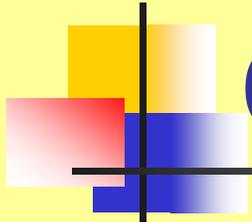
A decorative graphic on the left side of the slide, consisting of a vertical black line intersecting a horizontal black line, with a blue square above the intersection, a red square to the left, and a yellow square below.

# Biomedical Sensors Foresight Workshop - fobis

Olof Lindahl

Centre for biomedical engineering & physics in Northern Sweden  
Luleå Technical University and Umeå University



# Outline

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- Presentation of CMTF-North
- Examples of biomedical sensor research
- A commercialization case – Bioresonator
- Trends and limitations for the future
- Conclusions



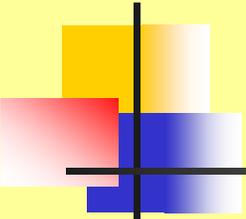
# Centre for Biomedical Engineering and Physics –North Sweden

- Umeå University
- Luleå Technical University
- Västerbotten County Council
- Norrbotten County Council

Biomedical Engineering is a rapidly developing field in Science and Industry. The aim is to take a leading part in this field through excellent scientific research and development in North Sweden. The means are co-operation and the goals are products and methods for a better and more safe Health Care.



**Increased Growth**



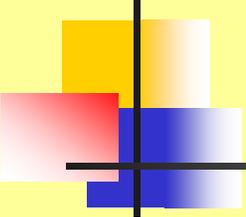
# Companies – Departments

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1. Axiom Co. Ltd, Japan
2. Bioresonator AB
3. Bruker Scand, AB
4. Dermaspec Co.
5. Explicit AB
6. GE-Health Care
7. Morgan Electroceramics, U.K.
8. SciBase AB
9. Tauzer Co Ltd, Japan
10. Videoakt AB

1. Computer Science
2. Pharmacology and neurological sciences
3. Public health and clinical medicine
4. Chemistry
5. Surgery
6. Clinical Sciences
7. Mathematics & Mathematical statistics
8. Medical biosciences
9. Social medicine and rehabilitation
10. Radiation sciences
11. Applied Physics and Electronics
12. Computer Science & Electrical Engineering

International scientific cooperation with Japan, USA, Israel, Italy, U.K., Norway, Finland, Germany etc. External funding from EU, Regional, Vinnova, VR and Companies

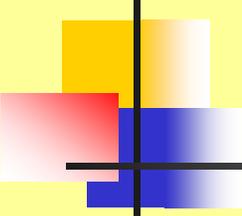
A decorative graphic on the left side of the slide consists of overlapping colored squares (yellow, red, blue) and a black crosshair.

# Results 2000-2005

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- New employments - 15
- Technological Platform -1, CMTF
- New companies -3, Bioresonator, Videoakt, Dermaspec
- Approved Patents - 6
- Support to companies > 10
- Competens development - univ courses.
- Networking - 10 ws, 1 int. conf
- Publications >100

More than 75 persons are today engaged in CMTF

A decorative graphic on the left side of the slide consists of a vertical black line intersecting a horizontal black line. To the left of the vertical line are three overlapping squares: a yellow one at the top, a red one in the middle, and a blue one at the bottom. To the right of the horizontal line is a white rectangular area.

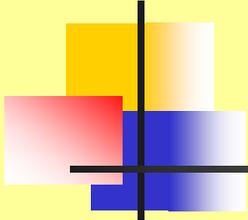
# Projects involving sensors

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1. **Resonance sensors**, Applied Physics & Electronics
2. **Tactile video**, Applied Physics & Electronics
3. **Classifying of tissue**, Chemistry
4. **Surface EMG**, Biomedical Eng & Informatics
5. **Analysis instrument for Diabetes**, Biomedical Eng & Informatics
6. **Automatic analysis of radiograph quality**, Computer science
7. **e-EKG**, Applied Physics & Electronics
8. **Cardiovascular signal analysis**, Biomedical Eng & Informatics
9. **Dynamics of the Liquor system**, Biomedical Eng & Informatics
10. **Signal proc. and image analysis of med. inform.**, Mathematics
11. **EU fp6 Sensor project**, Chemistry

