



Clinical proteomics in future health care

Prof. Geert Baggerman

Email: geert.Baggerman@vito.be



CENTRE FOR PROTEOMICS

.be

What is proteomics?

Proteins = chains of amino acids that perform much of life's function. The sequence of amino acids is **encoded in the genes**

Proteome = set of all proteins in a cell

Proteomics = study of the structure & function of proteins

More exact: **Proteomics** represents the effort to establish the identities, quantities, structures, and biochemical and cellular functions of all proteins in an organism, organ, or organelle, and how these properties vary in space, time, or physiological state.

Why study the proteome?

- Proteins represent the actual functional molecules in the cell.
- Differences in phenotype are a result of differences in protein expression
- When mutations occur in the DNA, it is the proteins that are ultimately affected.
- Drugs, when they have beneficial effects, do so by interacting with proteins.

Why study the proteome?

- Proteins represent the actual functional molecules in the cell.
- Differences in phenotype are a result of differences in protein expression
- When mutations occur in the DNA, it is the proteins that are ultimately affected.
- Drugs, when they have beneficial effects, do so by interacting with proteins.

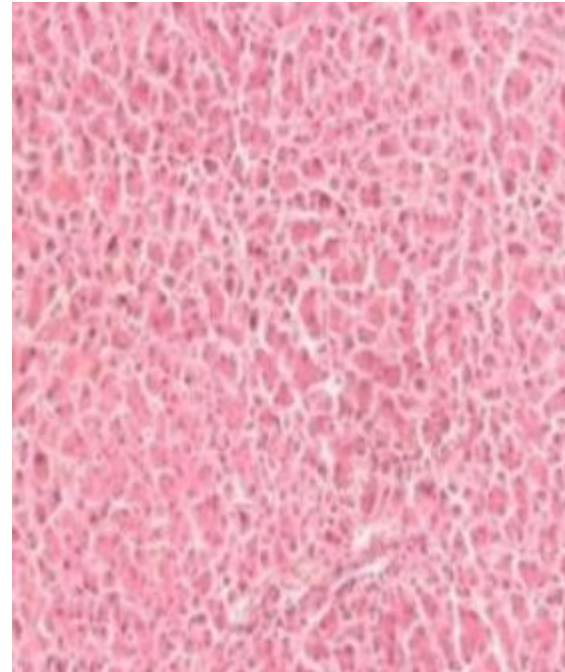
- Same Genome, different proteome



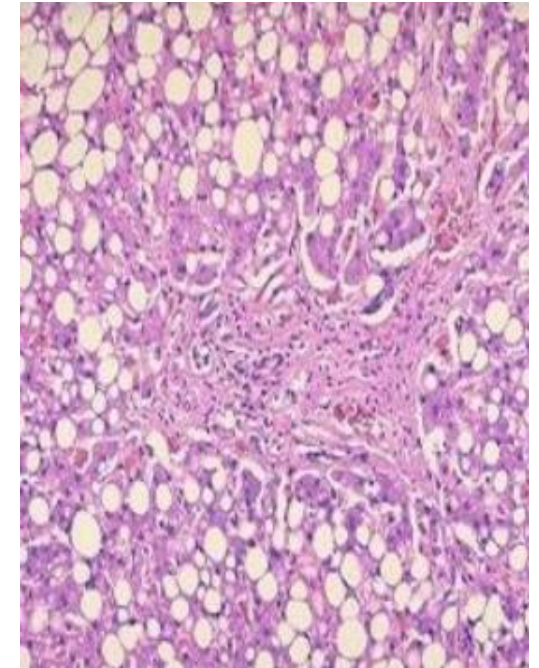
Why study the proteome?

- Proteins represent the actual functional molecules in the cell.
- Differences in phenotype are a result of differences in protein expression
- When mutations occur in the DNA, it is the proteins that are ultimately affected.
- Drugs, when they have beneficial effects, do so by interacting with proteins.

