PREDEMICS

Preparedness, Prediction and Prevention of Emerging Zoonotic Viruses with Pandemic Potential using Multidisciplinary Approaches

predemics.biomedtrain.eu

01/11/2013 to 31/10/2016

SEVENTH FRAMEWORK PROGRAMME

OBJECTIVES

- Identify key **factors associated with** the highest risk of virus emergence at the **4 stages of emergence**
- determine the **impact of the transmission route** on viral **evolutionary trajectories and cross-species transmission**
- unravel the mechanisms that govern **interactions** between a **virus**, its **hosts** and the **environment** to favour/limit cross-species transmission and adaptation to a new host
- evaluate most effective intervention strategies to **limit cross-species transmission and spread** in the new host
- **identify risk patterns of emergence** of practical relevance for disease surveillance, control and intervention, and pandemic preparedness

Semi-flexibility clause to include work on other viruses in area of expertise in **response to emergence** (MERS-CoV, Ebola Disease virus).

Contacts

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PARTNERS

18 partners – 24 teams
8 countries

1. **Institut Pasteur (coordinator)**
2. Istituto Zooprofilattico Sperimentale delle Venezie
3. Katholieke Universiteit Leuven
4. Aix Marseille Université
5. Eidgenössisches Departement des Innern
6. Imperial College of Science, Technology & Medicine
7. Agence Nationale de Sécurité Sanitaire de l'Alimentation, de l'Environnement et du Travail
8. Max Planck Gesellschaft zur Foerderung der Wissenschaften E.V.
9. Universitat de Barcelona
10. Goeteborgs Universitet
11. Philipps Universität Marburg
12. Istituto Nazionale per le Malattie Infettive L. Spallanzani - IRCCS
13. The University of Edinburgh
14. Fondazione Istituto per l'Interscambio Scientifico
15. Foundation Health Sciences e-Training
16. Istituto Superiore di Sanità
17. Alma Mater Studiorum-Universita di Bologna
18. Freunde von GISAID e.V.

Kick-off Meeting – 22-23/11/2011 – Institut Pasteur

Hepatitis E virus

- Viral diversity in Europe and globally
- Ecologic, epidemiologic, virologic or host factors for:
  - maintenance and spread in local ecosystems
  - cross-species transmission between wild boars, pigs and humans (role of environment & food-chain)

Novel hepatitis E like virus found in Swedish moose
Lin et al J Gen Virol 2014 H. Norder UGOT

Hepatitis E Virus Genotype 4 Outbreak, Italy, 2011
Garbuglia et al EID 2013 M.R. Capobianchi INMI

Hepatitis E Virus Genotype in a pig farm, Italy, 2013
Monne et al Epidemiol Infect 2014 G. Cattoli IZSVe

Host factors modulated during HEV infection in swine
Rogee et al J. Virol. 2014 N. Pavio ANSES

JEV & related (WNV, USUV, ZIKAV)

CHIKV

- Competence of European mosquitoes for JEV transmission ?
- What animal could act as an amplifying host in Europe ?
- What viral/host determinants determine the change of vector and host susceptibility ?

Phylogeny of USUV from patient w/ neurological symptoms
Gaibani et al PLoS One 2013 V. Sambri UNIBO, E Gould AMU

Novel flaviviruses from mosquitoes:mosquito-specific lineages
Huhtamo et al Virology 2014 E Gould, X de Lamballerie AMU

RNA(+) viruses generated in days using infectious subgenomic replicons
Aubry et al JGV 2014 E Gould, X de Lamballerie AMU

Sensitivity of WNV to the antiviral activity of IFNs
Bordii et al J Biol Regul & Hom Agents 20134
M.R. Capobianchi INMI

Influenza A virus

- Extent and drivers of influenza virus diversity?
- What factors determine potential for cross-species transmission and adaptation to humans?
- What is the impact of the viral population (quasispecies) structure on cross-species transmission potential and pathogenicity?

Structural determinants of IAV outside its host JC Manuguerra IP
Shigematsu et al.Influenza Other Respir Viruses, 2014
Sawoo et al. PLoS ONE 2014

Switch from LP to HP for H7 viruses *Monne et al. JVI 2014* G. Cattoi ISZeV

Synchronized global sweep of internal genes of modern avian influenza virus
Worobey et al. Nature 2014 A. Rambaut UEDIN

Virus –host interactions using iPCA
Munier et et al. Mol Cell Proteomics 2013 N. Naffakh, Y Jacob IP

PB2 mutations promote adaptation of H5N1 to mammalian host
Volker Czudai-Matwich et et al. JVI 2014 M. Matrosovich UNIMAR

Avian influenza A virus PB2 promotes IFN I induction of SIV in swDC
Ocana-Macchi et al. Virology 2012 A. Summerfield FDEA-IVI

Cellular and humoral cross-immunity against H3N2 in HIV + subjects
Agrati et al. PLoS ONE 2014 M.R. Capobianchi INMI

Prediction of global transmission of influenza H3N2
Lemey et al. PLoS Pathogens 2014
P. Lemey KU-Leuven

Lyssavirus

- What is the viral diversity in Europe and globally?
- What ecologic, epidemiologic, virologic or host factors condition maintenance and spread of the virus in local ecosystems?
- What factors determine cross-species transmission from bats to carnivores and humans ?

