

# **ERCIM “Alain Bensoussan” Fellowship Scientific Report**

## **Fellow**

Taxiarchis Botsis

## **Visited Location**

Computer Science Department  
University of Tromsø  
Norway

## **Duration of Visit**

20 March 2007 – 19 March 2008

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## **Introduction**

This report describes my scientific activity during my post doctoral fellowship period from 20 March 2007 to 19 March 2008. This one-year period was spent in Computer Science Department, University of Tromsø, Tromsø, Norway.

## **I - Scientific activity**

### **IA - Main scientific activity**

During my fellowship I worked on disease surveillance field trying to establish and research some new directions. So far, the developed systems are mainly targeted at the general population and less attention is paid to groups with special physical needs such as patients suffering from chronic diseases, elderly individuals and infants. Vulnerable populations of this kind, defined here as Sensitive Population Groups (SPGs), may be at heightened risk even in non-outbreak settings.

Another new direction is the identification of a threat before people even know that they have been infected, which done with the first symptoms. This approach is highly correlated to the study of methodologies for the detection of infections before symptom onset, while current systems are based on people's awareness of their health status. These observations could be valid not only for SPGs but also for the general population.

The existing disease surveillance systems collect data after the onset of symptoms. So, the syndromic surveillance is based on pre-clinical and pre-diagnostic data, while diagnosis-based surveillance relies on a diagnosis established by lab tests and confirmed by the physician who ordered the test. Timeliness is very important in disease surveillance because it can reflect the time delay between any number of response steps in the process. The majority of existing disease surveillance systems relies much on the individual initiative since the process is not so automated.

Apart from what is mentioned above I was also involved in a project for 'Context-aware systems for mobile communication in healthcare'. This project attempts to solve the communication problems in the current hospital setting. Especially, physicians need a mobile context-aware communication system in their daily practice. This project aims at developing a reliable communication system to help physicians accomplish their tasks.

The outcomes of my scientific activity have already been presented in two conferences and in two more coming this spring (after the end of my fellowship). Moreover, they appear in journals and a book series. Also, there are two papers that are still under review. Details for my publication activities are presented below in section II.

### **IB - Exchange Programme**

#### **1<sup>st</sup> ERCIM Institute Visit**

The first ERCIM Institute I visited was FORTH (Crete, Greece) from 2 October 2007 to 02 November 2007. My scientific contact, Dr. Manolis Tsiknakis, organized some demonstrations of FORTH's research activities. Also, I presented my scientific activity in a two hours session entitled 'Tromsø Telemedicine Laboratory (TTL) – Disease Surveillance Project' (Thursday, 1 November 2007). More information for this session can be found at: [http://www.ics.forth.gr/news/taxiarchis\\_botsis\\_lecture.html](http://www.ics.forth.gr/news/taxiarchis_botsis_lecture.html).

#### **2<sup>nd</sup> ERCIM Institute Visit**

The second ERCIM Institute I visited was VTT (Tampere, Finland) from 27 January 2008 to 01 February 2008. My scientific contact, Dr. Jyrki Lötjönen, organized a series of meetings where I was informed for their work and had extensive discussions on common fields of interest. I also presented my work in a one hour session on Thursday, 31 January 2008.

## **II- Publication(s) during my fellowship**

### **II.A - Journal and book series publications**

1. T. Botsis, O. Hejlesen, J.G. Bellika, G. Hartvigsen. Electronic disease surveillance for sensitive population groups – The diabetics' case study. Studies in Health Technology and Informatics (book series) (under publication).

Abstract:

Diabetics are quite susceptible to infectious diseases and can easily spread them under certain circumstances. Their blood glucose levels are increased after infection and this can cause a hyperglycemic crisis. Our study indicates that this increase results in glucosylated hemoglobin elevation, even when a diabetic is monitored closely and his/her blood glucose is under tight control. Thus, it is important to detect infections at the very early stages of disease evolution in order to aid the patient. For this purpose, an electronic Disease Surveillance System could be developed to collect and analyze blood glucose data. Generally, we could extend the use of blood glucose data to the implementation of disease surveillance systems for the general population.

2. T. Botsis, O. Hejlesen, J.G. Bellika, G. Hartvigsen. Disease surveillance systems for diabetics. Telemedicine Journal and e-Health (under publication).

Abstract:

Diabetics are rather susceptible to infections and suffer more compared to normal subjects. This study tested the hypothesis that there is a strong correlation between elevated blood glucose (BG) levels and infection. This observation can lead to the development of a system for the early detection of infections in diabetics.

3. T. Botsis, G. Hartvigsen. Telehomecare for elderly individuals suffering from chronic diseases: current status and future perspectives. Journal of Telemedicine and Telecare (under publication).

