BIOPATTERN – Network of Excellence

BIOPATTERN - Computational Intelligence for Biopattern Analysis in Support of eHealthcare

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Outline of talk

• The BIOPATTERN Project
  – Project information
  – Main drivers
  – Grand vision and challenges
• Concepts of biopattern analysis and bioprofilling
• ICT requirements and implications for e-Health
• The future and concluding remarks
• How to contact us
BIOPATTERN – Project information

- EU FP6, 4-year, Network of Excellence (NoE), project within the ICT for Health
- The NoE integrates the activities of 31 partners from healthcare, academia and industry to reduce fragmentation
- It brings together researchers in relevant areas – e.g. medical informatics, bioinformatics, biosignal analysis and e-delivery technology
- Partners are from 11 countries
- More details are available at: www.biopattern.org
BIOPATTERN – Main drivers

• The Data Problem – data deluge
  – Modern technology enables us to generate large volumes of biodata, e.g. from:
    • modern clinical practice
    • novel biosensors
    • genomics and proteomic
    • emerging area of ‘systems biology’
  – Limited ability to analyse and interpret the vast and complex data being generated in biomedicine.
  – New ways will be needed to represent, process and analyse such data.

• EU eHealth and Biomedical Informatics Research Agenda.
Example: Informatics in support of the next generation of brain research: Molecular Neuroscience

1. Medical Informatics (MI)
citizen, patient and population informatics

- Electronic Health Records
- Decision Support Systems
- Terminologies, ontologies
- Telemedicine
- Interoperability of systems

2. Bioinformatics/Genomics (BI)
molecular and cell informatics

- Structural Genomics
- Functional Genomics
- Proteomics
- Biochip Technologies
- Computational Biology

3. Neuroinformatics (NI)
cell to organ informatics

- Biosignal Analysis and Pattern Recognition
- Neuro Algorithms
- Neurocell Technology
- Human Computer Interfaces
- Machine Learning

Medical Sciences

Biological Sciences

Behavioral Sciences

Social Sciences

Example: Advancing into the molecular causes of diseases: Genomic Medicine

Example: integration of genomic and neuroscience databases: Neurogenomics

Biomedical Informatics - Knowledge Empowering Individual Health Care & Well-Being
BIOPATTERN – Grand vision and challenges

“To integrate co-operative research aimed at a pan-European approach to coherent and intelligent analysis of a citizen’s bioprofile; to make the analysis of this bioprofile remotely accessible to patients and clinicians; and to exploit the bioprofile information to combat major disease classes”.

• Vision is long term, but will inspire new objectives.
Meaning of biopattern & bioprofile

• **Biopattern** – basic information which provides clues about underlying clinical evidence for diagnosis and treatment.
  – A snapshot which includes features derived from data (e.g. genomics, EEG, ECG, imaging etc);
  – Often used for diagnosis and short-term patient monitoring.

• **Bioprofile** – personal “fingerprint” that combines a person’s current and past bio-history and future prognosis.
  – Combines data, biopatterns, analysis and predictions of future or likely susceptibility to diseases.

• Focus – to see how far we can realise the vision of a citizen’s bioprofile; to identify barriers to the vision, to examine ways in which bioprofile could be exploited for healthcare.
Objectives of the NoE

– Integration – to tackle and reduce fragmentation in existing research capacities (31 partners in the NoE);
– ‘Virtual Research Institute’ – to create a new research community;
– Roadmap – to identify gaps in knowledge, key challenges and to initiate joint activities to address them;
– New opportunity – to identify how bioprofiles could be exploited for healthcare, such as disease prevention, diagnosis and treatment;
– Accessibility and spreading excellence – to make the results and their applications widely accessible; to spread excellence within and beyond the network partners.
Thematic organisation of project

Special Interest Groups

Data Acquisition
Analysis
Evaluation
E-Delivery
Cancer
Brain diseases
Bioinformatics
Others

Management, Dissemination and Exploitation
Subprojects - creating the basis for integration

• Partners activities have been organised into subprojects as a key step towards integration

• Each partner contributes to specific subprojects based on partner’s:
  – interests
  – expertise and
  – capacity to undertake agreed research activities.
This way, we strengthen complementarities and mutual specialisation.

• Subprojects create focal points around which groups of experts can gather to undertake clearly defined joint activities and to exchange ideas. This should facilitate the exchange of knowledge and integration.