# Non Invasive Diagnostics

## Ass Prof. Britta Sethson



- **Development of a combination probe for diagnosis and characterisation of:**
  - Neuropathy
  - Erythema
  - Malignant Melanoma
- **Methods:**
  - NIR spectroscopy, Skin Impedance, Digital Photography, (Laser Doppler Imaging)
  - Chemometrics
- **Development of methods for characterisation of dental materials and disturbances in the oral mucosa**
  - Titanium
  - Cu-Al Alloy
- **Methods**
  - Classical Electrochemical Techniques
  - Skin Impedance
  - Chemometrics

**In collaboration with:** Northern University Hospital, Deps of Surgery, Oncology and Odontology. SLU Rönneby.

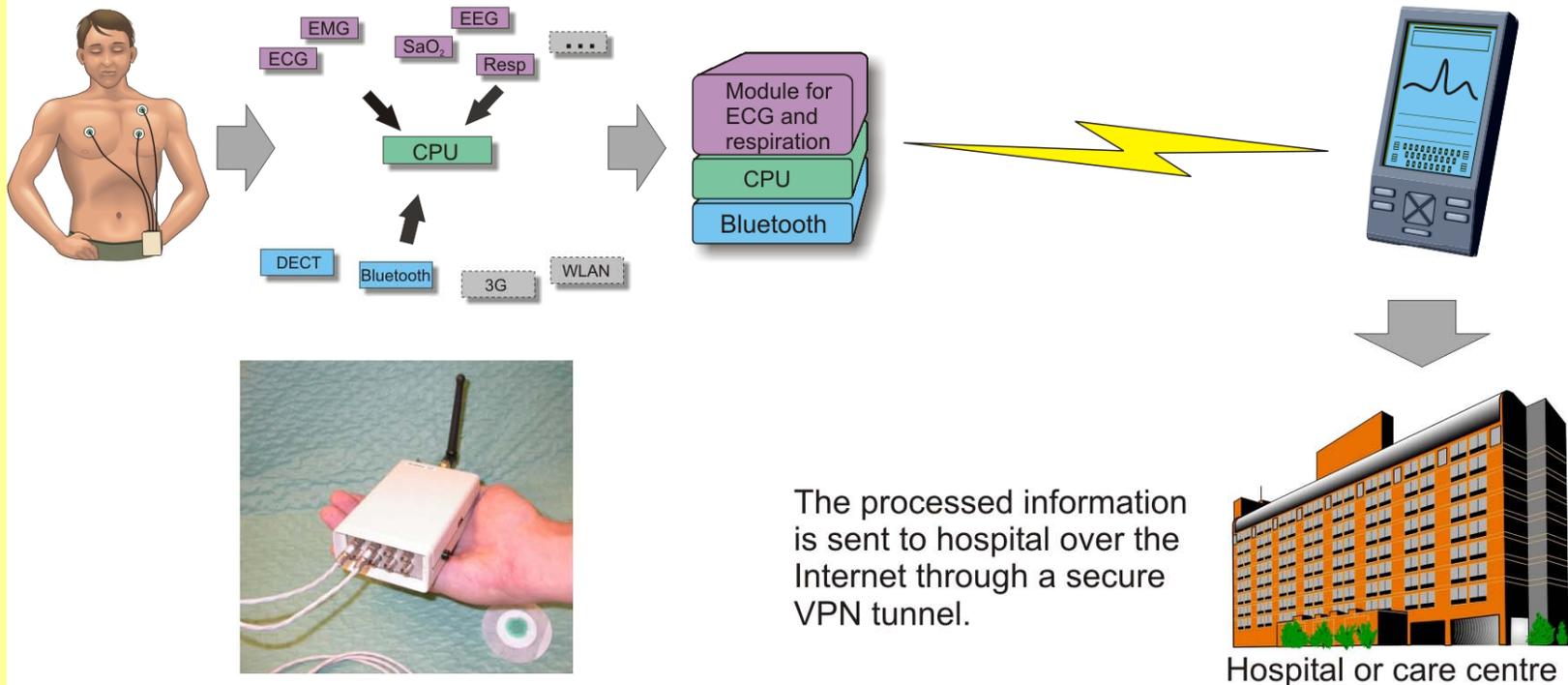
# Distance spanning application

Prof. Stefan Karlsson, MTI, NUS

Parameters are selected depending on the patient's situation. For example, respiration, oxygen saturation, ECG and surface temperature can be measured simultaneously.

