Het exposoom en arbeidsgerelateerde gezondheid

Roel Vermeulen, PhD
IRAS, Environmental Epidemiology Division
Utrecht University, the Netherlands

Julius Center, Health Sciences and Primary Care
University Medical Center Utrecht, The Netherlands

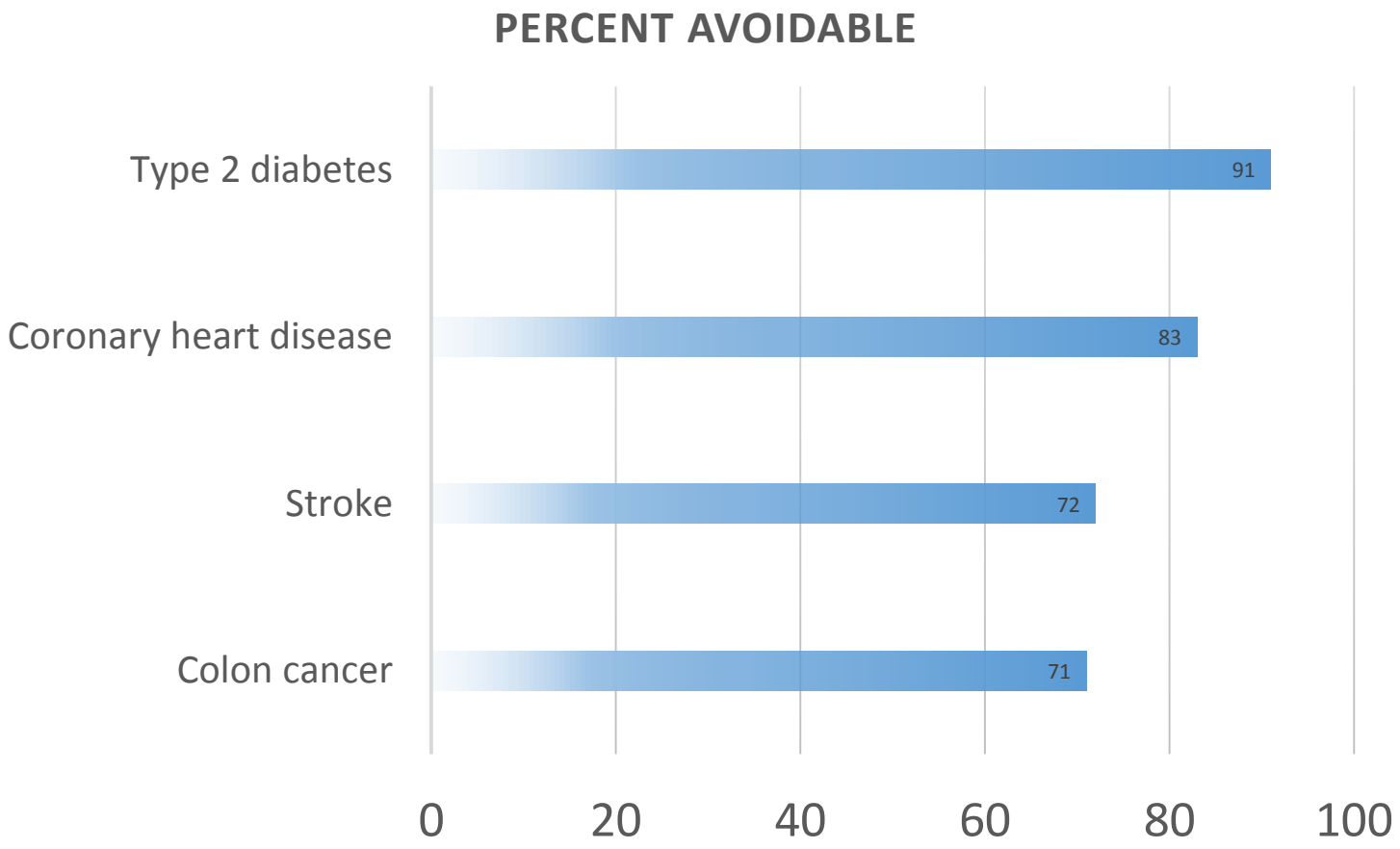
Imperial College London, School of Public Health, London, UK

Opzet

- Hoe belangrijk zijn milieu-blootstellingen?
- Introductie van het Exposoom
- Aantal voorbeelden
- Uitdagingen en toekomst perspectief

Milieu: Alles dat niet genetisch is inclusief voeding, levensstijl, woon en werkomgeving, etc.

