A wireless sensor network to measure the health care workers exposure to tuberculosis

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May 19, 2009

In parallel to the advances in modern medicine, health sciences and public health policy, epidemic models aided by computer simulations and information technologies offer an important alternative for the understanding of transmission dynamics and epidemic patterns. In this paper, we focus on the first steps that may lead towards the design of epidemic models, i.e. the measure and analysis of interactions within a closed socio-professional context. More precisely, this project was motivated by the study of the Health Care Workers (HCWs) exposure to tuberculosis in their work environment.

Despite the progresses in treatment and prevention, tuberculosis remains a disease in expansion and represents the third cause of death by infectious pathologies in the world. In the health care context, if the transmission is globally controlled, the HCWs exposure remains obscure. Individual factors associated to the contamination of HCWs in their work environment are not precisely known. Our study focus on the evaluation of the intensity and the frequency of contacts between tuberculosis infected patients and HCWs. To gather this information, classical methods consist in performing audits, consulting medical and administrative files or using self-reports of conversations and trusting HCW souvenirs. All these methods are time-consuming, subject to memory failures and interpretations. As an alternate method, we have chosen to dedicate a Wireless Sensor Network (WSN) to gather these interactions inside a Service of Infectious and Tropical Diseases (Bichat-Claude Bernard Hospital, Paris) and a Service of Pneumology (La Pitié Salpétrière Hospital, Paris). Within the two services, each room has been equipped with a sensor node and each HCW carries an autonomous sensor during his presence in the service. An important characteristic of this measurement campaign is that it was performed in a closed environment, over a closed population and during a large continuous period of time. That is, the presence of all HCWs of the units was monitored in all patient rooms, 24/7 during a three months period. In addition to the experimental measure system description, this paper main contributions are the analysis and characterization of this huge and unique data set describing a complex dynamic interaction network, and the impact study of the measurement process bias on the network dynamic. The analyze of large dynamic in situ interaction networks provides an opportunity to study dynamical processes occurring on dynamical networks, such as spreading or epidemical processes, taking into account the dynamics both on and of the network structure.