Depending on distance and transfer bandwidth different digital radios can be selected, for example DECT or Bluetooth.

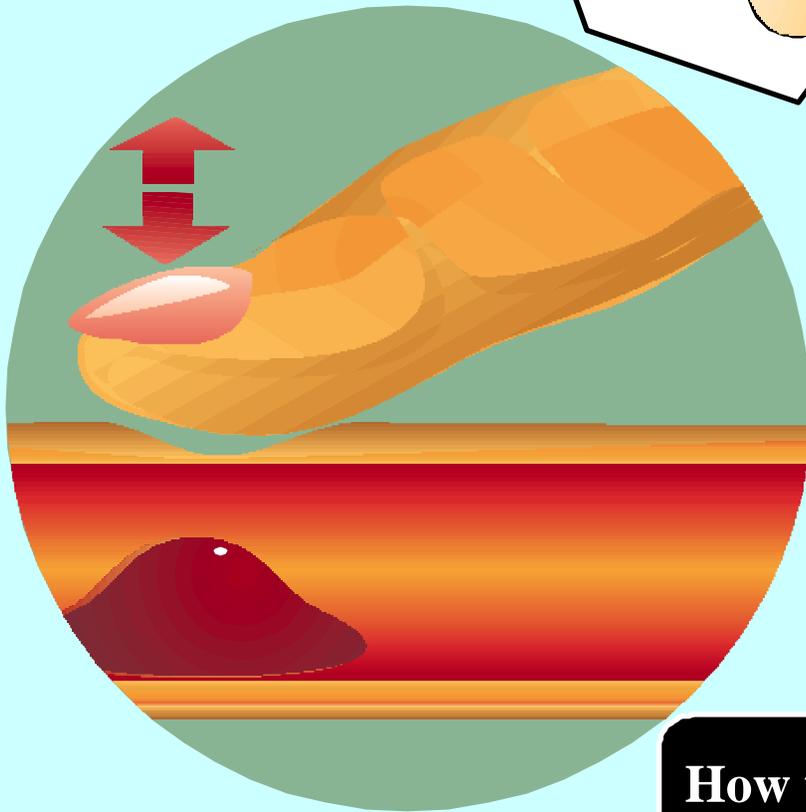
Visualization and analysis on an ordinary Windows PC or PDA.



The processed information is sent to hospital over the Internet through a secure VPN tunnel.