Chronic diseases are primarily environmental in origin



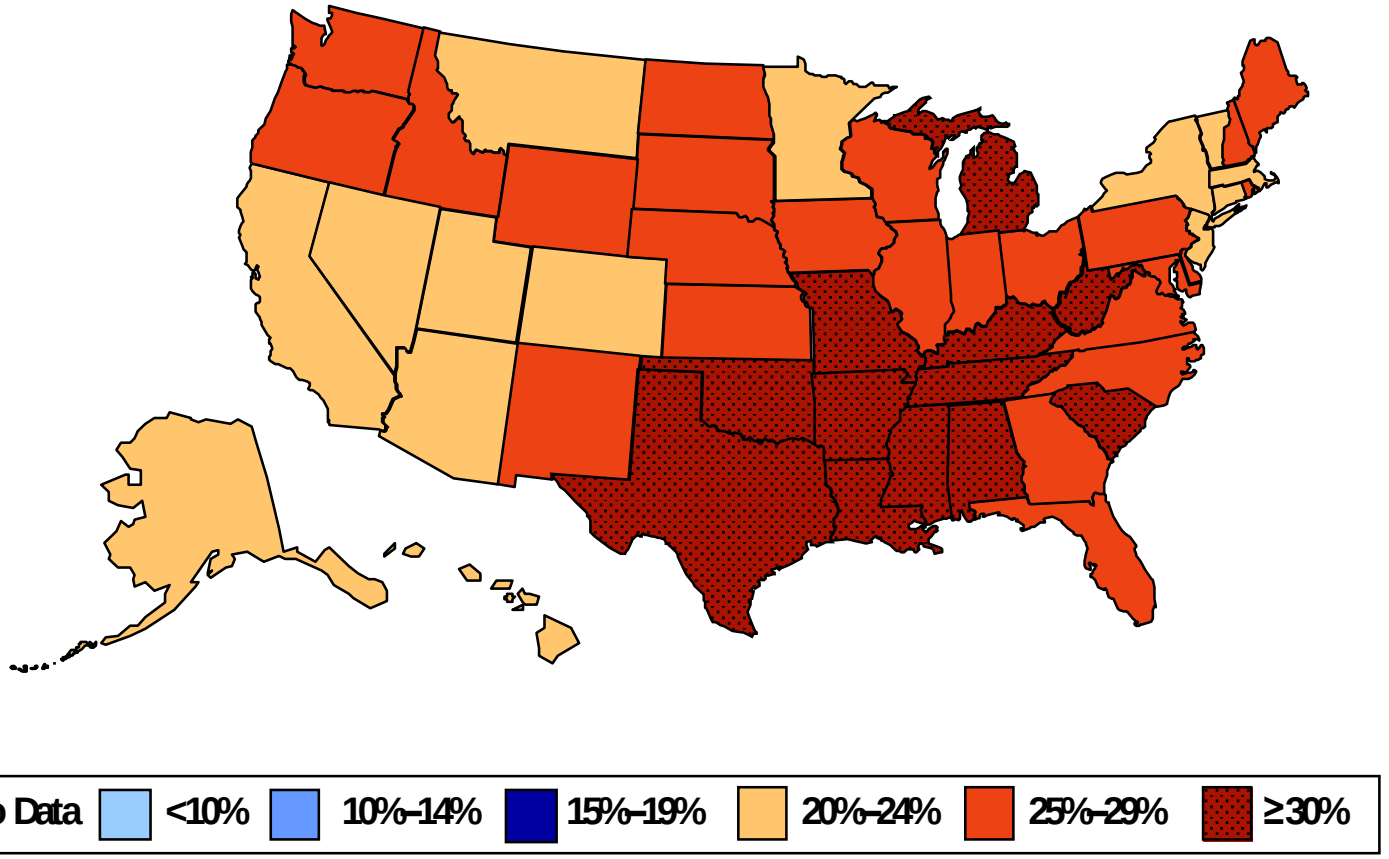
Universiteit Utrecht

Willett, 2002, Science

Obesity Trends* Among U.S. Adults

BRFSS, 2010

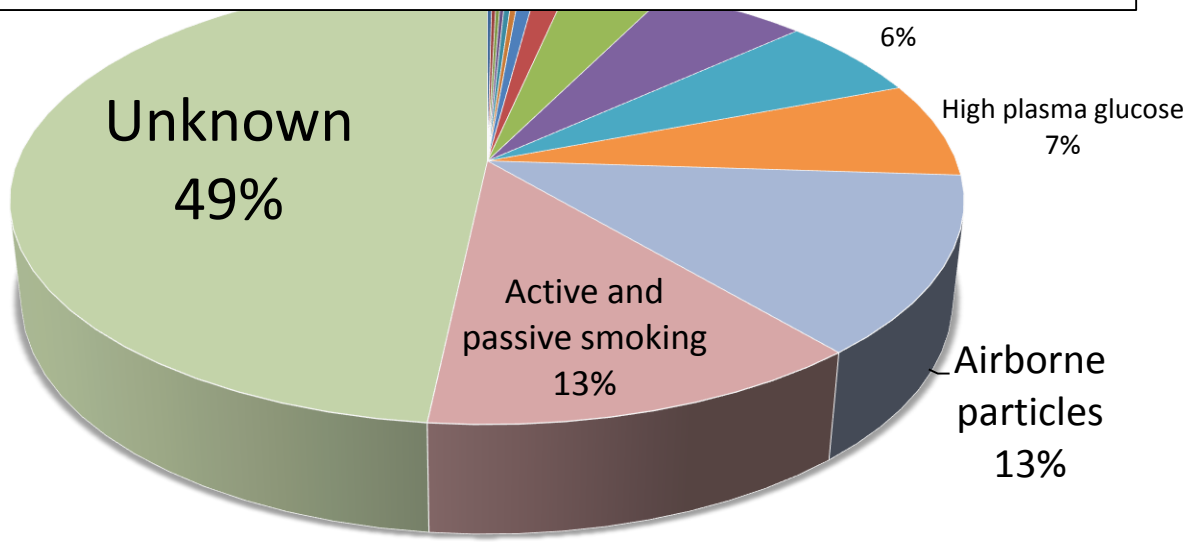
(* BMI ≥ 30, or ~ 30 lbs. overweight for 5' 4" person)



Source: Behavioral Risk Factor Surveillance System, CDC.

What do we know of these environmental risks?

1. Current risks underestimated
   - Measurement error
   - In appropriate risk models
2. Unknown risks
   - Nature of risks are different
   - Limitations in investigative tools
3. Stochastic

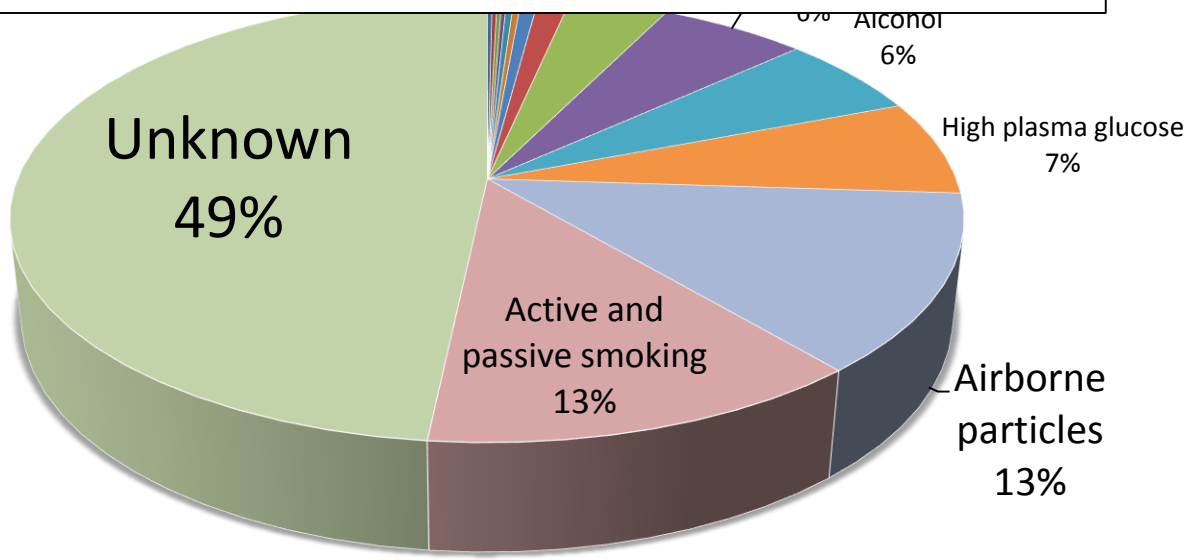


Rappaport et al., 2014 based on Lim et al., 2012

Universiteit Utrecht

Why do we need new investigative tools?