- Same Genome, different proteome



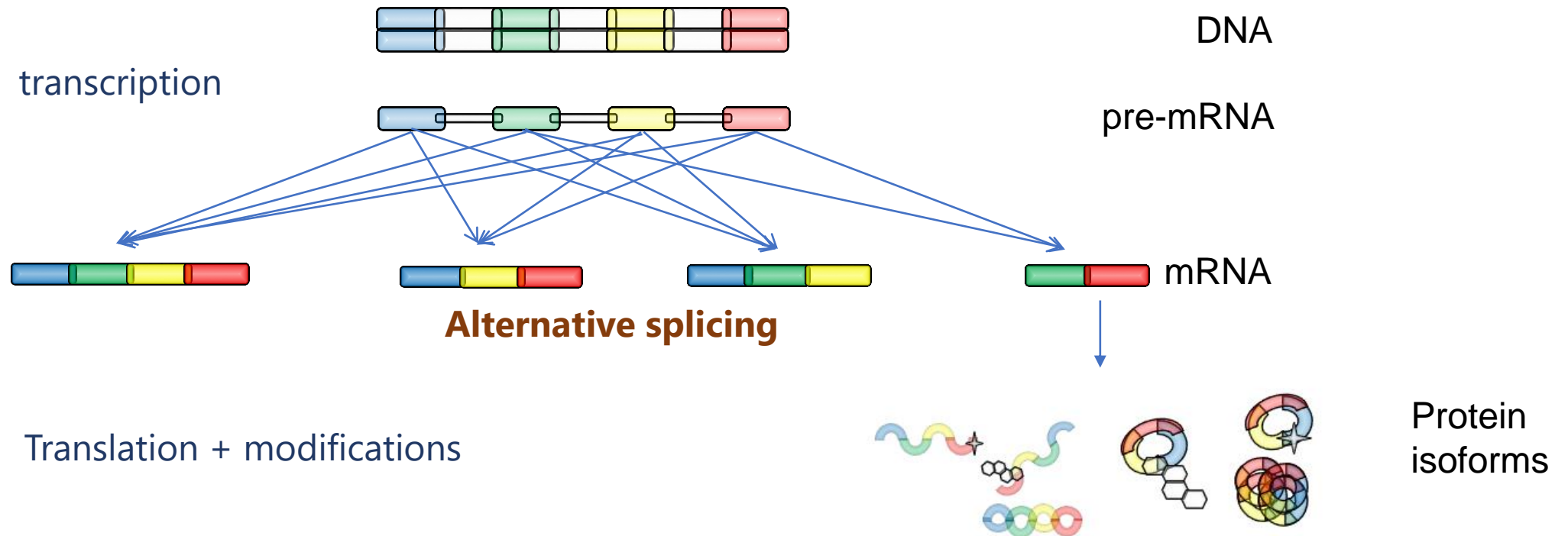
Healthy Liver



Fatty Liver

From Genome to Proteome

The proteome is very complex! A gene can give rise to a “cloud” of translation products. It is hard to predict the exact sequence, structure and modification states of an eventual protein product.

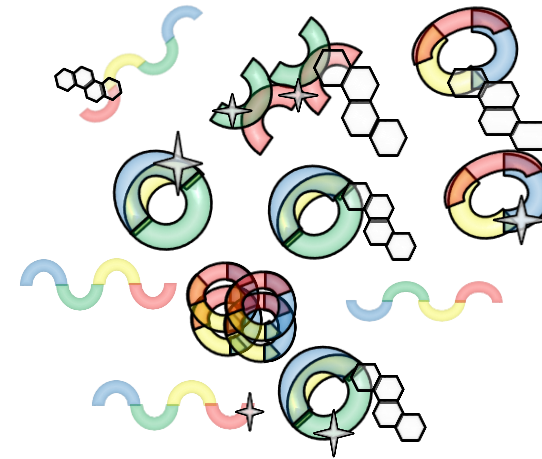
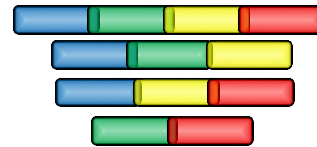
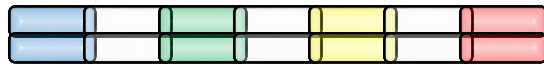


From Genome to Proteome

Genome
 $2,3 \times 10^4$

Transcriptome
 $>10^6$

Proteome
 $>10^8$



DNA tells what is possible

RNA tells what is likely

Proteins tell what is Happening

Proteomics

Part of Life Sciences

A true multidiscipline science requiring high expertise

- Protein chemistry -> including antibody chemistry
- Mass spectrometry
- Genomics
- Bioinformatics Proteomics
- Computer science
- Separation science

Current techniques allow analysis of thousands of proteins in 1 hour -> **high throughput analysis**