Hospital or care centre

# Soft or hard?



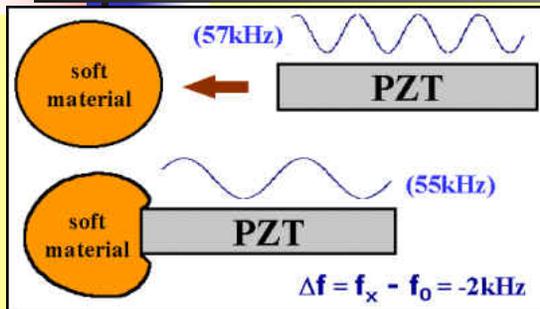
Från Omata 2005



**How to measure stiffness of human tissue?**

# Resonance sensors

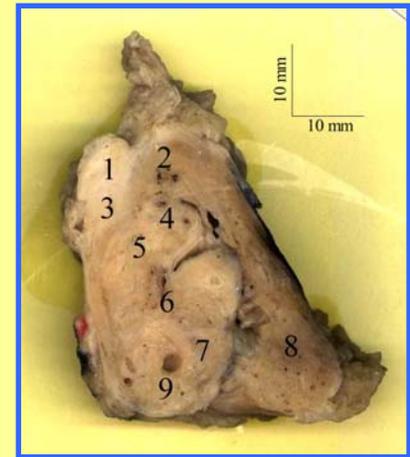
Prof Olof Lindahl TFE, UmU



- Piezoelectric sensors
- Frequency shift



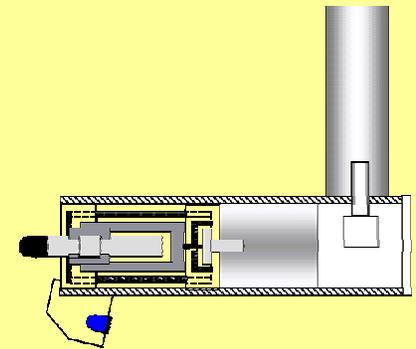
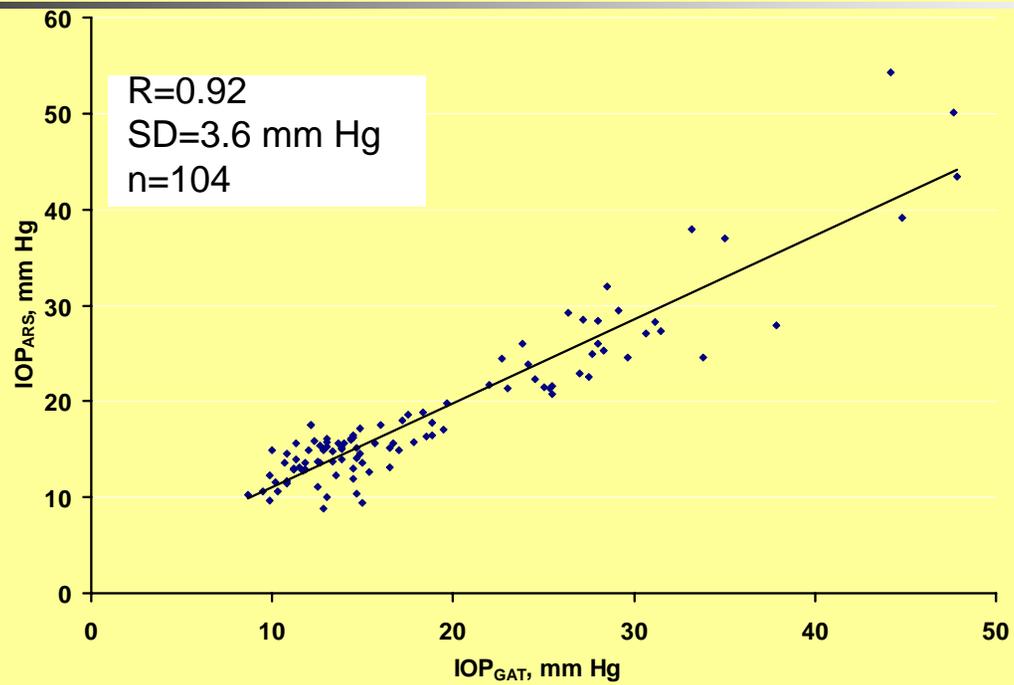
Eye pressure monitor for diagnosis of glaucoma (5% of population above 70 year.)



Detection of prostate cancer



# Clinical Study



Hallberg *et al*, *Physiological measurement*, 25, 2004

# Bioresonator Co, Ltd.

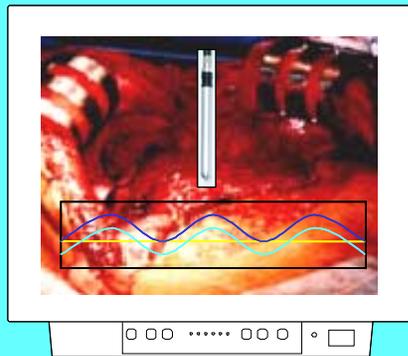


- 1999 Patent application and market analysis via Uminova
- 2000 Finances through NUTEK and LinkMed Co Ltd, formation of company, PCT-application, business plan, market plan, design.
- 2001 Cooperation agreement with researchers, university and county council. Research and "grants".
- 2002-2004 Research/ productification, risc financing via Karolinska Innovation, CE-marking, international patent, partner search, alliances.
- 2005-2006 Keeler Co Ltd

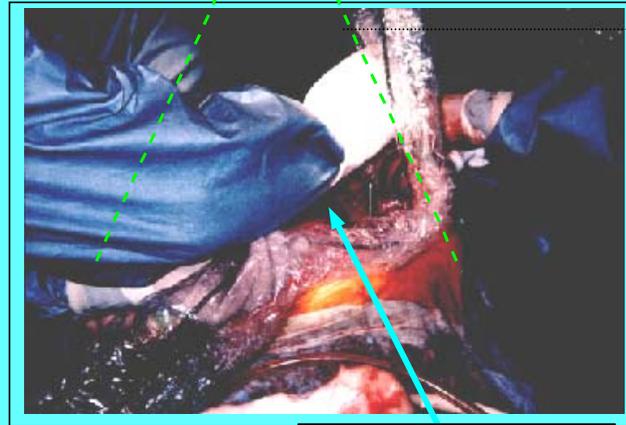
# Operating system using haptic technology



