

FOBIS – NORDIC FORESIGHT ON BIOMEDICAL SENSORS

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Abstract

The health care systems of the industrialized countries are expected to undergo major changes within the next 10 - 15 years. The number of elderly people requiring treatment will grow considerably, so-called welfare diseases is increasing, and increasing use of new advanced treatments will occur. This will require a more efficient health care system offering better services. A number of new health care technologies will emerge and several will be adopted by the health care systems.

A Nordic consortium headed by SINTEF (Norway) and with the participants VTT (Finland), FOI (Sweden), S-SENCE (Sweden), Sensor Technology Centre (Denmark) and MedCoast-Scandinavia is conducting a foresight study on Biomedical Sensors. The project is supported by the Nordic Innovation Centre. The project revolves around a series of workshops, the first on held in Copenhagen 6-7 October 2005, the second one in Oslo on 2 November 2005, the third in Stockholm on 3 March 2006 and the fourth in Tampere on 7 June 2006. The objectives of the workshops have been to establish status, needs and perspectives for sensors in relation to health care and in particular the need for biomedical sensors. This paper presents the background, workshops and some of the findings so far in the project.

Background

How will biomedical sensors shape the healthcare systems of the future? How can they impact the quality and cost of healthcare and what are the business opportunities in the Nordic region?

The health care systems of the industrialized countries are expected to undergo major changes within the next 10 - 15 years. The number of elderly people requiring treatment will grow considerably, so-called welfare diseases is increasing, and increasing use of new advanced treatments will occur. This will require a more efficient health care system offering better services. A number of new health care technologies will emerge and several will be adopted by the health care systems.

Biomedical sensors will be a central unit embedded in several health related applications

and scenarios. By using micro- and nano-technology it will be possible to design small, smart, robust and cost-effective sensors with a wide functionality. Biomedical sensors will monitor important body functions and status (i.e. blood sugar level, heartbeat rate, presence of toxic agents), and advanced algorithms adapted to each individual may trigger alarms when non-normal values are encountered.

Chips implanted in the body will function as a constant on-board doctor, detecting diseases early and delivering drugs directly into the bloodstream. We define a biomedical sensor as a device that provides information about the state of the human body or elements affecting the state of the human body. A biomedical sensor may be a biosensor. However, other sensors may also serve as biomedical sensors.

The biosensor market

The actual biosensor market in 2002 was expected to USD 2.3 billion of which glucose sensors accounts for the largest part. The growth rate is estimated to be somewhere between 5-10%, probably closer to 10% in the medical sector. This estimate is obtained on the basis of a Swedish analysis of what type of diagnostics and systems that will be needed in order to maintain a health-care system of at least the current standard in the Nordic countries under changing demographic and economic conditions. Estimates of markets in high-throughput screening indicates a potential for a billion \$ market of which a large part may be disposable devices. Key challenges for establishing a world class industry is to quickly gain critical mass and be in the forefront in key areas.

Relevance for the Nordic society

Within the public health service the Nordic countries will face a growing amount of elderly in the years to come and it will be important to offer high quality cost effective health care services to them.

Demographic changes will inevitably require a change in health-care procedures. Monitoring, diagnostics and therapy must become much more closely coupled than it is with current procedures. In addition to this fact there will be a strong pressure for improved services. On the other hand it is unlikely that the societies will tolerate drastic increases in health-care costs. It is inconceivable that this will be feasible without an extended use of biomedical sensor systems.

Early detection using biosensors, enabling the patient to read and monitor the health status, will shorten hospital stays and contribute to a better life quality. Today many decisions in a hospital are taken on the basis of samples that have been analyzed in the laboratory on a manual basis. The introduction of biosensors to automate the whole or part of this manual processes will reduce the hospital costs considerably. Implanted biomedical sensors and actuators will also make a huge impact in the years to come; examples are glucose sensors for diabetics, cardiovascular ventricular assist devices, pressure sensors for post-surgery leakage detection, and on-demand drug delivery pumps.

The pressure on faster and more efficient developments of drugs as well as the need for improving health care without increasing costs makes it extremely important to provide likely

scenarios for technology and application. Biomedical sensors will be one of the main driving forces for a high quality cost effective health care system.

The Nordic countries also have a tradition as key players in peace-keeping missions and humanitarian aid support, where telemedicine, exposure of personnel to unknown chemical or biological exposures is a major hazard. Biomedical sensor can provide significant improvements.

FOBIS – Nordic foresight on biomedical sensors

A Nordic consortium headed by SINTEF (Norway) and with the participants VTT (Finland), FOI (Sweden), S-SENCE (Sweden), STC (Denmark) and MedCoast Scandinavia is conducting a foresight study on Biomedical Sensors. The project is supported by the Nordic Innovation Centre. The project revolves around a series of workshops, the first one was held in Copenhagen on October 6-7, 2005, the second one in Oslo on November 2, 2005, the third in Stockholm on March 3, 2006 and the fourth in Tampere on June 7, 2006. The biomedical sensors foresight project will focus on three important aspects of health care: Home based care, emergency medicine and chemical hazards. The objectives of the workshops have been to establish status, needs and perspectives for sensors in relation to health care and in particular the need for biomedical sensors.

Some key questions for the FOBIS workshops were given: How will biomedical sensors shape the healthcare systems of the future? How can they impact the quality and cost of healthcare and what are the business opportunities in the Nordic region?

Project objectives established:

- To enable a strategic understanding of the possibilities and implications of the use of biomedical sensors for healthcare purposes by establishing likely scenarios for technology, applications and markets.
- To provide for a framework for commercially viable exploitation of biomedical sensor penetration in the Nordic region by enhancing a network of competencies relevant to technology and applications.