• It should create the basis for, small, co-ordinated 'virtual research groups', with clearly defined objectives which are directly linked to the goals of the NoE.
Some of the subprojects

Subprojects (some linked to other major EU projects) include:

- A framework for bioprofiling in brain diseases
- Perinatal brain damage, identification of risk situations and prevention
- Early detection and progression of dementia
- Epilepsy assessment
- Brain tumour diagnosis
- Breast cancer bioinformatics
- Ocular melanoma
- Ovarian cancer assessment
- Oncological diseases of the blood
- A framework for bioprofiling in cancer diseases
- New and emerging e-delivery technologies
- Evaluation and benchmarking
- Standardisation and protocols for data acquisition.
Relationship between DoW deliverables and subprojects
Remarks

• Some subprojects are designed to integrate and co-ordinate activities. Others to look into key emerging areas (e.g. grid computing) or to tackle specific technical or clinical problems.

• The benefits of subprojects include that they:
  – enable partners to contribute to the Grand Vision, based on their interests, expertise and capacity to contribute;
  – serve as an important mechanism for partners to work together and to develop new ideas;
  – provide lead partners the opportunity to make the best use of available resources to advance knowledge in an integrated way;
  – enable the Exec Team to restructure and re-orientate partners’ research activities to facilitate integration.
Concepts of biopattern analysis and bioprofiling
– time line for brain diseases

Conception (Genealogy; Maternal Health; Environment)

Birth Obstetric Data (HR; ECG; BG)

Neonatal Assessment (EEG; Other) + STEM cell sample; blood samples

Childhood and adolescence
Developmental Data (EEG; EP; psychometric tests)

Childhood Health Records & Demographics:
{Recordings from operative Procedures
Weight; Height; Diet; Activity; Medication;
Environment; Social-economic data; Injuries}

Early adult years
(Onset of personality disorders such as Schizophrenia)

Post 65 - At risk group for degenerative disease & cancer
EEG, MRI

Death Certificate & Post mortem
Main research challenges and goals

• Biopattern and bioprofile analysis – an aspect of this will involve, observing changes in biomarkers derived from analysis of biodata (MI/BI).

• For long term (e.g. months or years) assessments
  – the markers may be used, e.g. for early detection of the onset of diseases (e.g. dementia);
  – the data and computing resources may be located at multiple centres.

• For short term (e.g. minutes, hours or days) assessments
  – the markers may be used for early detection of onset of events (e.g. adverse events during labour, epileptic seizure, key changes in the depth of anaesthesia during surgery);
  – real-time, nonlinear processing may be necessary to derive the markers so that timely action would be taken.
Subject-specific bioprofile analysis – hypothetical trends in biomarker/index

Index

Onset of disease

Index is abnormal

Normal spread

Time
ICT requirements and key features

• Conceptually, we wish to ‘bioprofile from birth to death’
• Bioprofiles will be dynamic, large and in databases geographically distributed:
  − Mobility of the citizen
  − Bioprofile databases are located in different centres/countries.
• Online access, analysis, remote diagnosis, prognosis and decision support capability will be needed.
A possible grid-based solution

- Bioprofile database
- Dementia database
- Healthcare unit
- U.K.
- USA
- Germany
- Italy
- France
- Super computer
- Computer resources

Internet

Dementia research centre
Implications of ICT and e-Healthcare

- GP check-up
- Specialist consultation exam
- Surgery or remote surgery
- Online enquire or remote consultancy
- Biosignal and imaging measure
- Genomic and biochemical measure
- Automated analysis/diagnosis
- Computing resources
- Databases
- Network
First 18 months - some performance indicators

- A large number of people integrated into the project (27% female).
- Strong commitment from partners (about 30% own contributions).
- Successfully completed first year deliverables (19 in total).
- Organised or contributed to many events (workshops, training events and conferences).
- Developed co-operative links with other projects (e.g. eTumour, GIMEMA), and major bodies (e.g. the IEE, ÎPEM).
- Established a Scientific Advisory Board (positive feedback so far).
- A large number of publications (43 journal, 57 int. conference, 8 edited books/proposals). Several joint publications involving 2 or more partners.
Next steps - proof of MI/BI concept

• How do we exploit and what do we gain from BI?

Decision with MI
Decision with BI

Fusion of Decisions

Decision with MI&BI data; fusion at data level

Comparison of approaches

• Substantiate relevance and evaluate potential
CIMED’2005
The BIOPATTERN Conference

• Venue:
  – Lisbon, Costa da Caparica, 29 June – 1st July 2005

• Papers submitted:
  – 69 papers received so far

• Several BIOPATTERN workshops and meetings

www.uninova.pt/cimed2005
Concluding remarks

• We have made significant progress towards achieving the project objectives in the first Period.
• Partners find the project very interesting and challenging and are strongly committed.
• BIOPATTERN provides an important framework for partners with similar interests and complementary expertise to work together to develop new ideas. The Commission should be commended for this.
How to contact us

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