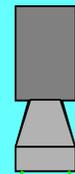
Operation



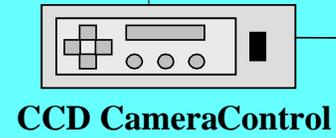
Monitor



Tactile sensor



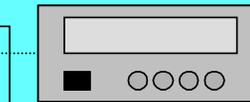
CCD Camera



CCD CameraControl

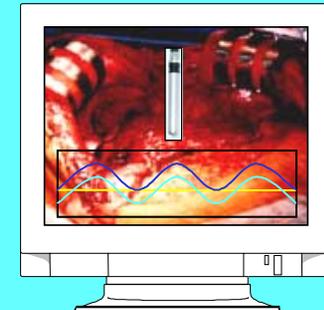


Super imposer

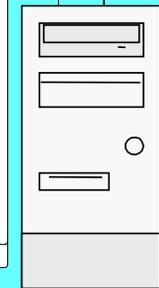


Tactile Sensor Control

I/F



Personal Computer



**Applications : liver operation/transplant, heart and heart-lung transplant, tele-surgery, and tele-medicine**

# Breast cancer checker and its applications

Home and/or office



Personal use

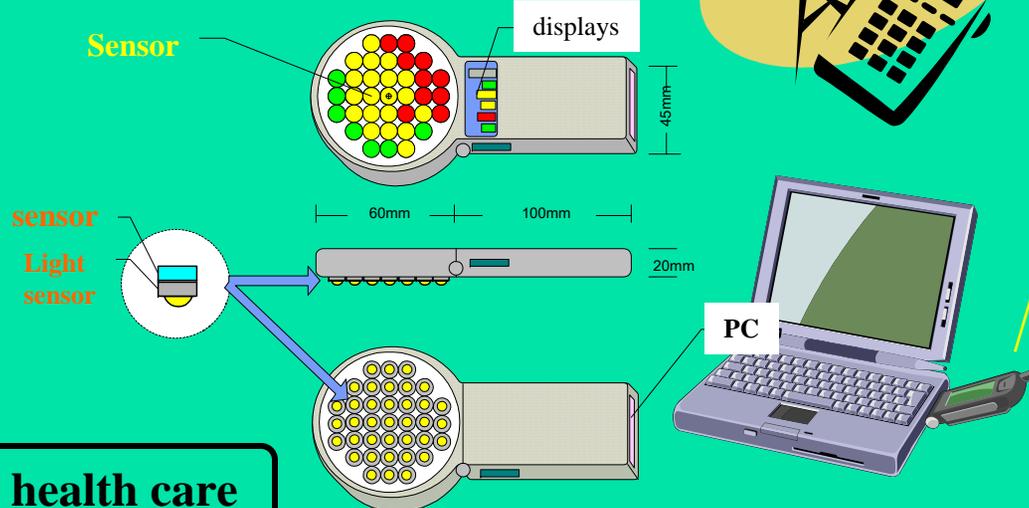
Hospital  
Clinic  
Doctor  
Mammography