1. Current risks underestimated
   - Measurement error
   - In appropriate risk models
2. Unknown risks
   - Nature of risks are different
   - Limitations in investigative tools
3. Stochastic

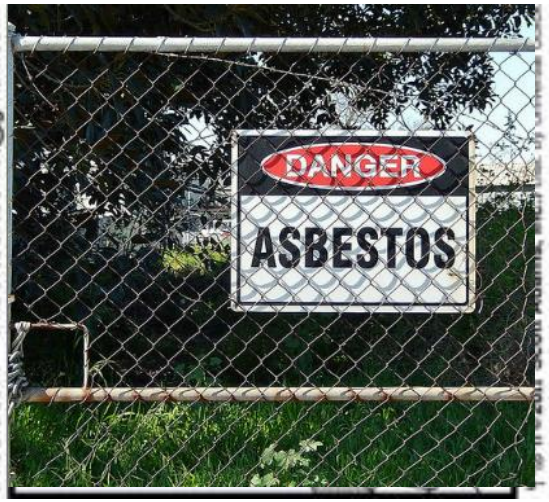


Rappaport et al., 2014 based on Lim et al., 2012

Universiteit Utrecht

Historical and new environmental risk factors

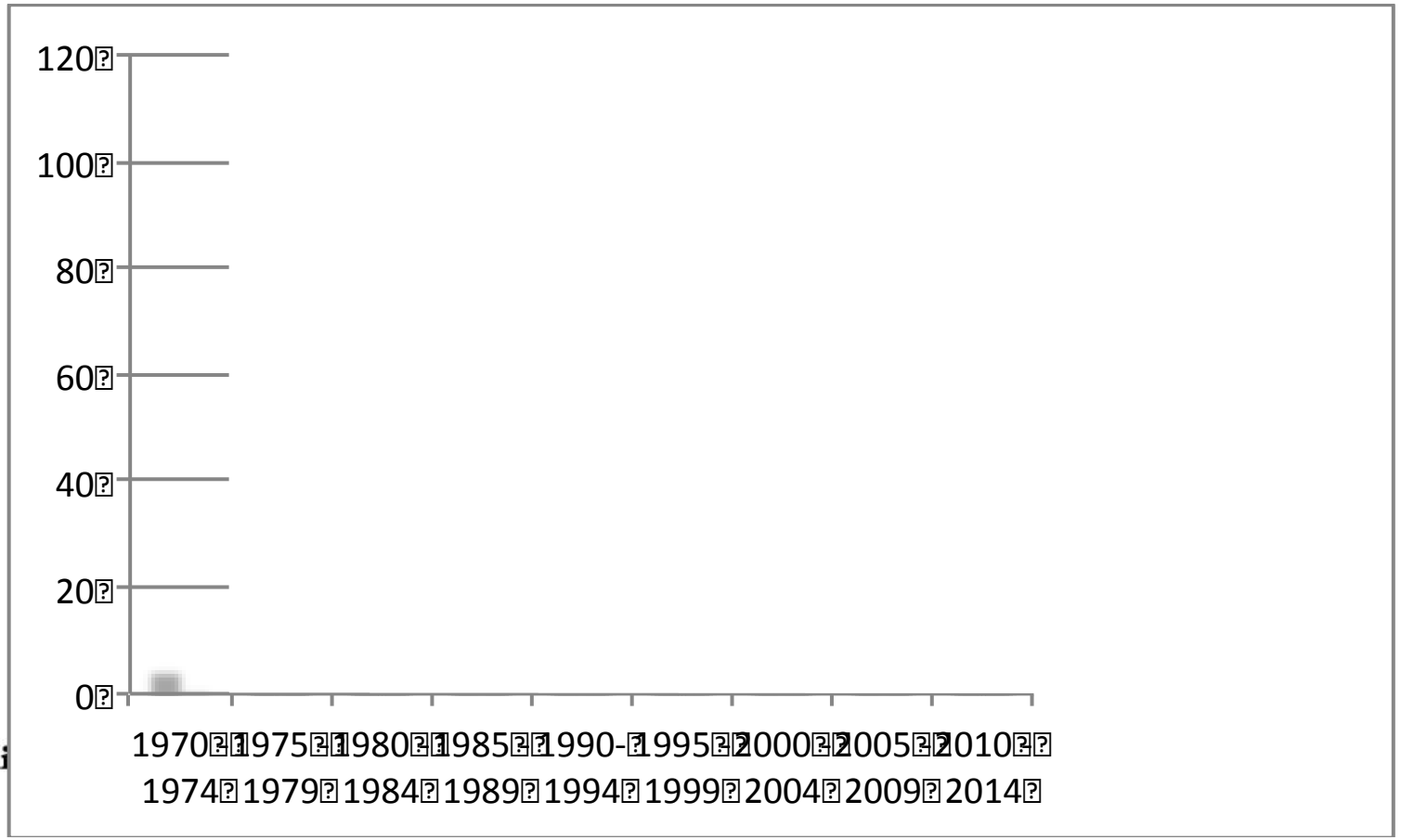
	Known risks	New risks
Potency	High	Low
Exposure levels	High	Low
Co-exposures	Few	Many



Occupational Hygiene and Health

- Occupational expidemiology has had a long history of studying the health effects of exposures experienced at the workplace

- Such studies have successfully identified a range of chemical and other agents that have been associated to a range of health outcomes



Occupational Hygiene and Health

- However, due to **declining occupational exposures** its increasingly likely that health risks experienced by workers are due to **a combination of wider range of workplace and non-workplace factors** *than was perhaps the case in the past where workers could be exposed to high levels to single or a limited number of substances.*

- **Furthermore, epidemiological studies of new technology and new infrastructure projects should not have to rely on studies of (irreversible) disease outcome in prospective cohort** studies, but novel markers of exposure and health outcomes will need to be developed to manage risk during the development of new technology.

