Information and Communication Technologies

EPIWORK

Developing the Framework for an Epidemic Forecast Infrastructure

http://www.epiwork.eu

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D7.6 Yearly activity report with assessment of lesson learned

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Work package participants

The following partners have taken active part in the work leading to the elaboration of this document, even if they might not have directly contributed writing parts of this document:

- ISI
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- AIBV
- SMI
- FFCUL

Change log

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Table of contents

List of figures

1 Project objectives and implementation strategy

A fully operational, accurate and reliable epidemic forecast infrastructure nowadays faces problems related to the lack of appropriate models to understand how an infectious disease spreads in the real world, lack of extensive and accurate epidemiologically relevant data (from societal data to epidemic surveillance data), lack of understanding of the interplay among the various scales of the problem (from the host-pathogen interaction, to human-to-human transmission, to the interaction with the environment) and, most importantly, lack of communication among the different areas of research which proceed almost independently, crucially hampering a significant progress in a highly interdisciplinary field of research. The present project intends to fill this gap. *Through computational thinking, complex systems*

concepts and data integration tools relevant for epidemiological understanding at all levels, it will provide a set of radical, paradigm-changing results enabling a novel approach to the modelling, forecast and policy making approach to infectious diseases. The projects overarching goals are:

- The identification of general principles and laws that characterize complexity and capture the essence of *complex epidemiological systems*.
- The development of a *collaborative information platform* enabling the production of knowledge, understanding and models from the novel *abundance of digital data in epidemic research*.
- The development of an *open, data driven, computational modelling platform* to be used in epidemic research as well as in policy making for the analysis of global epidemics, integrating and leveraging on transnational data.
- The development, deployment and validation of an *Internet-based Monitoring System (IMS) producing real time data on disease incidence and epidemic spreading*.

The project aims at exploring the following *work areas* as the major research themes directly matching the objectives of this proposal:

- ***Modelling and theoretical foundations***
- ***Data-driven computational platform***
- ***ICT monitoring and reporting system.***

The work plan is organized around six distinct scientific work packages (WP1-WP6) whose parallel scheduling of the work packages is necessary to jump-start the cycle and the Inter-WP validation. WP1 and WP2 are aimed at exploring theoretical issues in the area of epidemic modeling in complex, multi-scale systems, structured populations and in the presence of the dynamical interplay between social and technological factors, seasonality and climate, health policies implementations, WP3 and WP4 are devoted to the collection and sharing of data on a computational platform and have a two-way continuous exchange of data and algorithms with WP1 and WP2. WP5 and WP6 is aimed at the development, set-up and deployment of innovative web monitoring and data gathering tools that should provide a continuous stream of data to WP3-WP4 and be informed by constant feedback on the modeling needs in terms of

data gathering by WP1 and WP2. The common research agenda of the consortium teams, which work in a coordinated way on the various tasks, favors a closer interchange of ideas and knowledge among the groups and the various components of the project in a truly interdisciplinary collective effort.

2 Assessment of the second years activities

In its first year of life the project this report has been a long analysis of the research and developments produced by the project and to which extent those activities did meet the schedule proposed in the initial project. As that, the report was an executive summary reporting or duplicating most of the information already contained in other documents submitted for the project. The feedback of the reviewers and the Program Manager at the review meeting made it clear that a more useful assessment report should be structured in a way that provides a guide through the material submitted for review and a discussion of specific relevant points in the life of the project and the eventual lessons learned and the measures eventually implemented to improve the work of the consortium. The report is therefore structured in the following sections:

- **Executive summary and highlights of the project activities.**
- **Collaboration/integration within the consortium.**
- **Problems encountered in the second year and lessons learned.**

While it is almost impossible not to duplicate information we will emphasize here the achievements of the project also by looking beyond deliverables and milestones. We will therefore try to assess the actual impact of the project achievements and the outlook of the consortium activities.

3 Executive summary and highlights of the projects activities

The second year of the project was extremely productive and the consortium has harvested a large number of scientific results and pushed forward the development of the data and computational tools. Here we discuss what we consider clear highlights of the second year activities. The following highlights have been chosen mostly because they show the level of interdependency and cooperation achieved by the project and provide a high level view of the

scientific progress made by the consortium. We have also selected some results which are hardly identifiable with a specific deliverable/milestone and thus may be overlooked, despite their relevance, in the conspicuous documentation provided for the review process.

