

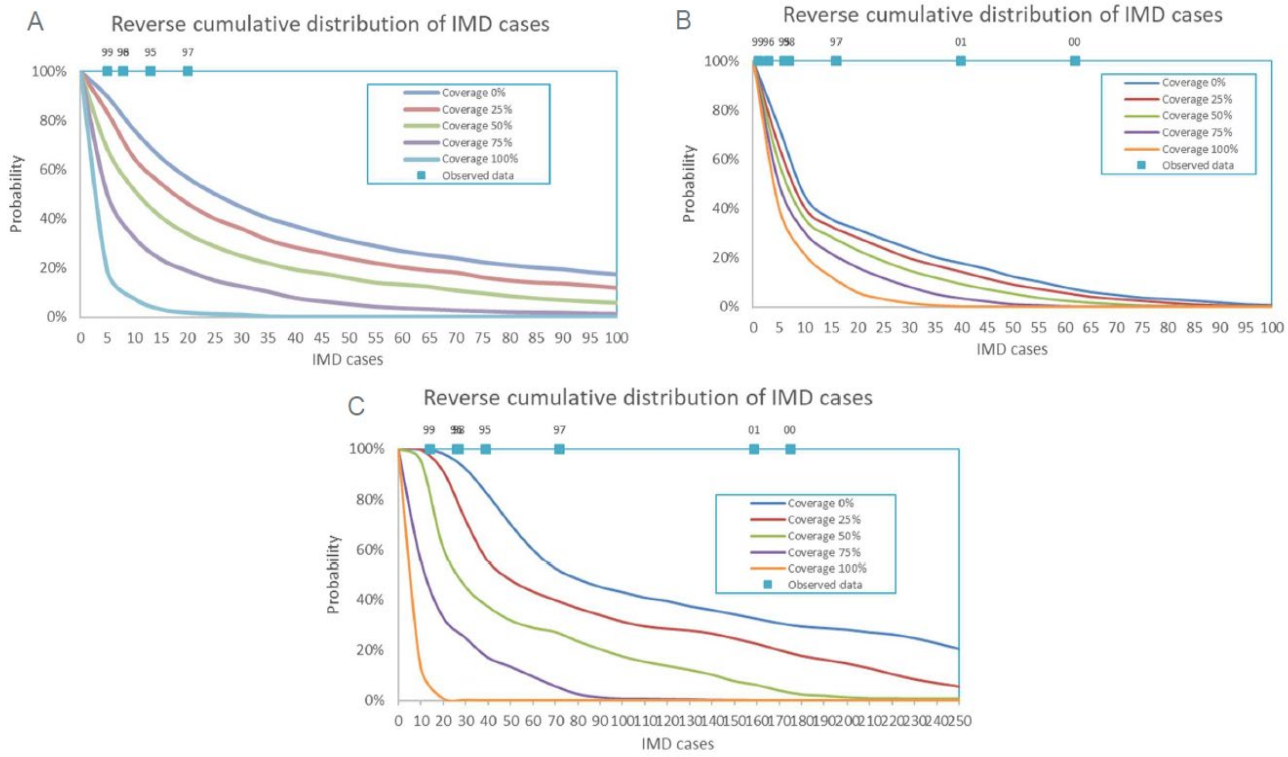

Figure 1. Impact of vaccine coverage. Reverse cumulative distribution curve of yearly IMD cases for a uniform coverage rate among pilgrims varying from 0 to 100%. (A) IMD cases among non-pilgrims in the rest of KSA; (B) IMD cases among non-pilgrims Mecca residents; and (C) IMD cases among pilgrims.

Abstract for: 17th Conference of the International Society of Travel Medicine (CISTM17)

Venue: online event

Date: 19-22 May 2021

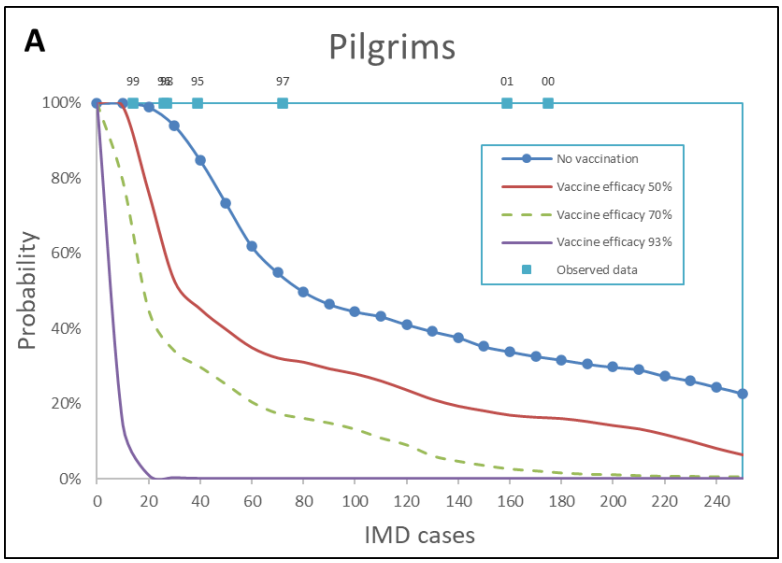

Figure 2. Impact of vaccine efficacy (VE) on pilgrims. Reverse cumulative distribution curve of yearly IMD cases for no vaccination, and VEs equal to 50%, 70%, and 93% (The latter is the expected VE of conjugated ACWY meningococcal vaccines)

This study is supported by the NSERC/Sanofi Industrial Research Chair Program in Vaccine Mathematics, Modelling and Manufacturing