After the four workshops, the project will end with dissemination workshops. The project results will then be presented to a wider

audience and discussed. The main event is planned to take place at the national hospital in Norway on October 31, 2006. A final report with documentation of main results will also be written and disseminated to a wider audience.

1st Biomedical Sensors Foresight Workshop, Copenhagen, October 6-7, 2005

The theme of workshop was “Where are we?” and attracted around 40 people from Sweden, Norway, Finland, and Denmark. The participants represented a cross-section of the relevant sectors and industries covering research institutions, granting agencies, companies addressing the health care sector and health care practitioners. The workshop consisted of two sessions with invited presentations covering needs of the health care system, assessment of health care technology, security and defence, commercialization of sensors and diagnostic equipment, and the technology of the sensors for the health care industry.

Group work was performed covering the topics: doctor’s office, home care, hospitals and defence. Some conclusions of the groups were:

Doctors’ office

The patients will be more active and demanding which calls for quicker and more reliable services.

Screening of patients will be an increasingly important task.

Preventive health care will become more important than it currently is.

Home care / Self testing

The need for home care will increase drastically, which will increase the use of medical sensors, telemedicine, and remote consultation and diagnostics.

Implantable devices where sensing and therapy are combined have a great potential, but poses a number of legal and ethical issues

Equipment must be developed in the form of simple, robust, and reliable kits.

Home care is currently the largest market for low-cost medical sensors and this will most likely also be the case in the future.

Cross-validation and consistency will be increasingly important with a growing market for home-care solutions.

Hospitals

They should be more service and production oriented! Greater attention to individuals would be required in the future.

Point-of-care vs. central laboratories will be needed in the future. However, more diagnostics must be performed at the point of care.

Distributed point-of-care systems puts pressure on the user friendliness of the systems.

Defence and Security

This sector can be divided into two main areas, personal safety and public security.

Generally, biomedical sensors for these purposes must be mobile and portable.

Strength of the Scandinavian countries is our tradition for peacekeeping and our environmental credibility. Application for humanitarian purposes could be an area of interest.

2nd Biomedical Sensors Foresight Workshop, Oslo, November 2, 2005

This workshop, with the theme “Where do we want to go?” attracted around 35 people from Sweden, Norway, Finland and Denmark.

The workshop consisted of two sessions with invited presentations covering ethical issues, state of the art and future perspectives of biomedical sensors, technology of the sensors and market issues/business opportunities.

Group works were performed covering the topics home care, defence, doctor’s office and hospitals. During the discussions, a number of important points were identified:

Technology trends:

- Personalized medication
- Multifunctional sensors
- Point of care diagnosis
- System biology and biosensors
- Change in treatment politics
- Education and research
- Organ specific analysis
- Unrealistic expectations
- Long time and high cost to market
- Conservative attitude
- Product quality?

Market scenario for year 2020

- Preventive medicine

- Early detection
- Telemedicine
- Patient self testing

Ethical, societal, policies – Uncertainties:

- Acceptance of the technology
- Right to privacy
- The role of the policies
- Bio criminality
- Bioterrorism
- Wellness/wellbeing – preventive/treatment
- Innovation, priority
- Price/recourses; who affords to use the technology, western countries contra undeveloped countries
- Grade of interdisciplinary
- What kind of diseases to we diagnose/treat, what do we afford
- How is the world developing on an economical level, will effect health care/diagnosis
- Religious/cultural influence

3rd Biomedical Sensors Foresight Workshop, Stockholm, March 3, 2006

This workshop, with the theme “How do we get there?” attracted around 40 people from Sweden, Norway, Finland and Denmark. The workshop consisted of a session with invited presentations covering technical aspects and a general overview of impact of biosensors for our future health. In the next session a panel discussed the general topic “Future health of human being. The panel was posed with several questions from the audience.

Some topics that were especially discussed were:

- What is the worst case scenario in future health care?
- Could the idea of prevention instead of diagnostics lead to difficult choices and new ethical problems?
- What about insurance of health when we have more information about our health?
- When do we stop being human and become robo-sapiens?
- Public acceptance of technology
- New technology will change the way tests are done.
- Is the Scandinavian market too small to play a role the development of this field?

4th Biomedical Sensors Foresight Workshop, Tampere, June 7, 2006

This workshop, with the theme “What do we do now?” attracted around 46 people coming from all Nordic countries. Also this workshop consisted of a session with invited presentations covering technological and business aspects of biomedical sensors for our future health. Challenges and opportunities with wireless sensors and how to realise future products were also discussed. A discussion with the key-note speakers ended the workshop. In this informal panel discussion the participants were asked to comment on various aspects of the future development in the field of biomedical sensors. The panel was also posed with several questions from the audience. Some of the questions discussed:

- Where can biomedical sensors make the greatest contribution to future health care?
- What markers do the panel think are the most important to measure?
- How bright is the future business potential of biomedical sensors?
- What do the public/health professionals/health authorities want?
- Security and public concerns about health data
- How will healthcare be carried out at the different locations in the future?
- Consequences for existing national health services

Conclusions

The Nordic countries all have well-developed and extensive health care systems. There are strong industries within pharmaceutical development, production and marketing as well as strong companies in medical diagnostics. Micro-and nanotechnology and telemedicine are also areas where the Nordic countries have strong competence. In order to take advantage of the needed symbioses of these technology fields, Nordic industry need to create collaborative networks and strategic alliances. The region is in an excellent position to exploit potential benefits of biomedical sensors both as users and as vendors of sensors and systems.

With a public health service and a growing geriatric population there will be an increase in demand for high quality medical devices. The need for improving health care without increasing costs makes it extremely important

to provide likely scenarios for technology and application.

References

FOBIS Newsletters: www.nordic-fobis.net