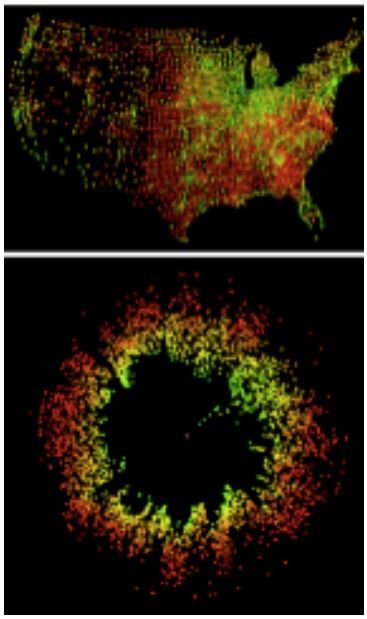

Figure 1: SPATO visualization algorithm

- **The theoretical work of the WP1 and WP2** has produced an impressive number of quality scientific publications that already appear in the literature. The work performed by the teams involved in the theoretical and algorithmic foundational part of the project are clearly defining the state of the art in several areas related to contact networks, seasonal forcing, mitigation and control measures. It is worth noticing that the work of WP1 and WP2 is starting to pay off in other work packages. This is a sign that the theoretical work is impacting the more applied work packages and that the foundational and applied part of the project are latching in. The most spectacular advances have been obtained in the analysis and modeling of contact patterns and the definition of models with specific age structured contact matrices that have been progressed across the board of the project's WPs. This work has spurred from the theoretical analysis in WP1 (Katriel et al. 2011), and has reverberated in the work Brooks-Pollock and Eames, 2011 made in collaboration with the activities of WP5 and found a computational application in the context of the epidemic modeling platform (WP4) PLoS Computational Biology, 6(12): e1001021, 2010.

- The WP2 has produced a truly novel visualization technique The **visualization algorithm of SPATO** (shortest path tree tomography) extracts mobility networks from their geographical embedding and visualizes the network based on shortest paths and effective distances. The interactive tool permits the visualization of network characteristics, node specific parameters and allows to investigate the perspective of mobility networks from a node of the user's choice. This tool generated by the foundational work of WP2 finds a clear application in the visualization of epidemic spreading in large mobility and

communications networks. The algorithm is considered for integration in the epidemic modeling platform as an alternative visualization scheme.

- The project has delivered publically the **first version of the epidemic marketplace** (EM 1.0). This is the first publicly available data repository of this type and represents a major milestone for the project. This allow a very positive outlook for the integration of the Marketplace with the modeling platform. The consortium is already working on EM 2.0 platform development for release in 2011. Major features: new user interface and component integration based on the Drupal Content-Management System, improved access control management, redesigned web-services.
- The project has delivered the **prototype of the modeling computational platform.** This defines an architecture made of three components: the client application, the proxy middleware, and the simulation engine. This platform is already in distribution for limited purposes and testing by agencies and in educational settings. The platform is fully documented and two publications provide the under the hood details of the theoretical and algorithmic basis of software as well as its validation. The work is progressing considerably in integrating results and models in the platform.

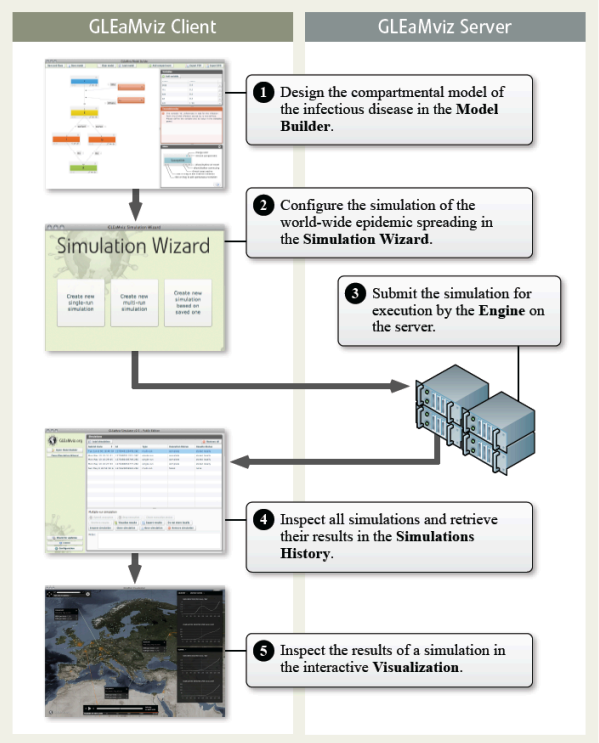

Figure 2: Work flow of the Computational Modeling Platform

- **The Internet based monitoring (IMS)** system comprises nine platforms in nine different countries. Most notably, in early 2011 it will be finally public the Influenzanet.org site that will present the project by federating all the IMS platform across Europe. We expect this web-site to be a major promoter of the concept of Internet-based Monitoring Systems in other countries, and a key step in expanding the scientific cooperation with colleagues all over the world by presenting a unified perspective of the IMS system.

- The project puts great emphasis on publication in high impact scientific communication channels such as papers and major conferences. It also envisions communicating results at top international conferences. During the first two years of life of the project the scientific outreach is simply stated by the sheer numbers of publications (69 papers in peer reviewed journals) and presentations at conferences (70 talks, lectures and seminars).
- The project has made great progress in interfacing with national and international health institutions. Just to mention a specific event, Epiwork was one of the very few projects in Europe invited to the *Influenza A(H1N1) 2009 modelling and Schools Closures working group meeting* ("Angers-II") promoted by the ECDC Stockholm 19-20 October 2010. This is only one of the events where the Epiwork project has been presented or provided educational/demonstrator material. In this context the developing of the Epidemic Planet setup has to be considered a major achievement for the project. The application displays the evolution of the 2009 H1N1 influenza pandemic and enables its users to interactively compare and learn about the effect of various intervention scenarios. Details on the set-up can be found in the deliverable D8.7.