Proteomics in health research

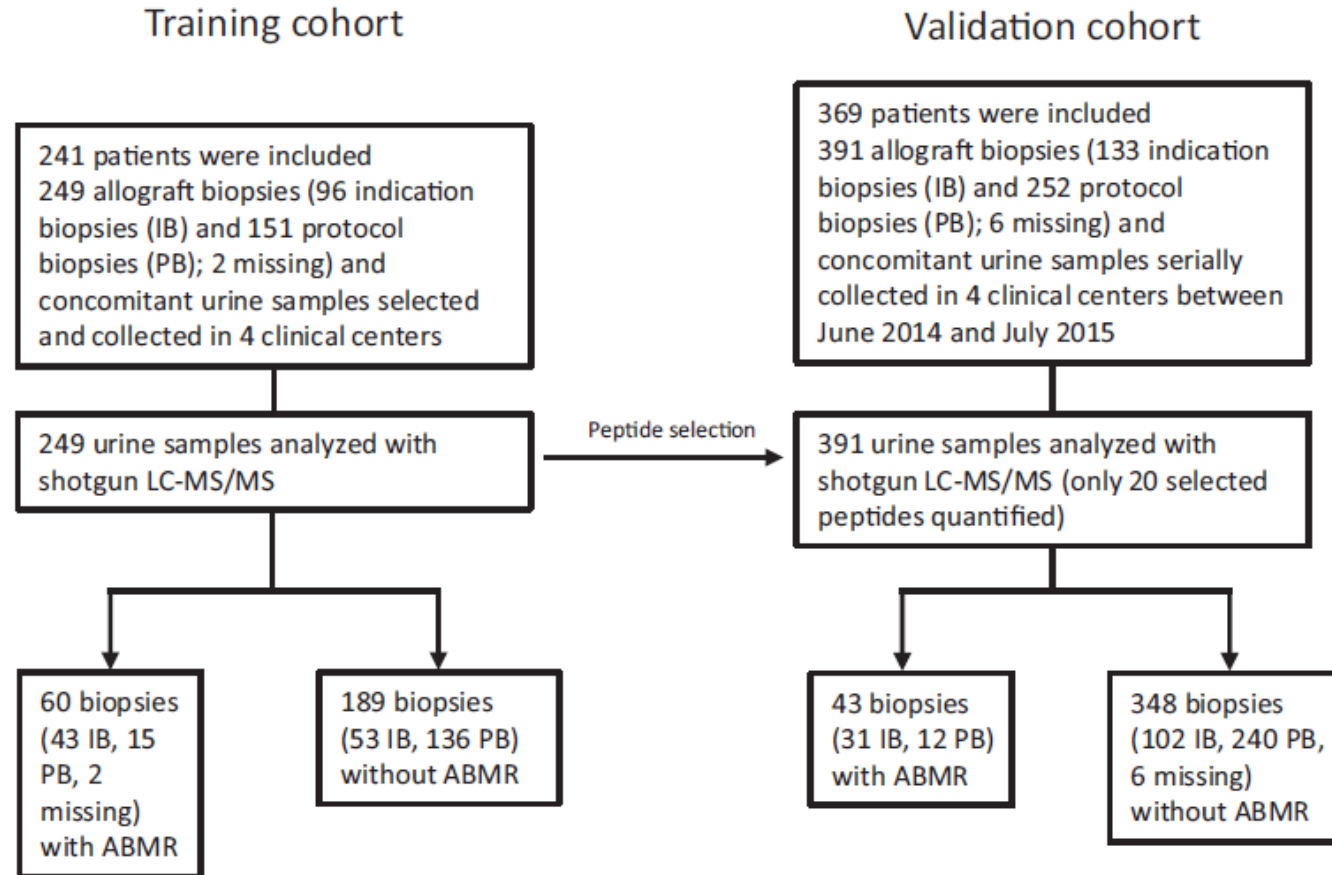
- General goal:
 - Better understanding of genesis and progression of disease
- Clinical goals:
 - Early detection of disease using BIOMARKERS
 - Identification of potential THERAPEUTIC TARGETS
 - Efficient selection of therapy (PERSONALISED MEDICINE)

Proteomics = multimarker analysis

- **Single biomarker assay: current applications**
 - Confirmation of diagnosis
 - Limited monitoring or detection
- **Multimarker (proteomics) further applications:**
 - Early detection of disease
 - Correct diagnosis
 - Staging/severity assessment
 - Patient stratification/therapy selection
 - Prognosis
 - Monitoring of treatment respons
 - ...

In order to unlock the full potential of proteomics in clinical practice we need **large data sets**

Example: Urinary biomarker search for ABM rejection transplanted kidney.



Mertens I, et al. Kidney Int Rep. 2020 Jun 29;5(9):1448-1458.

In order to unlock the full potential of proteomics in clinical practice we need **large data sets**







Important issue: Data safety and privacy



Opinion

Beyond Genes: Re-Identifiability of Proteomic Data and Its Implications for Personalized Medicine

Kurt Boonen^{1,2,*} , **Kristien Hens**³ , **Gerben Menschaert**⁴ , **Geert Baggerman**^{1,2},
Dirk Valkenburg⁵ and **Gokhan Ertaylan**^{1,*} 

¹ VITO Health, Boeretang 200, Mol 2400, Belgium

² Centre for Proteomics, University of Antwerpen, Antwerp 2020, Belgium

³ Department of Philosophy, University of Antwerp, Antwerp 2000 & Institute of Philosophy, KU Leuven, Leuven 3000, Belgium

⁴ Biobix, Department of Data Analysis and Mathematical Modelling, Ghent University, Ghent 9000, Belgium

⁵ Hasselt University, Hasselt 3500, Belgium

* Correspondence: Kurt.Boonen@vito.be (K.B.); Gokhan.Ertaylan@vito.be (G.E.)