Hospital

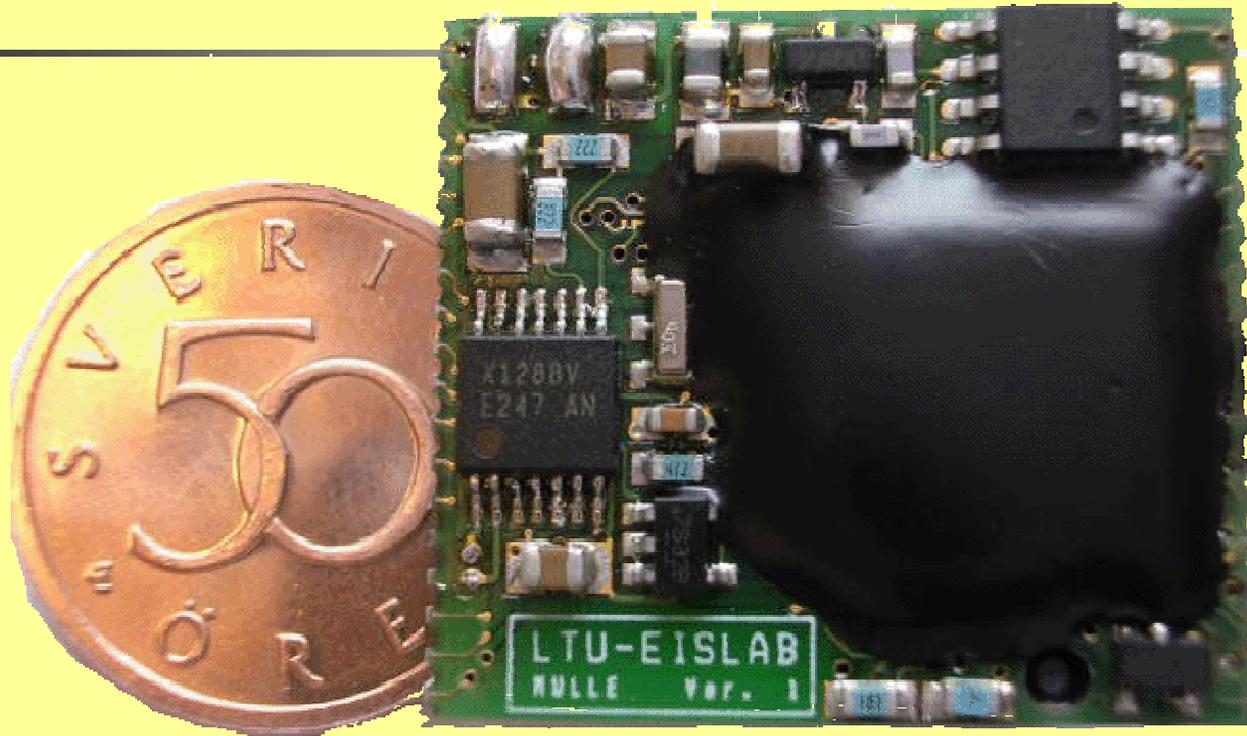
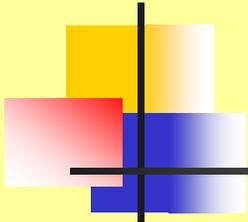


Clinic, public health care



Från Omata 2005

# The Embedded Internet Systems Laboratory or EISLAB



# Trends for the future

## MyHeart

### Mission:

*Fighting Cardio-Vascular Diseases by Preventive Lifestyle & Early Diagnosis*

**Integrated Project**  
2.3.1.11 e-health  
IST-2002-507816

**Project Manager:**  
Josef Lauter  
Philips GmbH  
Tel.: +49 241 6003 214

Start: 31.12.03  
Duration 45 Months

Budget: 33 M€  
EC contrib. 16 M€  
Swiss contrib. 3 M€

### Key words:

Biomedical clothes  
Prevention, health,  
cardio-vascular diseases



### Project Summary:

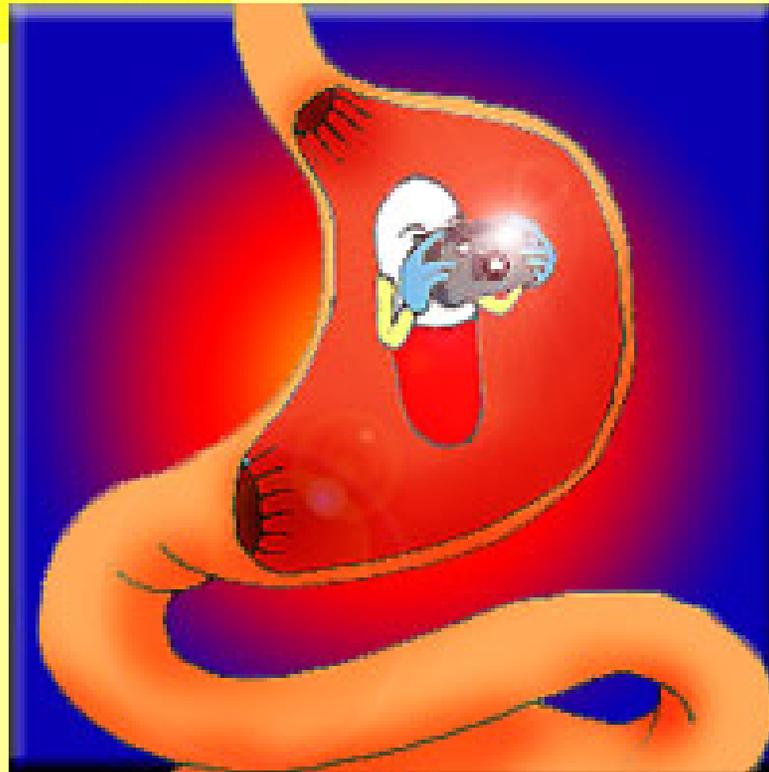
Cardio-vascular diseases (CVD) are the leading cause of death in the west. In Europe over 20% of all citizens suffer from a chronic CVD and 45% of all deaths are due to CVD. Europe spends annually hundreds billion Euros on CVD. With the upcoming aging population, it is a challenge for Europe to deliver its citizens healthcare at affordable costs.