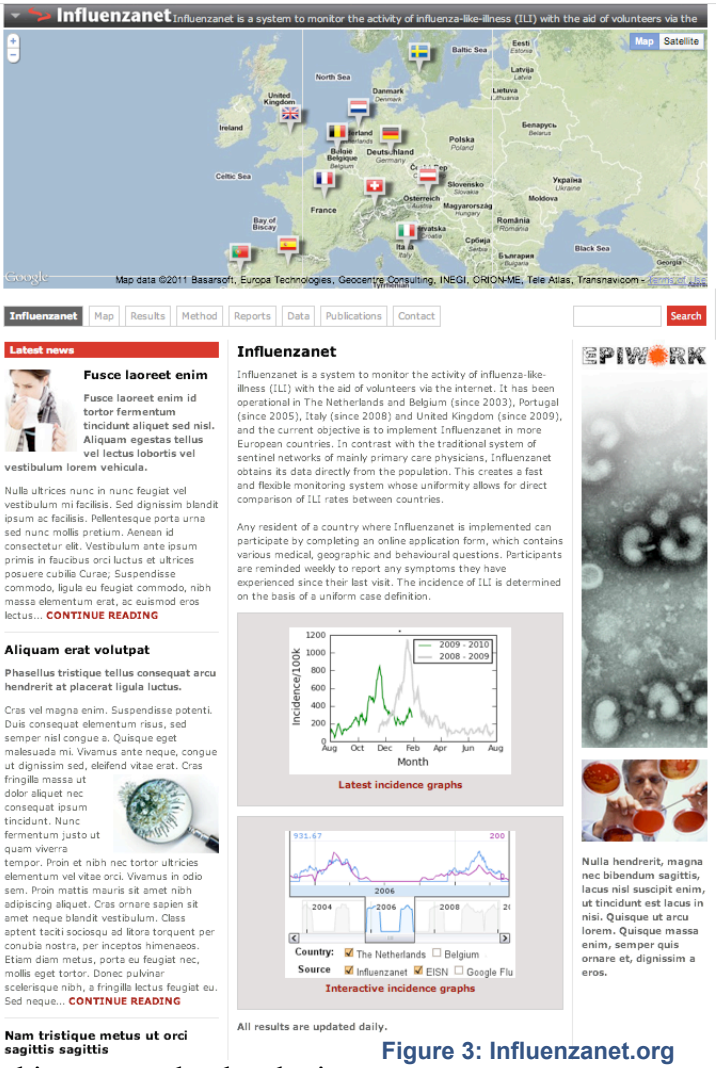

Figure 3: Influenzanet.org

4 Collaboration/integration within the consortium

One of the major problem in large Integrated project such as Epiwork consists in keeping a high level of interconnection and collaborations among partners. While specific deliverables

such as software and demonstrators help in keeping the focus of the teams involved on the collaborations, teams involved mostly in theoretical works may have the tendency of drifting away and eventually work in isolation. Another issue is the integration among WPs, with the sake of avoiding parallel but poorly integrated activities with each individual WP progressing in isolation. Indeed, during the first review meeting, reviewers raised the question of the integration of the research activity of the projects and the collaborative efforts of the teams. Let us first discuss the integration across WPs reached during the second year.

Synergy and integrated efforts:

WP1-WP2 : Integrated effort toward modeling approach used for studying the effects of population vaccination on disease transmission in a set of n-cities interconnected by a complex transportation network. The model is based on a sophisticated mover-stayer formulation of inter-city population migration, upon which is included the classical SIS dynamics of disease transmission which operates within each city. Several concrete examples are presented and discussed, and some counter-intuitive results found by using data from WP2 and theoretical analysis from WP1.

WP1-WP3 and WP5: WP1 researchers have gained access to ten years of data from Israel's largest Health Insurance companies in which millions of members are registered. As such, they have spent considerable time building and organizing a data base that provides us with a picture of the spatio-temporal dynamics of influenza in Israel over the last decade. In Katriel et al (2011) we describe new computational and modelling tools for studying the dynamics of an epidemic in its initial stages that use both available incidence time series and data describing the population's infection network structure. We formulated a new discrete-time stochastic epidemic SIR (susceptible-infected-recovered) model that explicitly takes into account the disease's specific generation-time distribution and the intrinsic demographic stochasticity inherent to the infection process. Moreover, in contrast with many other modelling approaches, the model allows direct analytical derivation of estimates for the effective reproductive number (Re) and of their credible intervals, by maximum likelihood and Bayesian methods. The basic model can be extended to include age–class structure, and a maximum likelihood methodology allows us to estimate the model's next-generation matrix by combining two types of data: (i) the incidence series of each age group, and (ii) infection network data that provide partial information of 'who-infected-who'. Unlike other approaches

for estimating the next-generation matrix, the method developed here does not require making a priori assumptions about the structure of the next-generation matrix. We show, using a simulation study, that even a relatively small amount of information about the infection network greatly improves the accuracy of estimation of the next-generation matrix. The method is applied in practice to estimate the next-generation matrix from the Israeli H1N1 pandemic data. The tools developed here should be of practical importance for future investigations of epidemics during their initial stages (WP3 and WP5). However, they require the availability of data which represent a random sample of the real epidemic process. We discuss the conditions under which reporting rates may or may not influence our estimated quantities and the effects of bias.