The Exposome – a unifying concept for exposure assessment

Recognizing the disparity in current knowledge between genes and environmental exposures, Chris Wild defined the "exposome"

Representing all environmental exposures (including those from diet, lifestyle, and endogenous sources) from conception onwards, as a quantity of critical interest to disease etiology

[1] Wild, C.P., Complementing the genome with an "exposome": the outstanding challenge of environmental exposure measurement in molecular epidemiology. Cancer Epidemiol Biomarkers Prev 14 (8), 1847-1850 (2005).

Total Worker Health – NIOSH CDC

Issues Relevant to Advancing Worker Well-being Through Total Worker Health®

Control of Hazards and Exposures
- Chemicals
- Physical Agents
- Biological Agents
- Psychosocial Factors

Compensation and Benefits
- Adequate Wages and Prevention of Wage Theft
- Equitable Performance Appraisals and Promotion

Changing Workforce Demographics
- Multigenerational and Diverse Workforce
- Aging Workforce and Older Workers
- Vulnerable Worker Populations
- Workers with Disabilities

the TWH approach focuses on how environmental, workplace factors can both mitigate and enhance overall worker health beyond traditional occupational safety and health concerns

- Safe and Clean Restroom Facilities
- Safe, Clean and Equipped Eating Facilities
- Safe Access to the Workplace
- Environments Designed to Accommodate Worker Diversity

Leadership
- Shared Commitment to Safety, Health, and Well-Being
- Supportive Managers, Supervisors, and Executives
- Responsible Business Decision-Making
- Meaningful Work and Engagement
- Worker Recognition and Respect

Community Supports
- Healthy Community Design
- Safe, Healthy and Affordable Housing Options
- Safe and Clean Environment (Air and Water Quality, Noise Levels, Tobacco-Free Policies)
- Access to Safe Green Spaces and Non-Motorized Pathways
- Access to Affordable, Quality Healthcare and Well-Being Resources

New Employment Patterns
- Contracting and Subcontracting
- Precarious and Contingent Employment
- Multi-Employer Worksites
- Organizational Restructuring, Downsizing and Mergers
- Financial and Job Security

November 2015

CDC Workplace Safety and Health NIOSH TOTAL WORKER HEALTH®

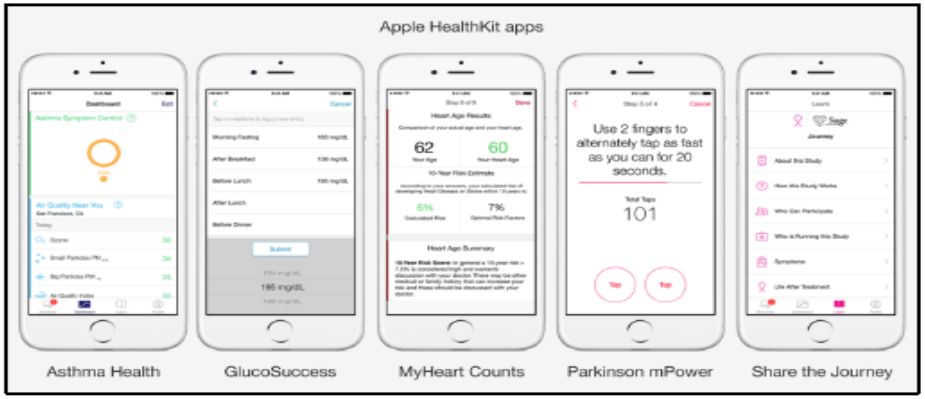
The Exposome

- Study design - Lifecourse
  - Exposure is dynamic (repeated samples)
  - Critical exposure windows; conception to death
- Improved exposure assessment
  - **Biomarkers (OMICS)**
  - **Sensor technologies**
  - Geographical Information Systems
  - **Portable computerized devices (momentary assessments)**
  - Improved use of conventional measurements / questionnaires / databases
- Advances in statistical methods and bioinformatics
  - Large number of environmental exposures (correlated, protracting)
  - Weak associations
  - Low priors

Improved assessment of the Exposome Using Sensors

New Investigative Technologies to Improve Occupational Exposure Assessment; Sensor Technology / Portable Communication Devices

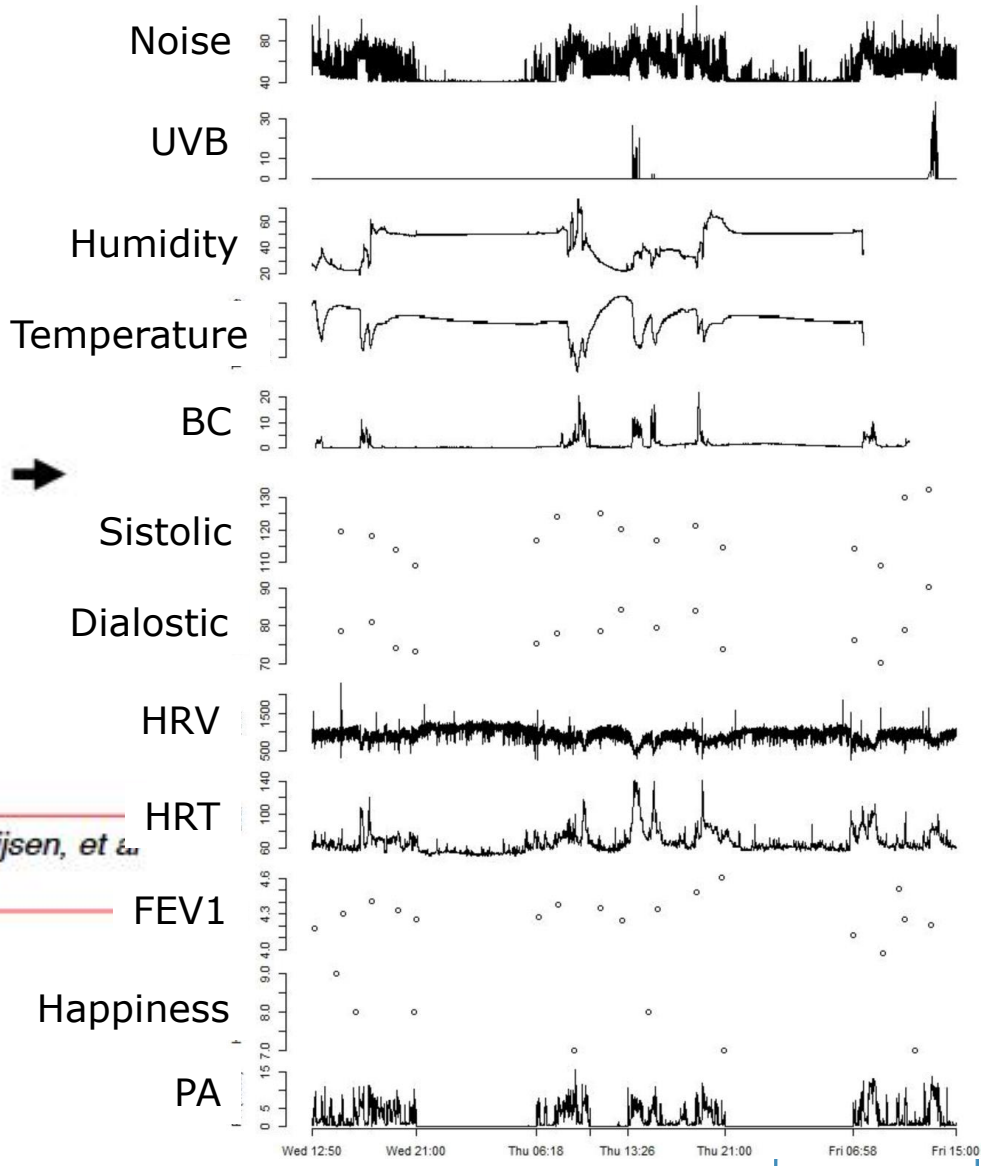
- Tracking sensors
- Chemical sensors
  - NO2
  - CO
  - …..