It is commonly accepted, that a healthy and preventive lifestyle as well as early diagnosis could systematically fight the origin of CVD and save millions of live-years. The MyHeart mission is to empower citizen to fight cardio-vascular diseases by preventive lifestyle and early diagnosis.

The starting point is to gain knowledge on a citizen's actual health status. To gain this info continuous monitoring of vital signs is mandatory. The approach is therefore to integrate system solutions into functional clothes with integrated textile sensors. The combination of functional clothes and integrated electronics and process them on-body, we define as intelligent biomedical clothes. The processing consists of making diagnoses, detecting trends and react on it. Together with feedback devices, able to interact with the user as well as with professional services, the MyHeart system is formed.

This system is suitable for supporting citizens to fight major CVD risk factors and help to avoid heart attack, other acute events by personalized guidelines and giving feedback. It provides the necessary motivation the new life styles. MyHeart will demonstrate technical solutions. The outcome will open up a new mass market for the European industry and it will help prevent the development of CVD, meanwhile reduce the overall EU healthcare costs.

# The Pill Camera



# PillCam™ Capsule Endoscopy Image Atlas

Healthcare Professionals > ImageAtlas

## Submit your own PillCam™ Images

### Main Category

Select category ...

#### Normal PillCam SB Anatomy (more) →



**Small Bowel**  
Healthy small bowel.

Submitted by:  
Eitan Scapa

#### Vascular Abnormalities (more) →



**Jejunal Ulcer**  
Active jejunal ulcer suspected to be...

Submitted by:  
Dr. Pedro Menchen

#### Malabsorption (more) →



**Abnormal Jejunum**  
Duodenitis as capsule passess into the...

Submitted by:  
Zvi Fireman

#### Iatrogenic Diseases (more) →



**Radiation Injury**  
Area of jejunum showing erythema and...

Submitted by:  
R. K Farris, USA

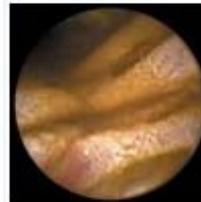
#### Esophageal/Gastric/Duodenal (more) →



**Distal Esophagus**  
Distal esophagus with edema and...

Submitted by:  
Eitan Scapa

#### Transplantation (more) →



**Transplanted Small Bowel**  
Blunted and ridge-shaped whitish villi...

Submitted by:  
Roberto De Franchis

#### Inflammatory Diseases (more) →



**Superficial Jejunal Ulcer**  
Patient with patchy areas of moderate...

Submitted by:  
Z. Fireman, Israel.

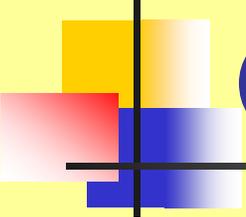
#### Miscellaneous (more) →



**Small Bowel**  
Healthy small bowel.

Submitted by:  
Eitan Scapa





# Conclusions

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- Ambient Assisted Living (AAL) for the Ageing Society  
EU fp6, including home health care
- Preventive lifestyle and high life quality
- Implantable devices (retinal- and cochlear prosthesis)
- Wireless sensor networks
- Smart sensors with low power consumption
- Distance spanning technology
- Micro- and nano sensors
- Limitations: CE-marking, FDA, Ethical committees,  
Large costs
- Triple Helix networks