WP1-WP2-WP4-WP5: The work packages have worked on the analysis of contact patterns and age structured contact matrices with different analytical and computational tools. Data from WP5 have been used to define age structured contact matrices and computational methodology for the synthetic constructions of the matrices carried out in a integrated effort across WPs. Finally those results have found their way in the Epidemic modeling platform that includes the possibility of considering worldwide heterogeneous age structured contact matrices. WP2 is planning a common effort with WP4 to integrate SPATO in the Epidemic modeling platform.

WP5-WP6: Integration between WP5 and WP6 emerged spontaneously with the implementation of the Swedish IMS. More integration is on the way for the future comparison of the population based approach (PBS) data with the IMS data.

WP3-WP4 (and the entire consortium)

The case for integration between WP3 and WP4 is evident. These are two sides of the same coin. WP3 distributes datasets required for modelling and WP4 distributes models based on the data. Moreover, the WP3-WP4 platform should receive input from analytical work packages (WP1 and WP2), data collection work packages (WP5 and WP6). WP3 and WP4 have already begun the design of a system architecture for the automatic interface of the two platform.

Further integration avenues

In addition the co-chair of the project identified further inter-WPs integration in order to provide avenues for the integration of the research activities in the project that are not obviously contained in joint deliverables or specific tasks. In the following we report the results of the document circulated within the consortium.

WP1-WP2 : WP1 includes a focus on spread and evolution of pathogens, while WP2 relates geographical spread to patterns of host proximity, which should reflect on patterns of pathogen evolution. Network analytic methods applied in WP2 to characterize human populations according to proximity can be applied to characterize pathogen populations according to genetic sequence similarity. A combination of computational and experimental models can be developed to establish a mapping between patterns of host proximity and pathogen evolution. This capability to translate between host and pathogen population patterns will greatly extend the possible data sources available to analytical research, which is especially valuable in the current era of high throughput genetic sequencing. FCG-IGC proposes to develop the computational and experimental models required for this translation. In terms of deliverables, this integration would benefit 1.4, 2.2 and 2.5.

WP1-WP5 (WP6): Focusing on influenza, population models are intended to provide forecast for the season. Relying on parameters estimated by incidence data, predictions will improve as the season progresses and more data becomes available. This could be transformed into an automated forecast system to become part of national Influenzanet systems. WP5, through its direct contact with the participants, could make a feature of this, and make the system more attractive for new countries. Simple epidemic models and games could be developed for education on this topic. This can be discussed at the next WP5 meeting in Amsterdam. In terms of deliverables, this integration would benefit 1.5 and 5.7.

EVIDENCE FOR COOPERATIONS BETWEEN PARTNERS:

At the level of single partners the sustained level of interaction and collaboration is witnessed by the number of joint publications and the joint development activities. Tel Aviv University has cooperated with Dr. Sebastien Bellasteros (FFCUL) on two projects.. 1) the study of a reinfection influenza model; 2) parameter fitting for seasonal influenza data. FFCUL collaborates with Instituto Gulbenkian and Prof Gomes and Stollenwerk have developed a spatial epidemic model of reinfection. FBK and ISI team are collaborating on the issue of

aligning agent based and spatially structured models in the epidemic platform This has generated a joint publication on BMC infectious diseases. Cooperation and collaboration between the teams in WP5 and WP6 has been continuous. During 2010, the teams at LSHTM, ISI, SMI and AIBV were very active in developing the agreed "gold standard" intake and weekly questionnaires and the new "contact questionnaire", participating in many teleconferences with other members of WP5, and attending the meeting in Amsterdam in May 2010, as well as the main EPIWORK meeting in Turin in December 2010. ISI and LSHTM have therefore been continually active in debugging and developing the new platform, and supporting other teams.

5 Problems encountered in the second year and lessons learned.

Although the project has kept sustained progress and has provided al the deliverables as scheduled, we have encountered problems in the coordination of joint activities where the progress of the all the teams involved has to be steadily and timely delivered.

In particular, the collaborative aspects of the WP5 are crucial for the effective and extensive collection of epidemiological data across Europe in real time and unbiased by local issues. The deployment in the 'old' five countries (The Netherlands and Belgium, Portugal, Italy and UK) started in October 2010. Whereas the European IMS platform was ready in April and ahead of schedule (Month 13 instead of 24), the integration of the national websites and the implementation of a single Gold Standard Questionnaire (a single intake and a weekly questionnaire) took far more time than expected and planned, despite careful preparation and ample communication. We planned to start with new websites on the new platform and a fully integrated Gold Standard Questionnaire (GSQ) in five countries in November 2010. Many technical issues have slowed down this deployment but at the end of November 2010 Italy and UK brought the platform into production. During the influenza season 2010/11 all the remaining issues with the other countries' platform have been continuously taken care of and solved, including the integration of the GSQ in the new platform in its latest version. The Italian and British websites are integrated in the European platform since November 2010, the Swedish websites since February 2011, the Portuguese and Belgian/Dutch will follow suit, most likely before May 2011.

The coordination of this process was cumbersome for several reasons and generated for a few partners delays of the order of 3-4 months on the planned timeline. The reasons of the problems have been identified in:

- an underestimation of the workload and an insufficient understanding of the Influenzanet concept and its functionalities at the platform level;
- the complex, ambitious and sophisticated nature of the European platform, more than foreseen;
- an underestimation of the required expertise at the national level;
- an underestimation of the 'challenges' to ICT management, including communication, with the WP leadership.

