

Press Release
Paris, 29 May 2015

New technologies help us understand how infectious diseases spread in a hospital environment



©Inria/Photo Kaksonen

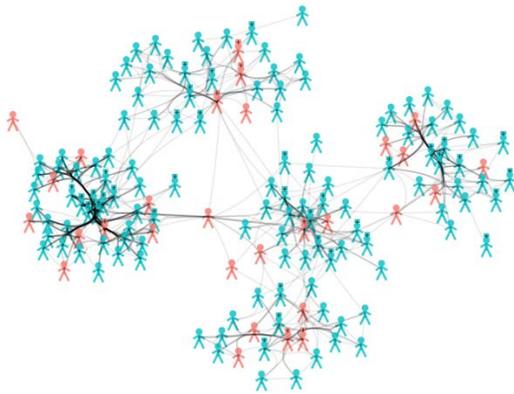
A joint study of the interactions between all the people in a hospital, the i-Bird (Individual-based Investigation of Resistance Dissemination) experiment has helped identify the factors involved in the spread and transmission of bacteria that cause nosocomial infections. The results confirm that new technologies may be useful in analysing epidemics. The initial results of this research project, led by teams at Inserm, the Institut Pasteur, ENS Lyon and Inria in conjunction with the AP-HP at the Hôpital Maritime de Berck-sur-Mer (Pas-de-Calais) have just been published in *PLOS Computational Biology*.

In Europe, 5 to 12% of hospital patients are affected by nosocomial infections. They result in higher mortality, prolonged hospital stays and costly treatment (antibiotics, surgery, etc.).

In 2009, 590 patients and healthcare professionals at the Hôpital Maritime de Berck-sur-Mer took part in the i-Bird experiment, which lasted six months and which aimed to determine the pathways by which certain bacteria that are resistant to antibiotics are spread. Particular attention was paid to monitoring *Staphylococcus aureus*, an especially virulent infectious agent. "To achieve this, the participants were equipped with wireless sensors, the size of a watch, which, at 30 second intervals, record, anonymously, all the people who come within close proximity to them. This made it possible to map out all their interactions with other people inside the Berck-sur-Mer hospital," explained Didier Guillemot (Inserm, Institut Pasteur, UVSQ, AP-HP), who conceived the project with Pierre-Yves Boëlle and Éric Fleury.

At the same time, nasal swabs were taken weekly to obtain microbiological data on the carriage and dissemination of certain "clones" (genetic subgroups of bacteria) of Methicillin-resistant *Staphylococcus aureus*.

A vertiginous amount of data to be processed and validation of a dissemination model



The grey lines indicate close proximity interactions between the various people, patients and healthcare professionals, at the site (marked with a "+"). The people shown in red are carriers of MRSA (Methicillin-resistant *Staphylococcus aureus*).

Credit: Obadia et al./PLOS Computational Biology

The results of the i-Bird study were published six years after its launch, due to the vertiginous amount of data that needed to be processed: 85,025 interactions a day were recorded by the sensors. "We had to develop algorithms to clean all these data in order to be able to interpret them," explained Didier Guillemot.

Using modelling to crosscheck the detailed information on the contact network, the researchers have succeeded in demonstrating that the transmission of strains of *S. aureus* follow the pathways recorded in this network.

In other words, close proximity contacts between individuals helps spread Methicillin-resistant *Staphylococcus aureus*. Apart from the purely medical aspects, these results validate the "use of wireless devices to assess the contact network within a hospital and open up new possibilities for controlling the spread of nosocomial infections," according to the researchers.

The experiment entailed the construction of a model to predict the dissemination of *Staphylococcus aureus* which can be used for other experimental setups, to prevent or stem the spread of infection in the event of an epidemic.

Exhaustive data and the use of wireless technology: a unique research model in epidemiology

i-Bird is distinguished by the exhaustive nature of the data gathered on-site and the use of wireless technologies.

The experiment, funded by the European MOSAR programme (Mastering hOSPital Antimicrobial Resistance in Europe) and the French clinical research programme, required synergy between experts in the fields of medicine and computer networks. These experts included:

- Éric Fleury, Professor at ENS Lyon, INRIA Chair and head of the DANTE team,
- Didier Guillemot, Professor of Epidemiology and the Université de Versailles Saint Quentin, Director of Inserm/Institut Pasteur/UVSQ Research Unit 1181,
- Thomas Obadia, doctoral researcher at Inserm
- Pierre-Yves Boëlle, University Professor and hospital practitioner at the Pierre et Marie-Curie Faculty of Medicine.

While i-Bird focuses on understanding how nosocomial diseases are transmitted, "it is a scientific experiment, not a practical application for solving epidemic problems," explained Didier Guillemot. Control instruments still need to be developed to assess these risks.

To obtain even more detailed results relating to the spread of the bacteria that cause nosocomial infections, the researchers are planning to develop technology that will factor in actual physical contact, rather than just proximity contact, between individuals. Further experiments of this kind will be undertaken in surgical, post-surgical and intensive care settings, this time measuring physical contacts.