Ecological Factors Associated with European Bat Lyssavirus Seroprevalence in Spanish Bats and persitence mechanisms.
Serra-Cobo et al PLoS One. 2013
Pons-Salort et al. PLOS ONE 2014 J. Serra-Cobo UB & H. Bourhy IP

Rates of viral evolution are linked to host geography
Streicker et al PLoS Pathogens. 2012 P. Lemey KU Leuven

Introduction of fox rabies in Italy is due to 2 genetic groups
Fusaro et al IGE 2013 G. Cattoli ISZeV

Mechanisms of innate immune response and immune evasion
Luco S et al PLoS Pathog. 2012
Wiltzer et al. J Virol 2012
Wiltzer et al. JID 2014 H. Bourhy IP

EBOV

- Mobile labs and diagnostics
- Virus evolution and origin
- Host-virus interactions
- Transmission dynamics & parameters

Contribution to mobile labs & diagnostics J.-C. Manuguerra IP; G. Ipolitto INMI

Genomic surveillance elucidates Ebola virus origin and transmission during the 2014 outbreak *Gire et al. Science 2014* A. Rambaut UEDIN

Phylogenetic analysis of Guinea 2014 EBOV outbreak
Dudas et al. PLoSCurrent 2014 A. Rambaut UEDIN

Ebola Virus Disease in West Africa – The first nine months of the epidemic
WHO Ebola Response Team NEJM 2014
West African Ebola Epidemic after One Year-
WHO Ebola Response Team *N Engl J Med* 2014 C. Donnelly IMPERIAL

Impact of travel restrictions on international Ebola spread
Poletto et al. Eurosurveillance 2014 V. Colizza ISI

MERS-CoV

- Clinical features
- sites and kinetics of virus shedding
- Virus evolution and origin
- Parameters of transmission

Clinical features and viral diagnosis of two cases of infection with Middle East Respiratory Syndrome coronavirus: a report of nosocomial transmission.
Guery et al. Lancet. 2013 S vd Werf, JC Manuguerra, A Fontanet IP

Transmission and evolution of the Middle East respiratory syndrome coronavirus in Saudi Arabia: a descriptive genomic study.
Cotten et al. Lancet. 2013 A. Rambaut UEDIN

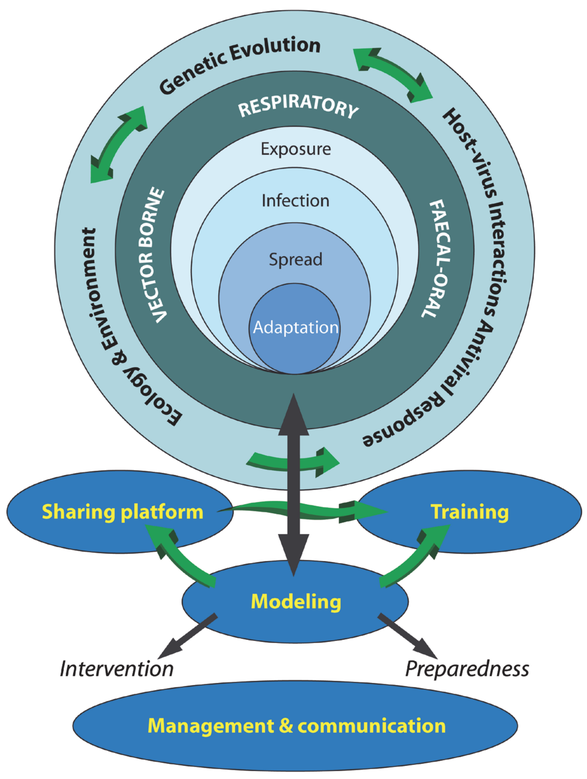
Transmission scenarios for Middle East Respiratory Syndrome Coronavirus (MERS-CoV) and how to tell them apart.
Cauchemez S et al.. Euro Surveill. 2013
C. Donnelly IMPERIAL S. Cauchemez IP

Interhuman transmissibility of Middle East respiratory syndrome coronavirus: estimation of pandemic risk.
Breban et al. Lancet. 2013 R. Breban, A Fontanet IP

Sharing Platforms

- Develop sequence databases
  - Lyssaviruses
  - Hepeviruses
  - Flaviviruses
- Based on GISAID concept and EpiFlu database model with associated literature database

STRUCTURE



Modelling

- Mapping methods for animal densities & behaviours
- Transmission models
- Models for risk assessment and contingency planning
- Evolutionary epidemic models

Rabies and CDV epidemics in rd fox population in Italy
Nouvellet et al PLoS One 2013 C. Donnelly IMPERIAL

Role of environmental compartment for IAV transmission
Breban J Math Biol 2012 R. Breban IP

Surveillance to estimate epidemic potential of emerging zoonoses : H3N2v
Cauchemez et al. PLoS Med 2013 C. Donnelly IMPERIAL S. Cauchemez IP

Host mobility drives pathogen competition in spatially structured populations
Poletto et al PLoS Comput Biol 2013 V. Colizza ISI

Exposure and human-to-human transmission for emerging pathogens
Kucharski et al PLoS Comput Outbreaksl 2014 V. Colizza ISI

Local and regional spread of chikungunya fever in the Americas
Cauchemez et Eurosurveillance 2014 S. Cauchemez IP

TRAINING

Scientist exchange Program

Training courses and workshops

- Zoonotic features of IAV, HEV, JEVr, LYS
- Virus evolution and phylogeny
- Rabies hands-on course (WHO, IP Int network)
- GISAID-WHO Training workshop : Geneticx analyses of influenza viruses"

E-learning

DISSEMINATION

- Interactions with other EU projects (ANTIGONE, PREPARE, SILVER, FLUPHARM, ….)
- Outreach to main stake-holders (WHO, OIE, ECDC,.)

ISABEL MINGUEZ~TUDELA
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