It has to be acknowledged that these delays are reasonable given the fact that the project is huge, complex and ambitious.

Another problems we have confronted was the identification/work with the French and Spanish IMS adopters. While the project was originally planning a deployment in France and Spain, those countries lagged behind. In order to include the planned number of countries we have relayed on the more responsive German subcontracting.

In a short time, the above issues have taught us a lot about the European platform and its possibilities and challenges at the national and European level. We have learned our lessons, which on their turn are of great help to introduce Influenzanet in 11 countries for the new season, starting in November 2011.

For the season 2011/12 ExploSYS GmbH will act as a representative for AIBV in German-speaking Europe. With the lessons learned of the past implementation experience in five countries, we are optimistic to introduce Influenzanet in Spain, France and German speaking Europe in time for the next seasons, starting in November 2011. Meanwhile, more and more organisations in other countries inside and outside Europe are becoming interested to start initiatives as the IMS. We are optimistic that in 2012, the IMS will be working in a number of countries larger than the original nine countries listed in the Epiwork proposal.

Actual unfolding of the IMS:

-Originally from 2010 and onwards, we have moved forward with first the UK in 2009 and Sweden, early 2011. Germany, Austria, Switzerland tested and ready in 2011. France and Spain will follow in 2011/2012.

-Key actions in 2011: We will start first now by applying the new, standard Influenzanet

design in three new versions: French, German and Spanish. The content is ready in English and translated into German and French. Spanish is expected to be ready before May 2011.

A final problem in our project is the promotion of a sustainable interface with public health agencies potentially interested in providing data and using the models (WP8). We have achieved good successes with the ECDC and the JRC. The ECDC has put Epiwork on the map of project to follow and has invited Epiwork for the *Influenza A(H1N1) 2009 modelling and Schools Closures working group meeting* ("Angers-II") promoted by the ECDC Stockholm 19-20 October 2010. We are also partnering with the JOINT RESEARCH CENTER (JRC) of the European Commission at Ispra, Italy. The Joint Research Centre is a research based policy support organisation and an integral part of the European Commission. The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. The objective of the collaboration is to share tools, including the GLEaM paltform to improve models for crisis management and decision making of emerging public health threats. We are proud to announce that the first version of the GLEaMviz Simulator has been released to JRC where usability tests have been started. However, the involvement of all stakeholders is requiring a constant effort and the consortium is discussing the creation of an ad-hoc working group. In order to provide more momentum and visibility to the project we have decided to transform the mid term meeting (D8.3) in a very high level conference with all the main actors in the field. This has led us to consider moving the conference to the next year in order to secure additional funding and the presence of key speakers and attendants who needs to be invited well in advance.

6 List of publications and scientific talks in the second year of the project.

Publications

Second Period

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D. Brockmann, *Following the money*, Physics World, Feb 2010.

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M. J. Silva, F. A. B. da Silva, L. F. Lopes, F. M. Couto. *Building a Digital Library for Epidemic Modelling*. Invited Paper. ICDL 2010. The 3rd International Conference on Digital Libraries. February, 2010.

S. Merler and M. Ajelli, *The role of population heterogeneity and human mobility in the spread of pandemic influenza*, Proceedings of the Royal Society B, 277: 557-565, 2010

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P. Bajardi, C. Poletto, D. Balcan, H. Hu, B. Goncalves, J. Ramasco, D. Paolotti, N. Perra, M. Tizzoni, W V. den Broeck, V.Colizza, and A. Vespignani, *Modeling vaccination campaigns and the Fall/Winter 2009 activity of the new A(H1N1) influenza in the Northern Hemisphere.* Emerging Health Threats Journal. **2**, e11, 2009.

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V. Colizza, **A. Vespignani**, N. Perra, C. Poletto, B. Goncalves, H. Hu, D. Balcan, D. Paolotti, W V. den Broeck, M. Tizzoni, P. Bajardi, and J.J. Ramasco, *Estimate of Novel Influenza A/H1N1 cases in Mexico at the early stage of the pandemic with a spatially structured epidemic model* Public Library of Science Currents: Influenza. RRN1129, 2009.

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V. Colizza, A. Vespignani, *The Flu Fighters*, Physics World, Feb 2010.

A. Godinho, *Epiwork: Developing the framework for a European forecast infrastructure*. Research Review Magazine 9: 49, 2009.

S.P. van Noort, N. Stollenwerk, L. Stone, *Analytic likelihood function for data analysis in the starting phase of an influenza outbreak* Proceedings of CMMSE 2009, ISBN 978-84-612-9727-6, 2009.

I.H. Friesema, C.E. Koppeschaar, G. A. Donker, F. Dijkstra, S.P. van Noort, R. Smallenburg, W. van der Hoek, M.A. van der Sande, *Internet-based monitoring of influenza-like illness in the general population: experience of five influenza seasons in The Netherlands*. Vaccine 27:6353-7, 2009.

International Conferences and seminars

Second Period

- Gabriela Gomes, Perspectives in integrative epidemiology.

Workshop on Dynamical Systems Applied to Biology and Natural Sciences, Universidade de Lisboa, Portugal.

