

# TEMU 2008 - Special Session

## Personalised Medicine: Current Trends and Scientific Challenges

Doctors have long known that people differ in susceptibility to disease and response to medicines. But, with little guidance for understanding and adjusting to individual differences, treatments developed have generally been standardized for the many, rather than the few.

### How will genetic science change how medicines are made?

Human DNA contains more than 20,000 genes, all of which are stored in our cells' nuclei. Each person's overall blueprint is basically the same, made up of about 3 billion "letters" of code, each letter corresponding to a chemical subunit of the DNA molecule. But subtle variants in about 1 percent of our DNA — often the result of just a single chemical letter being different — give humans their individual identities.

Beyond physical appearance, genes give rise to distinct chemistries in various realms of the body and brain. Such differences sometimes predispose people to particular diseases, and some dramatically affect the way a person will respond to medical treatments.

Ideally, doctors would be able to diagnose and treat people based on those individual differences, a concept commonly referred to as "personalized medicine." At its core, personalized medicine is about combining genetic information with clinical data to optimally tailor drugs and doses to meet the unique needs of an individual patient. Eventually, personalized medicine will be further informed by detailed understanding of the body's distinct repertoire of proteins (proteomics) and complete catalogue of biochemical reactions (metabolomics).

"Personalized medicine," writes L. Lesko of the U.S. Food and Drug Administration, "can be viewed . . . as a comprehensive, prospective approach to preventing, diagnosing, treating, and monitoring disease in ways that achieve optimal individual health-care decisions." [Lesko p. 809]

Already, some aspects of the personalized medicine approach are in place for some diseases. Variants of a gene linked to breast cancer, for instance, can foretell a woman's likely susceptibility to developing or surviving the disease, a helpful guide for taking preventive measures. In certain cases of breast cancer, the production of a particular protein signals a more aggressive form of the disease that might be more effectively controlled with the drug Herceptin.

Still, multiple challenges remain in the quest for a widespread effective system of personalized medicine. They will be addressed by the collaborative efforts of researchers from many disciplines, from geneticists to clinical specialists to computer scientists and engineers.

### What prevents us from creating personalized medicines (treatments) now?

One engineering challenge is developing better systems to rapidly assess a patient's genetic profile; another is collecting and managing massive amounts of data on individual patients; and yet another is the need to create inexpensive and rapid diagnostic devices such as gene chips and sensors able to detect minute amounts of chemicals in the blood.

In addition, improved systems are necessary to find effective and safe drugs that can exploit the new knowledge of differences in individuals. New methods are also needed for delivering personalized drugs quickly and efficiently to the site in the body

where the disease is localized. For instance, researchers are exploring ways to engineer nanoparticles that are capable of delivering a drug to its target in the body while evading the body's natural immune response. Such nanoparticles could be designed to be sensitive to the body's internal conditions, and therefore could, for example, release insulin only when the blood's glucose concentration is high.

### **The role of Information and Communication Technologies**

Information and Communication technology is playing an increasingly critical role in health and life sciences research due to the profound expansion in the scope of research projects in the post-genomic age. Robust data management and analysis systems are becoming essential enablers.

Many efforts are underway to develop standards and technologies to promote large-scale integration of publicly-funded systems and databases including infrastructure developed for individual studies. Predicted benefits include an enhanced ability to conduct meta-analyses, an increase in the usable lifespan of data, a funding agency-wide reduction in the total cost of IT infrastructure, and an increased opportunity for the development of third party software tools.

The session will bring together scientists from medicine, computer science, engineering and life sciences to discuss future challenges and directions. The session will critically examine efforts towards developing publicly-accessible interoperable and distributed production systems in the health and life sciences via ontologies, formal metadata, service oriented architectures, and grid computing models with a focus on the results of several flag-ship international projects.

### **Topics of Interest**

The workshop is seeking original research papers presenting innovative solutions applied to life sciences applications.

Specifically we are interested in the following topics:

- complex analysis and simulation tasks from emerging research fields like systems biology
- computational proteomics and biomedical image analysis
- biomedical simulation
- data management, analysis and integration
- workflow modelling
- distributed bioinformatics/biomedical applications
- high performance computing with application in the health and life sciences
- service orientation
- eScience applications in life sciences

### **References**

1. EP. Bottinger, "Foundations, Promises, and Uncertainties of Personalized Medicine," *Mount Sinai Journal of Medicine* 74 (2007), pp. 15 -21.
2. M. Dietel and C. Sers, "Personalized medicine and development of targeted therapies: The upcoming challenge for diagnostic molecular pathology. A review," *Virchows Arch* 448 (2006), pp. 744 -755.
3. W. Kalow, "Pharmacogenetics and pharmacogenomics: Origin, status, and the hope for personalized medicine," *The Pharmacogenomics Journal* 6 (2006), pp. 162-165. doi:10.1038/sj.tpj.6500361
4. L.J. Lesko, "Personalized Medicine: Elusive Dream or Imminent Reality?" *Clinical Pharmacology & Therapeutics* 81 (June 2007), pp. 807 -816.

5. M. West et al., "Embracing the complexity of genomic data for personalized medicine," *Genome Research* 16 (2006), pp. 559-566.

### **Speakers**

The speakers in the session will be both invited speakers and peer reviewed papers. We invite original contributions that are not submitted concurrently to another conference. The submitted paper must be formatted according to the rules of LNCS (for formatting information see Information for LNCS Authors -

<http://www.springeronline.com/sgw/cda/frontpage/0,10735,5-164-2-72376-0,00.html>).

Submission implies the willingness of at least one of the authors to register and present the paper.

PDF and source versions of your paper must be submitted electronically to one of the organisers. Please, note that papers must not exceed ten pages in length, when typeset using the LNCS format. A paper without figures can be around 5500 words maximally.

### **Important Dates**

|                             |                |
|-----------------------------|----------------|
| Full papers submission:     | April 30, 2008 |
| Notification of acceptance: | May 16, 2008   |
| Camera ready papers:        | June 18, 2008  |

### **Session Co-organisers**

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