Universiteit Utrecht

Using Personal Sensors to Characterize our External Exposome

Nieuwenhuijsen, et a.
2014



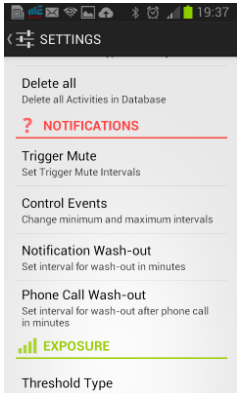
Universiteit Utrecht

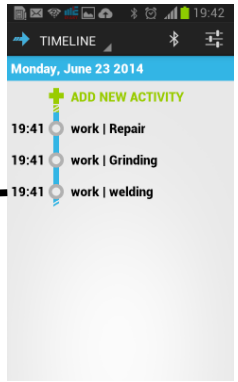
exposomics

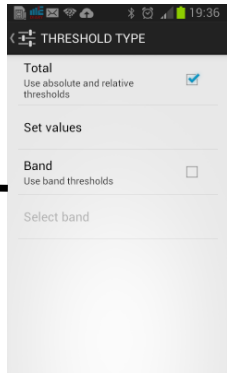
Improved Occupational Exposure Assessment; ExpomDiary - context-sensitive ecological momentary assessment (CS-EMA)

Data processing

Data acquisition







Data repository

Contextual Data acquisition
Exposure / health

Luuk van Wel et al., unpublished

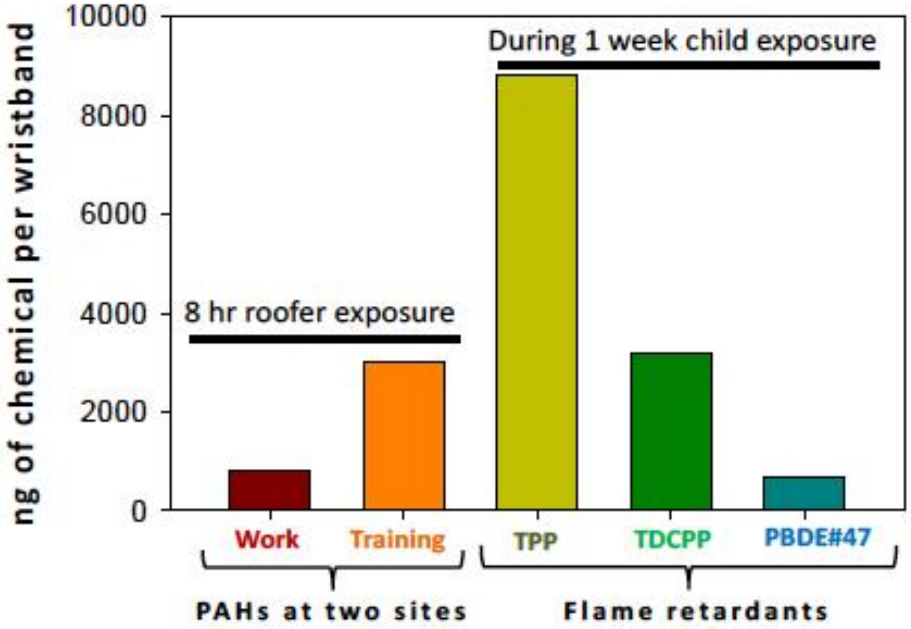
Using Big-Data to characterize the Exposome

- Develop method to analyze “Exposome” wrist bands and broaches

New Investigative Technologies to Improve Occupational Exposure Assessment

Children: Flame Retardant Exposure

Roofers 8 hrs wristband: PAHs



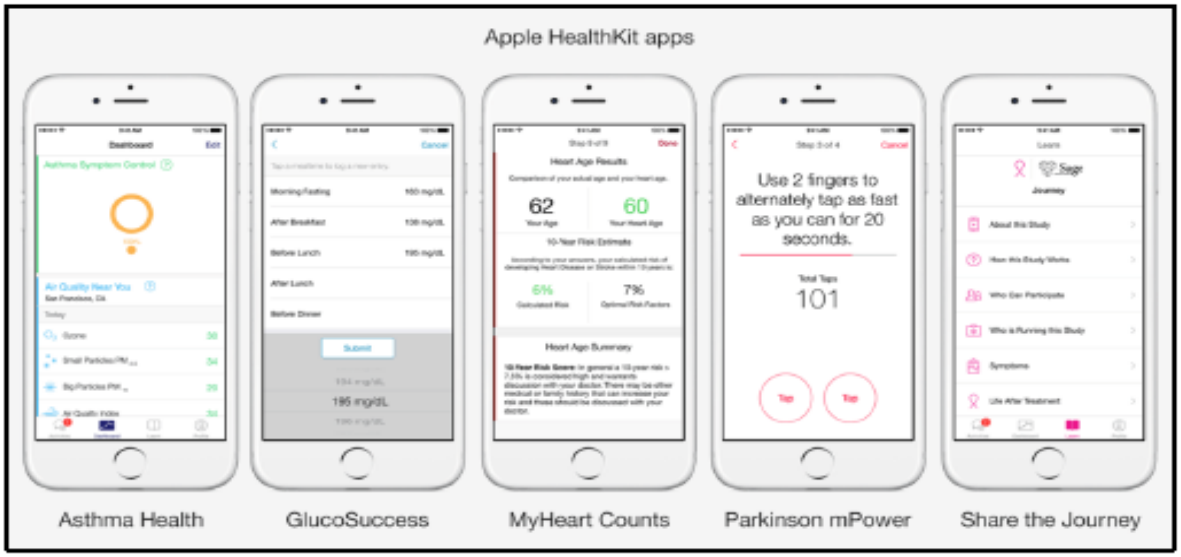
Abbreviations used : ng = nanograms, hr = hours, PAHs = sum of 33 polycyclic aroma hydrocarbons; TPP = triphenyl phosphate, TDCPP = tris(1,3-dichloro-2-propyl) phosphate, PBDE#47 = pentabromodiphenyl ether congener 47.