February 2010

- Gabriela Gomes Monitoring and modeling influenza epidemics.
Seminar at Instituto de Higiene e Medicina Tropical, Lisboa, Portugal.
May 2010

- Gabriela Gomes Epidemiology and evolution of infectious diseases: The case of influenza.
III Conference on Computational and Mathematical Population Dynamics, Bordeaux 2 University, France.
June 2010

- Gabriela Gomes Ecology and evolution of infectious diseases: The case of influenza.
Seminar at Fundação Oswaldo Cruz, Rio de Janeiro, Brazil.
October 2010

- Gabriela Gomes Shifting priorities in the mathematics of infectious diseases.
Seminar at Instituto de Matemática Pura e Aplicada, Rio de Janeiro, Brazil.
October 2010

- Sander van Noort Immune Selection and Within-Host Competition Can Structure the Repertoire of Variant Surface Antigens in Plasmodium falciparum.
Workshop on Dynamical Systems Applied to Biology and Natural Sciences, Universidade de Lisboa, Portugal.
February 2010

- Sander van Noort Climate and ILI incidence.
Seminar at Centro de Geofísica, Instituto Dom Luis, Universidade de Lisboa, Portugal.
April 2010

- Sander van Noort Influenzanet: internet-based monitoring of ILI 2003-2010.
First Annual Symposium Lessons from the 2009 H1N1 Pandemic Influenza, Center for Communicable Disease Dynamics, Boston, USA.
June 2010.

- Sander van Noort The Influenzanet self-reporting system warrants consistency in epidemic monitoring across countries and seasons.
European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE), Lisbon, Portugal.
November 2010

- Ricardo Águas Applicability of simple deterministic models in epidemiologically complex scenarios.
Workshop on Dynamical Systems Applied to Biology and Natural Sciences, Universidade de Lisboa, Portugal.
February 2010

- Ricardo Águas Applicability of simple deterministic models in epidemiologically complex scenarios.
Seminar at Oxford University.
February 2010

- Delphine Pessoa Modelling the dynamics of Streptococcus pneumoniae colonization in children.
Seminar at Universidade de Lisboa.
December 2010.

- Flávio Coelho A Bayesian Framework for Parameter Estimation in Dynamical Models.
Workshop on Dynamical Systems Applied to Biology and Natural Sciences, Universidade de Lisboa, Portugal.
February 2010

- APS March Meeting: March 14 - 18, 2010, Portland, USA

- 11th Experimental Chaos & Complexity Conference: June 1 - 4, 2010, Lille, France

- Black Forest Focus on Soft Matter: June 2 - 5, 2010, Breisach, Germany

- International School of Physics Enrico Fermi: June 28 – July 2010, Varenna, Italy

- HPA conference on Pandemic Influenza London, June 2010; Prof Edmunds gave an invited talk: “Web-based Surveillance During a Pandemic”.

- Meeting with Health Protection Agency Syndromic Surveillance Centre, Birmingham, November 2010.

- University of Cambridge, November 2010; Ken Eames gave a research seminar: “Living in interesting times”.

- Meeting with representatives of the US Centers for Disease Control and Prevention (CDC) on modelling and surveillance of influenza December 2010.

- University of Strathclyde, February 2011; Ken Eames gave a research seminar: “Modelling epidemics when things change”.

- Luis Filipe Lopes, Fabrício A.B. Silva, Francisco Couto, João Zamite, Hugo Ferreira, Carla Sousa, Mário J. Silva, Epidemic Marketplace: An Information Management System for Epidemiological Data. Presented at ITBAM'10 - 1st International Conference on Information Technology in Bio- and Medical Informatics - DEXA 2010 - August, 2010.

- João Zamite, Fabrício A.B. Silva, Francisco Couto, Mário J. Silva, MEDCollector: Multisource Epidemic Data Collector. Presented at ITBAM'10 - 1st International Conference on Information Technology in Bio- and Medical Informatics - DEXA 2010 - August, 2010.

- Mário J. Silva, Fabrício A.B. Silva, Luís Filipe Lopes, Francisco Couto, Building a Digital Library for Epidemic Modelling. Proceedings of ICDL 2010 - The International Conference on Digital Libraries 1, p. 447--459, New Delhi, India, 23--27 February, 2010. TERI Press -- New Delhi, India. Presentation of invited paper.

- Presentation and demo of EPIWORK to students at the University of Valencia, Spain in an invited 4hrs seminar, by Fabricio Silva, June 2010.

- Presentation of EPIWORK to students of the Master/Phd in Epidemiology at the Faculty of Medicine of the University of Lisbon, in an invited 3h seminar, by Mário J. Silva.

- Mário J. Silva, Privacy in Socially Intelligent ICT. Imperial College, London, UK. ASSYST Perada Workshop - Towards a Science of Socially Intelligent ICT. August, 2010.

- Maíra Aguiar, Sebastien Ballesteros and Nico Stollenwerk, ``The influence of seasonality on dengue epidemiology, modelling and data analysis", Proceedings of 10th Conference on Computational and Mathematical Methods in Science and Engineering, CMMSE 2010}, ISBN 978-84-613-5510-5, edited byJesus V.A., Almeria, 2010, pp. 25--35.