Abstract:

The purpose of this study is to give an overview of home telecare that is used for elderly patients suffering from chronic diseases and indicate the potential benefits of their implementation. The scientific literature published between 1990 and 2007 was retrieved via the PubMed database using a specific search algorithm. The 485 publications were studied and a final set of 54 were selected for further investigation. The results showed that the number of publications in the field increases each year and that many aspects are under investigation. The patients were quite satisfied with home telecare, but they preferred a combination with traditional healthcare strategies. Health care professionals were positive as well. Regarding the effects on chronic diseases, it seemed that there were benefits for all home telecare-enabled but cognitive (dementia and Alzheimer's) diseases where the patients faced difficulties in accomplishing even simple new tasks. There was also the impression of cost reduction among patients in terms of travelling expenses and time saving, which was validated in many studies through a reduction in hospitalizations and reduced in-patient times. Even though the foreseen benefits are important, there are also quite significant organizational, ethical, legal, design, usability as well as other issues that have to be discussed for a better implementation of home telecare for the elderly suffering from chronic diseases.

4. Botsis T, Hejlesen O, Bellika JG, Hartvigsen G. Blood glucose levels as an indicator for the early detection of infections in type-1 diabetics. Advances in Disease Surveillance 2007; 4:147.

Abstract:

The aim of the study was to assess the correlation between blood glucose levels and infection and to propose the development of a model for the early detection of infections in diabetics.

5. Botsis T, Bellika JG, Hartvigsen G. Disease surveillance systems for sensitive population groups. *Advances in Disease Surveillance* 2007; 4:148.

Abstract:

The aim of this study was to reveal the need for developing disease surveillance systems for sensitive populations.

6. Taxiarchis Botsis, Terje Solvoll, Jeremiah Scholl, Per Hasvold, Gunnar Hartvigsen. Context-aware systems for mobile communication in healthcare – A user oriented approach. In: M. Hu Le, M. Demiralp, V. Mladenov, Z. Bojkovic (eds). *Applied Informatics and Communications (Proceedings of the 7<sup>th</sup> International Conference on Applied Informatics and Communications)*. WSEAS Press 2007, ISBN: 978-960-8457-96-6. pp 69-74.

Abstract:

A variety of communication problems is a common phenomenon in the current hospital setting. Physicians need a mobile context-aware communication system in their daily practice. Our approach, based on an initial study performed at the Oncology Department at the University Hospital of North Norway and an extensive collection of user needs according to CSCW and use case methodology, will develop a reliable communication system to help physicians accomplish their tasks.

## **II.B Conference Presentations**

**Some of the conference presentations were also included in journals or book series as mentioned below.**

1. T. Botsis, O. Hejlesen, J.G. Bellika, G. Hartvigsen. Electronic disease surveillance for sensitive population groups – The diabetics' case study. *Medical Informatics in Europe 2008 Conference*, Göteborg, Sweden May 25-28, 2008 (accepted for presentation). Also included in a book series (see II.A-No1).

Abstract:

Diabetics are quite susceptible to infectious diseases and can easily spread them under certain circumstances. Their blood glucose levels are increased after infection and this can cause a hyperglycemic crisis. Our study indicates that this increase results in glucosylated hemoglobin elevation, even when a diabetic is monitored closely and his/her blood glucose is under tight control. Thus, it is important to detect infections at the very early stages of disease evolution in order to aid the patient. For this purpose, an electronic Disease Surveillance System could be developed to collect and analyze blood glucose data. Generally, we could extend the use of blood glucose data to the implementation of disease surveillance systems for the general population.

2. T. Botsis, O. Hejlesen, J.G. Bellika, G. Hartvigsen. Disease surveillance systems for diabetics. 13<sup>th</sup> Annual International Meeting and Exposition of the American Telemedicine Association, Washington State Convention Center, Seattle, Washington, USA, April 6-8, 2008 (accepted for presentation). Also included in a journal (see II.A-No2).

Abstract:

Diabetics are rather susceptible to infections and suffer more compared to normal subjects. This study tested the hypothesis that there is a strong correlation between elevated blood glucose (BG) levels and infection. This observation can lead to the development of a system for the early detection of infections in diabetics.

3. T. Botsis, O. Hejlesen, J.G. Bellika, G. Hartvigsen. Electronic disease surveillance systems for diabetics. 1<sup>st</sup>International Conference on Advanced Technologies and Treatments for Diabetes, Prague, Czech Republic, February 27 - March 1, 2008 (accepted for presentation).

Abstract:

Diabetics are quite susceptible to infectious diseases and can easily spread them under certain circumstances. This study proposes the use of electronic Disease Surveillance Systems (eDSSs) for the early detection of infectious diseases in diabetics. An eDSS can employ biological sensors for collecting physiology data and transmit them to a data repository where an algorithm for patient processing will detect the infections. The kind of collected data could include blood glucose (BG) that seems to increase significantly after infections as indicated in our study.

