

# New teaching tools for new epidemiologists

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### Background

Molecular epidemiology is moving from an era of single marker studies to omics driven population based studies.

The reductionist approach that most epidemiologists are being taught is failing with the introduction of large-scale omics measurements in population studies.

This does not imply, however, that basic epidemiological principles no longer hold.

Basic concepts such as confounding, interaction, selection of the population and measurement error are still important to consider.

They can bias the results of molecular epidemiology studies just as they do traditional epidemiology studies, and they are often not addressed adequately in many of the current population-based studies incorporating omics measurements.

How can teaching in molecular epidemiology advance the field?

### Teaching molecular epidemiology

Teaching those involved in molecular epidemiology is necessary.

New teaching tools need to be developed in this rapidly changing and complex area of research.

### Interdisciplinary

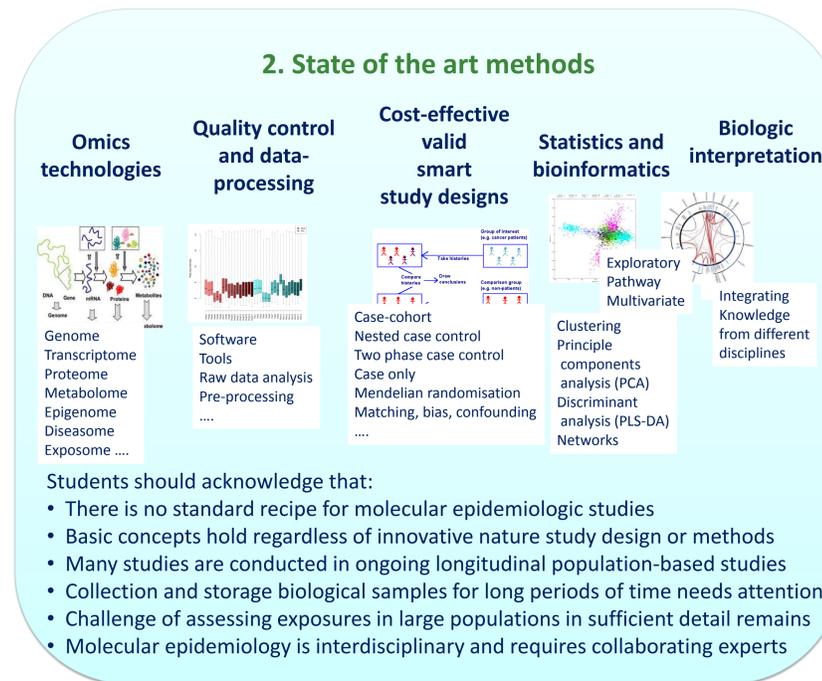
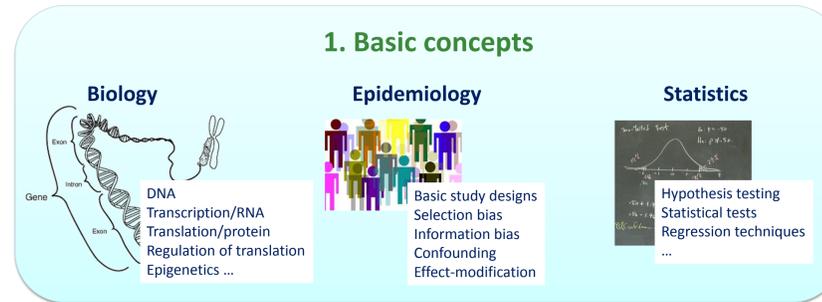
When introducing omics in population studies, interdisciplinary collaboration is necessary to ensure valid results. Scientists from multiple disciplines need to understand each others languages and techniques.

This has consequences for training in molecular epidemiology with respect to:

- teaching staff  
multidisciplinary teams are needed in teaching molecular epidemiology
- students  
students coming from different areas of research such as pathology, molecular biology, genetics, analytical chemistry, statistics, bioinformatics, general public health, and traditional epidemiology are seeking training in molecular epidemiology, therefore the teaching needs to be adapted to these diverse backgrounds
- format of the teaching
  - three-level approach
  - problem-based learning

We propose the approach outlined in the boxes

### Three level approach



### Problem-based learning (PBL)

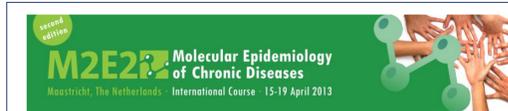
**Constructive learning:** activation of prior knowledge

**Self-regulated learning:** students have active role

**Contextual learning:** acquiring knowledge in the context of multiple disciplines

**Collaborative learning:** deep interactions in groups around complex problems

PBL is an ideal approach to learning for complex interdisciplinary fields



Both molecular epidemiologic research and teaching are by definition a collaborative effort.

The Maastricht Molecular Epidemiology Group (M2E2) has developed an international course "Molecular epidemiology of chronic diseases" which is a collaborative effort between scientists from multiple areas of research.

Expert	Institute	Expertise
Prof. dr. Paolo Vineis	Imperial College London, UK	Molecular epidemiology Environmental epidemiology
Prof. dr. Paolo Bonassi	IRCCS San Raffaele Pisana Rome, IT	Environmental epidemiology Molecular epidemiology
Prof. dr. Kristel van Steen	Univ. of Liège Liège, BE	Biostatistics Molecular biology
Prof. dr. Tomasz Burzykowski	I-BioStat, Hasselt Univ. Hasselt, BE	Biostatistics
Prof. dr. Angela Brand	Inst. Public Health Genomics, Maastricht Univ. Maastricht, NL	Public Health Genomics
Dr. Theo de Kok	Dept. Toxicogenomics, Maastricht Univ. Maastricht, NL	Toxicogenomics
Dr. Roger Godschalk	Dept. Toxicology, Maastricht Univ. Maastricht, NL	Toxicology
Dr. Lars Eijssen	Dept. Biostatistics, Maastricht Univ. Maastricht, NL	Bioinformatics Nutrigenomics
Dr. Valeria Limapassos	Dept. Methodology & Statistics, Maastricht Univ. Maastricht, NL	Statistics Biology
Dr. Rachel Cavill	Dept. Toxicogenomics, Maastricht Univ. Maastricht, NL	Bioinformatics Molecular biology
Dr. Ilja Arts	Dept. Epidemiology, Maastricht Univ. Maastricht, NL	Molecular epidemiology Metabolic profiling
Prof. dr. Matty Weijnenberg	Dept. Epidemiology, Maastricht Univ. Maastricht, NL	Molecular epidemiology Cancer epidemiology Nutritional epidemiology



### Conclusion

Training tools characterized by interdisciplinarity, and a multi-level and problem-based learning approach will shape the molecular epidemiologists of the future.