Maíra Aguiar, Sebastien Ballesteros and Nico Stollenwerk, ``Two strain dengue model with temporary cross immunity and seasonality", AIP Conference Proceedings 1168 volume 2, of 8th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2010}, ISBN 978-0-7354-0831-9, edited by Theodore E. Simos, Greece, 2010, pp.732--735.}

Maíra Aguiar, Sebastien Ballesteros and Nico Stollenwerk, ``Dynamic noise and its role in understanding epidemiological processes", AIP Conference Proceedings 1168 volume 2, of 8th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2010}, ISBN 978-0-7354-0831-9, edited by Theodore E. Simos, Greece, 2010, pp.736--40.

APS March Meeting: March 14 - 18, 2010, Portland, USA
Human mobility in an emerging epidemic: a key aspect for response planning, a contributed talk presented by Chiara Poletto in the *Focus Session: Complex Networks I*
Human mobility and epidemic invasion**,** an invited talk by Vittoria Colizza in the *Focus Session: Stochastic Processes in Biology I*

NETSCI 2010
Global invasion of H1N1 influenza: could have we stopped it by grounding planes?**,** a contributed talk presented by Paolo Bajardi in the Epidemic Spreading session (Wednesday, May 13) [see picture on the left].
Pandemic influenza and medical response: assessing the sustainability and ecotoxicity risks **,** an invited talk by Vittoria Colizza (Wednesday, May 13).

ICCS 2010 10th edition of the International Conference on Computational Science, Amsterdam from May 31 to June 2, 2010
contributed talk by Corrado Gioannini titled "The GLEaMviz simulator. A software tool to explore realistic epidemic spreading at the global scale".
The talk was part of the workshop "Frontiers in the computational modeling of disease spreading", organized by Vittoria Colizza, Alessandro Vespignani, Dirk Brockmann and Stefano Merler.

"International Summer School on Complex Systems: Structure and Dynamics" ITAP, in Turunç, Turkey, August 23 - 27, "Workshop on Complex Systems" ITAP, on August 30 - September 1.
Series of three lectures titled “Epidemic processes on complex networks” by Vittoria Colizza.
oral presentation: Modeling the 2009 A/H1N1 pandemic: the experience after the 2009-2010 winter wave by Michele Tizzoni.

Workshop "Data driven dynamical networks", that took place at the Ecole de Physique in Les Houches, France, September 26 - October 1.
"Multiscale networks and epidemics" - a keynote talk by Vittoria Colizza.
"Longitudinal analysis of microdynamical complex networks: a case study" - a contributed talk presented by Paolo Bajardi.

D. Paolotti, 3rd International ICST Conference on Electronic Healthcare for the 21st century - 13-15 December 2010 - Casablanca, Morocco**,** “Internet-based monitoring system for influenza-like illness: H1N1 surveillance in Italy”, oral contribution

A. Vespignani, First Global Symposium on Health Systems Research, Session on complex systems, Montreaux, Switzerland November 16-19, 2010.

A. Vespignani, Connecting the Dots Symposium, Harvard University, Cambridge, MA, October 22, 2010 (keynote speaker).

A. Vespignani, Influenza H1N1 modeling working group meeting, European Center for Disease Control ECDC, Stockholm, 19 October 2010.

A. Vespignani, ESF-Cost Conference on Future Internet and Society: A Complex Systems Perspective, Acquafredda di Maratea, Italy, October 4-9, 2010 (keynote speaker).

A. Vespignani, WIN 2010 Workshop on Information in Networks, New York University, New York, September 25-26, 2010

A. Vespignani, Socially Coupled Systems & Informatics-Science, Computing and Decision Making in a Complex Interdependent World 2010 Conference, Old Town Alexandria, VA, July 12-14, 2010

A. Vespignani, Workshop on Cascading Events in Complex Financial Networks, The Fidelity Center for Applied Complexity May 11, 2010, Boston, MA (keynote speaker).

A. Vespignani, Symposium “The Physics of Global Catastrophes and Countermeasures”, American Physical Society (APS) March Meeting, Portland, OR, March 14-17, 2010

A. Vespignani, Symposium "Human Mobility: the Statistical Physics of When, Where, and How" American Physical Society (APS) March Meeting, Portland, OR, March 14-17, 2010.

A. Vespignani, International Workshop on Nonlinear Dynamics of Networks, Center for Scientific Computation & Mathematical Modeling (CSCAMM), University of Maryland, College Park, April 7, 2010,

A. Vespignani, International Conference: Networks, a framework for cross disciplinary applications, Zaragoza, Spain, February 3-6, 2010 (keynote speaker).

Daniele Miorandi attended EGAIS 2010 and presented some of the EPIWORK results and activities.

First Period

Gabriela Gomes (FGC-IGC)
Workshop Design and Analysis of Infectious Disease Studies
November 2009, Oberwolfach, Germany.
High rates of reinfection tuberculosis: The selection hypothesis.

Gabriela Gomes (FGC-IGC)
Workshop on Modelling, Computation, and Measurement of Multiple Carriage
December 2009, Saariselkä, Finland
Interpreting genetic variation in pathogen populations.

Gabriela Gomes (FGC-IGC)
Workshop on Theoretical Epidemiology, Centro Internacional de Matemática,
January 2010, Coimbra, Portugal
Integrative Epidemiology.

J.P. Boto and N. Stollenwerk (FFCUL)
9th Conference on Computational and Mathematical Methods in Science and Engineering,
June 30, July 1-3, Gijón, Spain
*Fractional calculus and Levy flights: **m**odelling spatial epidemic spreading*.