Anderson, Oregon State University

Use of Sensors if Occupational Health

- Combination of measurements sensors, geo-location (GPS, I-beacons), and CS-EMA allows for a more comprehensive assessment of external exposures.
  - Industrial hygiene / Exposure Science
  - Occupational Health Research
  - Individual (quantified-self)

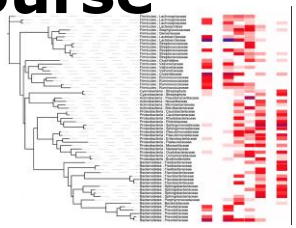
- Could be combined with e-health applications



Universiteit Utrecht


Improved assessment of
the Exposome
Using OMICS

Improved identification of environmental exposures across the lifecourse

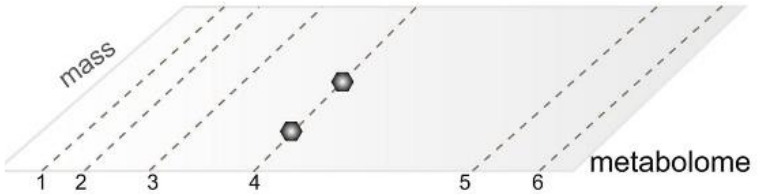


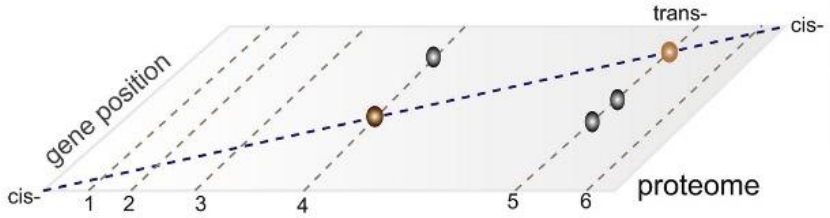
Microbiome

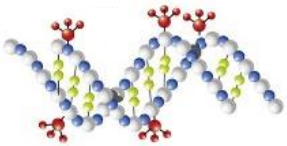
QTL maps

ENVIRONMENTAL INPUTS

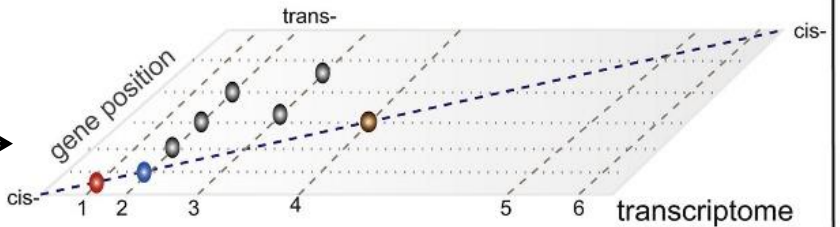
Exposures, Nutrition, Lifestyle



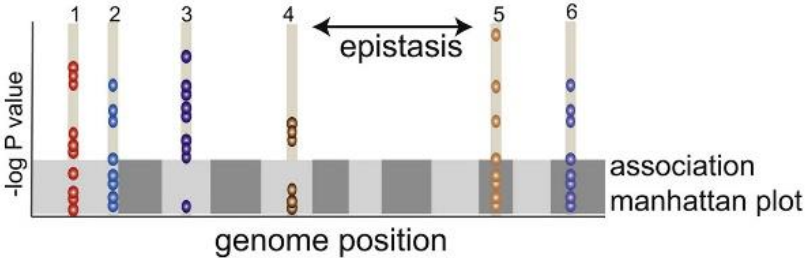




Epigenome

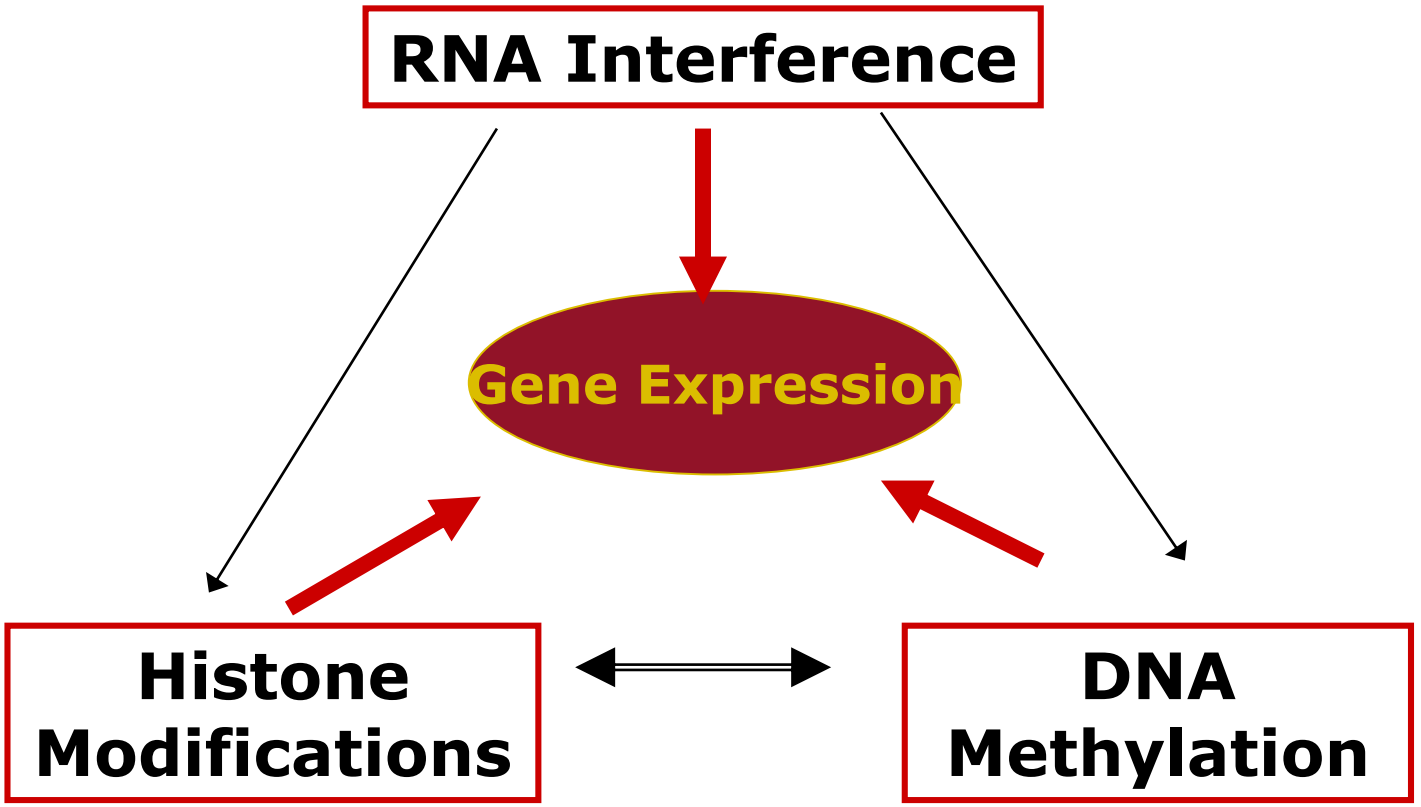


Genome

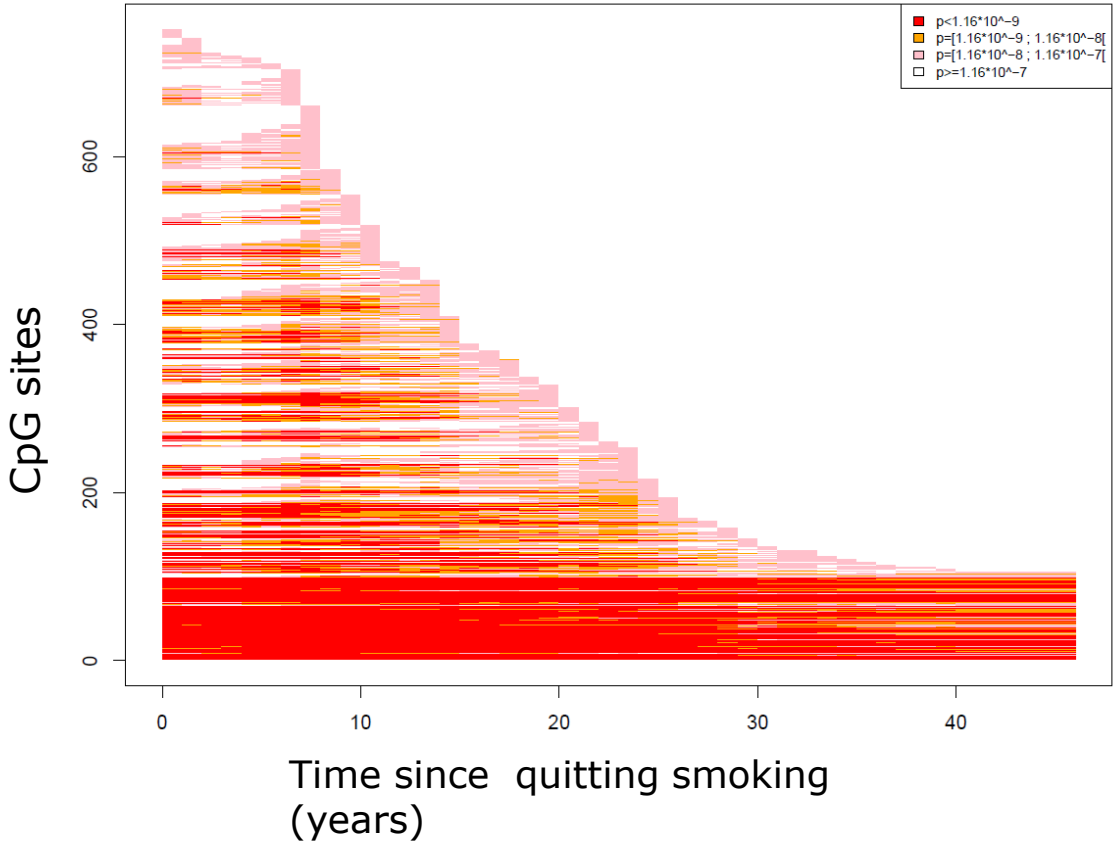


Epigenetics

Epigenetics refers to the study of changes in the regulation of gene activity and expression that are not dependent on gene DNA sequence.