4. Botsis T, Hejlesen O, Bellika JG, Hartvigsen G. Blood glucose levels as an indicator for the early detection of infections in type-1 diabetics. Sixth Annual International Society for Disease Surveillance Conference, Indianapolis, Indiana USA, October 11-12, 2007. Also included in a journal (see II.A-No4).

Abstract:

The aim of the study was to assess the correlation between blood glucose levels and infection and to propose the development of a model for the early detection of infections in diabetics.

5. Botsis T, Bellika JG, Hartvigsen G. Disease surveillance systems for sensitive population groups. Sixth Annual International Society for Disease Surveillance Conference, Indianapolis, Indiana USA, October 11-12, 2007. Also included in a journal (see II.A-No5)

Abstract:

The aim of this study was to reveal the need for developing disease surveillance systems for sensitive populations.

6. Taxiarchis Botsis, Terje Solvoll, Jeremiah Scholl, Per Hasvold, Gunnar Hartvigsen. Context-aware systems for mobile communication in healthcare – A user oriented approach. Applied Informatics and Communications Conference, Vouliagmeni Beach, Athens, Greece, August 24-26, 2007. Also included in a book series (see II.A-No6)

Abstract:

A variety of communication problems is a common phenomenon in the current hospital setting. Physicians need a mobile context-aware communication system in their daily practice. Our approach, based on an initial study performed at the Oncology Department at the University Hospital of North Norway and an extensive collection of user needs according to CSCW and use case methodology, will develop a reliable communication system to help physicians accomplish their tasks.

## **II.C Submitted papers (Under Review)**

1. Botsis T, Bellika JG, Hartvigsen G. New Directions in Electronic Disease Surveillance: Earlier Detection of Infectious Diseases for Sensitive Population Groups using Electronic Disease Surveillance Systems. IMIA 2008 yearbook.

Abstract:

The main objective of this paper is to present the idea of developing electronic disease surveillance systems for detecting infections at the first stages of disease progression (incubation period) when the subject has been exposed to a disease agent, but is not contagious yet. Apart from the general population, this is important for vulnerable

population groups with special physical needs, defined in this paper as Sensitive Population Groups. The importance of detecting an infection during the incubation period is demonstrated through some infectious disease examples and the bottom-up approach is proposed for Sensitive Population Groups disease surveillance. Through the diabetics' case study the use of certain physiology indicators, such as blood glucose levels and white blood cell count, is suggested for the early detection of infections. The results from the diabetics' case study showed that glycosylated hemoglobin values, as a reliable indicator of long-term blood glucose regulation, increased significantly after infection. Also, it is widely known that white blood cells count is increased during the incubation period. An electronic disease surveillance system could use blood glucose levels and white blood cell count in order to offer early warnings of infections at the personal level and of potential outbreaks at the population level.

2. Botsis T, Demiris G, Pedersen S, Hartvigsen G. Telehomecare technologies for the elderly: milestones and challenges. Tromsø Telemedicine and eHealth Conference June 11-13, 2008 - Innovation in eHealth.

Abstract:

The present study attempts an overview of the telehomecare technologies that are used for chronically diseased individuals, their potential implementation in the care of elderly patients, and a discussion of challenges and trends. Numerous systems have already been developed for serving elderly patients, utilizing a variety of technologies; selected representative examples are presented in this paper. In addition to the foreseeable benefits, there are significant organizational, ethical, legal, usability and other issues that need to be investigated to ensure successful implementation.

### **III -Attended Seminars, Workshops, and Conferences**

#### **Seminars**

- Standards in medical informatics. Key speaker: Dr. G. Klein. Lecturing room 2, Research Park, Tromsø, Norway, March 22, 2007.
- Past, present and future of electronic health records. Key speaker: Dr. S. K. Andersen. Lecturing room 2, Research Park, Tromsø, Norway, April 24, 2007.

#### **Workshops**

- Disease Surveillance for Sensitive Population Groups Workshop, Nordlysplanetarriet, Tromsø, Norway, September 21, 2007.

#### **Conferences**

During my fellowship I attended the following conferences:

- 1<sup>st</sup>International Conference on Advanced Technologies and Treatments for Diabetes, Prague, Czech Republic, February 27 - March 1, 2008
- Sixth Annual International Society for Disease Surveillance Conference, Indianapolis, Indiana USA, October 11-12, 2007.
- Applied Informatics and Communications Conference, Vouliagmeni Beach, Athens, Greece, August 24-26, 2007.
- Elderly-Who cares? Tromsø Telemedicine and eHealth Conference, Tromsø, Norway, 11-13 June 2007.

#### **Acknowledgements**

I would like to thank my scientific contact Professor Gunnar Hartvigsen for welcoming me in his research group. I would also like to thank the administrative and technical staff of the department for their invaluable help in many occasions.