Nico Stollenwerk, J.P. Boto, (FFCUL)
International Conference on Numerical Analysis and Applied Mathematics,
18-22 September 2009, Rethymno, Crete, Greece.
Reaction-superdiffusion systems in epidemiology, an application of fractional calculus

Shlomo Havlin (BIU)
International Conference on Complex Systems
Feb. 23 - 25, 2009**,** Shanghai, China
Percolation and immunization of complex networks

Shlomo Havlin (BIU)
Complex Networks: Topology and Dynamics
June 4, 2009, Tel-Aviv, Israel
Statistical Physics and Complex Networks

Shlomo Havlin (BIU)
International Workshop on Coping with Crises in Complex Socio-Economic Systems
June 8 - 12, 2009, Zurich, Swizerland
Efficient Immunization Approaches to Avoid Epidemic Spreading

Shlomo Havlin (BIU)
NETSCI 09 International Workshop and Conference on Complex Networks and their Applications
June 29 - July 3, 2009, Venice, Italy
Novel Percolation Models in Complex Networks

Roni Parshani (BIU)
International Conference on Complexity and Interdisciplinary Sciences,
July 12-8th ,2009, Chengdu, Sichuan, P. R. China,
SIS epidemic threshold on random networks

Stefano Merler (FBK)
NETSCI 09 International Workshop and Conference on Complex Networks and their Applications
June 29 - July 3, 2009, Venice, Italy
Comparing large-scale computational approaches to epidemic modeling: Agent based versus structured metapopulation models.

Marco Ajelli (FBK)
NETSCI 09 International Workshop and Conference on Complex Networks and their Applications
June 29 - July 3, 2009, Venice, Italy
Factors affecting the spread of an epidemic in Europe: population heterogeneity and human mobility.

Marco Ajelli (FBK)
White Workshop on Mathematical Biology
December 17-19, 2009, Trento, Italy
A dynamic individual based model of hepatitis A transmission.

Stefano Merler (FBK)
White Workshop on Mathematical Biology
December 17-19, 2009, Trento, Italy
The role of population heterogeneity and human mobility in the spread of pandemic influenza.

Mario J. Silva (FFCUL)
The International Conference on Digital Libraries New Delhi, India,
February, 2010.

Luis F. Lopes, João M. Zamite, Bruno C. Tavares, Francisco M. Couto, Fabrício Silva and Mário J. Silva (FFCUL)
September 2009, INForum – Simposio de Informatica
Automated Social Network Epidemic Data Collector

Alessandro Vespignani (ISI)
The James Martin 21st Century School Seminar Series
February 25, 2010, University of Oxford, UK
Predicting the Behaviour of Techno-Social Systems: How Informatics and Computing Help to Fight Off Global Pandemics.

Vittoria Colizzza (ISI)
Global Health Conference – Global Flows in Global Health: Inter-Asian Connections
Jan 4-8, 2010, United Arab Emirates University, Al-Ain, UAE
Epidemic Science in real time: the H1N1 case [keynote]

Alessandro Vespignani (ISI)
Symposium 'Frontiers in Network Science'
September 28-30, 2009, Berlin, Germany
Predicting the behavior of techno-social systems [keynote]

Vittoria Colizza (ISI)
Symposium 'Frontiers in Network Science'
September 28-30, 2009, Berlin, Germany
Epidemic Science in real time: the H1N1 case [keynote]

ECCS09 - European Conference on Complex Systems 2009
September 21-25, 2009, University of Warwick, UK
Worldwide spread of the unfolding swine flu epidemic: early assessment and predictions [contributed]
C. Poletto
Complex Techno-Social Networks for Epidemic Forecasting [invited]
B. Goncalves

Alessandro Vespignani (ISI)
NetSci09 - International Workshop on Network Science 2009
June 29 - July 3, 2009, Venice, Italy
Multiscale networks and forecasting techno-social systems: Planning for pandemic outbreaks in real time [keynote]

Vittoria Colizza (ISI)
ICCS 2009 - International Conference on Computational Science "Compute. Discover. Innovate."
May 25-27, 2009, Baton Rouge, Louisiana, USA
Computational epidemiology: a new paradigm in the fight against infectious diseases [keynote]

Sander van Noort (FGC-IGC)
Influenzanet: Internet-based monitoring system for ILI.
Annual Meeting of the Influenza Surveillance Network in Europe.
ECDC, Stockholm, Sweden.
June 2009.

Sander van Noort, Vitor Faustino (FGC-IGC)
July 2009, ISC, Salvador, Brazil.
On the use of the internet to monitor infectious diseases.

Gabriela Gomes (FGC-IGC)
September 2009, Workshop on Mathematical Modelling of Epidemics, University of Bristol, UK.
Influenzanet.

Ken Eames (LSHTM)
Seminar
October 2009, Imperial College, London;
Weighted networks, mathematical models, and a bit of flu;

Ken Eames (LSHTM)
May 2009, University of Georgia;
Human social contact patterns and the spread of infection;
Ecology and Evolution of Infectious Disease conference,

Shlomo Havlin (BIU)
Seminar
Dec. 7 2009, Northeastern University,
Percolation in interconnected networks