Source

Detailed Contact Data and the Dissemination of *Staphylococcus aureus* in Hospitals, *PLOS Computational Biology*, 19 March 2015

Thomas Obadia^{1,2}, Romain Silhol³, Lulla Opatowski^{4,5,6}, Laura Temime⁷, Judith Legrand⁸, Anne C. M. Thiébaud^{4,5,6}, Jean-Louis Herrmann^{9,10}, Éric Fleury^{11,12,*}, Didier Guillemot^{4,5,6,13,*}, Pierre-Yves Boëlle^{1,2,14,*}, on behalf of the I-Bird Study Group¶

(1) Sorbonne Universités, UPMC Univ Paris 06, UMR_S 1136, Institut Pierre Louis d'Epidémiologie et de Santé Publique, F-75013, Paris, France,

(2) INSERM, UMR_S 1136, Institut Pierre Louis d'Epidémiologie et de Santé Publique, F-75013, Paris, France,

(3) Department of Infectious Disease Epidemiology, Imperial College London, London, United Kingdom,

(4) Inserm UMR 1181 "Biostatistics, Biomathematics, Pharmacoepidemiology and Infectious Diseases" (B2PHI), F-75015, Paris, France,

(5) Institut Pasteur, UMR 1181, B2PHI, F-75015, Paris, France,

(6) Univ. Versailles St Quentin, UMR 1181, B2PHI, F-78180 Montigny-le-Bretonneux,

(7) Laboratoire MESuRS, Conservatoire National des Arts et Métiers, 75003, Paris, France,

(8) Univ Paris-Sud, UMR 0320/UMR8120 Génétique Quantitative et Evolution—Le Moulon, F-91190, Gif-sur-Yvette, France,

(9) INSERM U1173, UFR Simone Veil, Versailles-Saint-Quentin University, 78180, Saint-Quentin en Yvelines, France,

(10) AP-HP, Hôpital Raymond Poincaré, Service de Microbiologie, F-92380, Garches, France,

(11) ENS de Lyon, Université de Lyon, Laboratoire de l'Informatique du Parallélisme (UMR CNRS 5668—ENS de Lyon—UCB Lyon 1), IXXI Rhône Alpes Complex Systems Institute, Lyon, France,

(12) Inria—Institut National de Recherche en Informatique et en Automatique, Montbonnet, France,

(13) AP-HP, Raymond Poincaré Hospital, F-92380 Garches, France,

(14) AP-HP, Hôpital Saint-Antoine, Département de Santé Publique, F-75571, Paris, France

*These authors contributed equally to this work.

¶ Membership of the I-Bird Study Group is listed in the Acknowledgments.

About

Inria

Inria, the research institute dedicated to Computer Science, promotes "scientific excellence at the service of technology transfer and society". Inria's 2,700 employees are graduates from the world's top universities. Their work involves rising to the challenges of Computer Science and Mathematics. Thanks to its open and agile model, Inria is able to explore new and original ways of working with its industrial and academic partners. This enables the Institute to be highly responsive to the multidisciplinary and applicative challenges of digital transition. Inria researchers have developed many innovative technologies that create value and jobs.

For more details: <http://www.inria.fr>

Follow Inria at twitter.com/inria

Inserm

Founded in 1964, Inserm, the French National Health and Medical Research Institute, is a public science and technology institute, jointly supervised by the French Ministry of Higher Education and Research and the French Ministry of Social Affairs, Health and Women's Rights. Inserm is the only French public research establishment entirely dedicated to biological, medical and public health research, with nearly 15,000 researchers, engineers, university hospital technicians, post-doc researchers and around 300 laboratories. Its

researchers study all diseases, from the most common to the rarest. Inserm is a founding member of Aviesan*, the French National Alliance for Life and Health Sciences, set up in 2009.

**The other founding members of Aviesan are: CEA, CNRS, CHRU, INRA, INRIA, Inserm, Institut Pasteur, IRD*

Go to Press Room/follow Inserm on Twitter :@Inserm

Ecole Normale Supérieure de Lyon

A public university institution, ENS Lyon trains higher education and research professionals, leading to careers in the senior civil service and the private sector. Forging close links between education and research, it promotes crossovers between disciplines for a more comprehensive, interdisciplinary approach. In particular, this can be seen in the field of education, in liaison with the Institut Français de l'Éducation, and in understanding complex systems, with the IXXI Rhône Alpes Complex Systems Institute, a key player in everything related to education. ENS Lyon is committed to international cooperation and has developed five special partnerships with the EPFL (Ecole Polytechnique Fédérale de Lausanne), the ECNU (East China Normal University) in Shanghai and the universities of Ottawa, São Paulo and Tokyo, through which it leads an active policy on sharing knowledge and openness to society.

For more details: www.ens-lyon.fr

Institut Pasteur

The Institut Pasteur is a private, non-profit foundation founded in 1887 by Louis Pasteur. It has become an internationally-renowned centre of biomedical research, and lies at the heart of a network of 32 institutes on all five continents. To further its aims in the prevention and treatment of disease, in France and worldwide, the Institut Pasteur develops its activities in four core areas: scientific and medical research, public health and health monitoring, teaching and technology transfer for economic development.

Over 2,400 people work at the Institut Pasteur campus in Paris. A world leader in infectious diseases, microbiology and immunology, its 130 research units also study certain types of cancer, genetic and neurodegenerative diseases, as well as genomics and developmental biology. Thanks to this research to improve our knowledge of living systems, new preventive approaches and innovative treatments are discovered and developed. Since it was first founded, ten researchers at the Institut Pasteur have received the Nobel Prize for Medicine, most recently in 2008 in recognition of the discovery, in 1983, of the human immunodeficiency virus (HIV) that causes Aids.

For more details: www.pasteur.fr

Institut Pasteur press contact

Myriam Rebeyrotte – presse@pasteur.fr – +33 1 45 68 81 01

Inria press contact

Laurence Goussu – laurence.goussu@inria.fr - +33 1 39 63 57 29

Thomas Marko & Associés press contacts

Mathilde Folliot – mathilde.f@tmarkoagency.com - +33 1 44 90 87 42
Constance Nisio – constance.n@tmarkoagency.com – +33 1 44 90 87 40