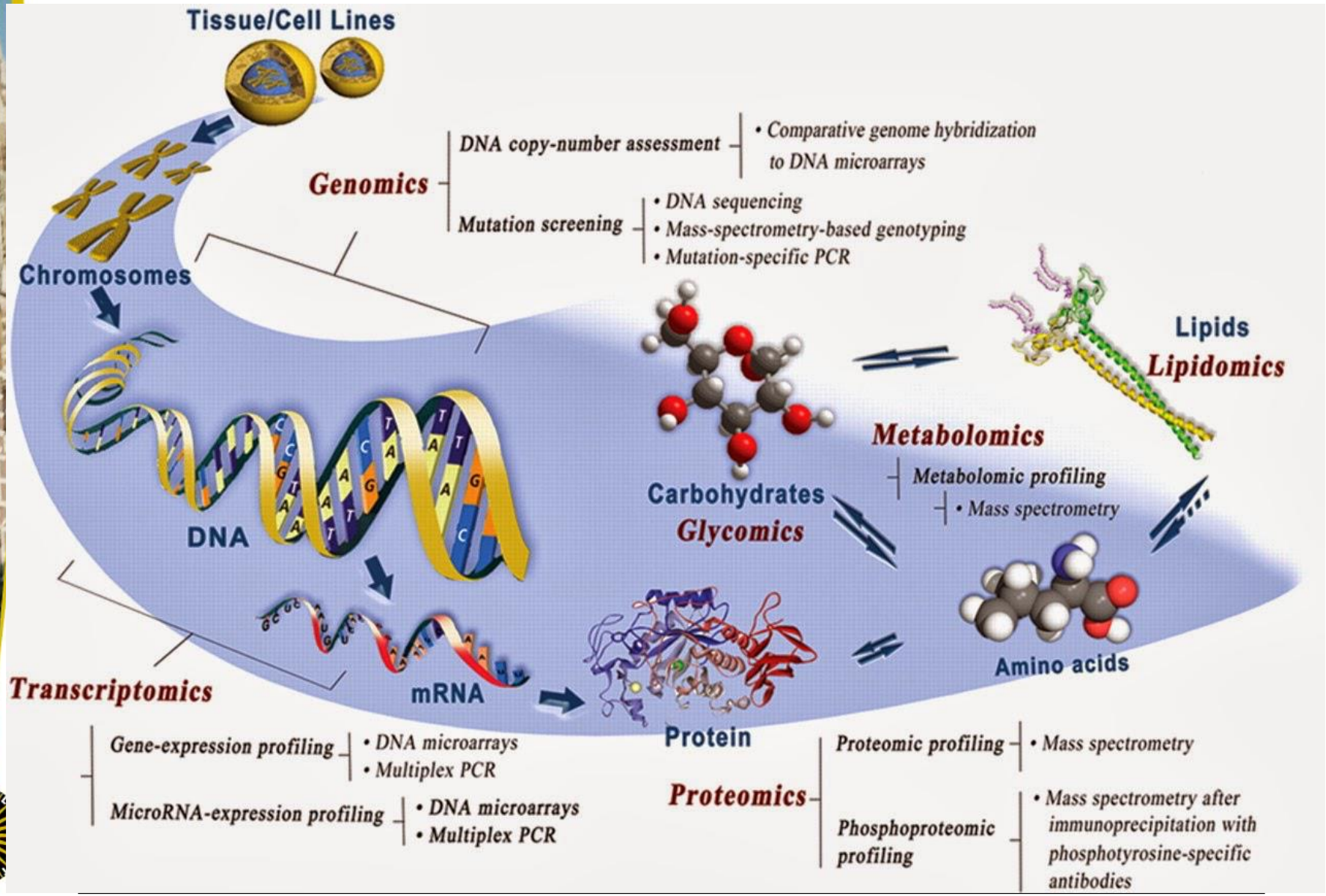


Dichotomised smoking status – p-values evolution according to *t*

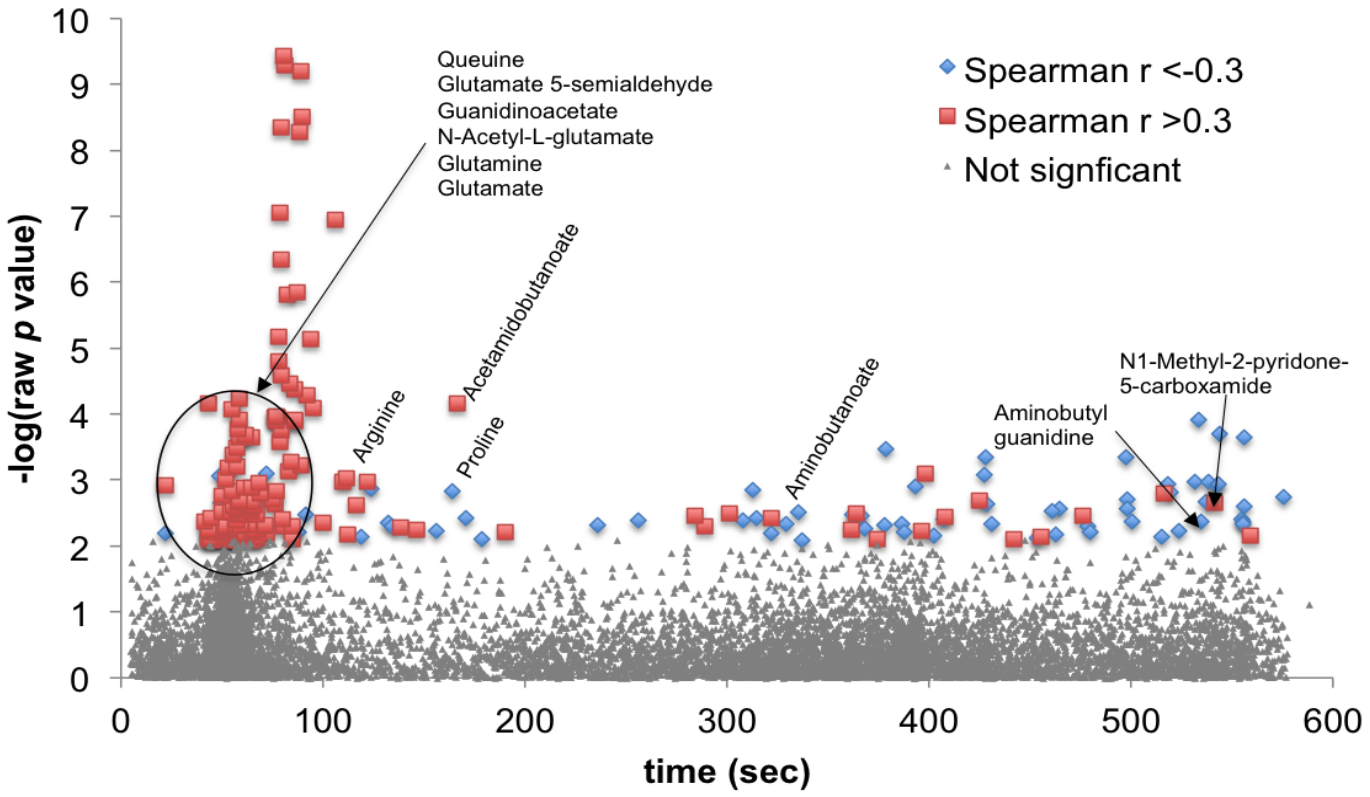


- Evolution of the strength of association between methylation level and dichotomised smoking status across *t*
  - 751 CpG sites significant at least once across t
- 2 groups identifiable in both cohorts
  - Those loosing statistical significance after a certain *t* within the 3 first decade after smoking cessation
  - Those remaining differentially methylated more than 35 years after smoking cessation

Metabolomics / High Resolution LC-MSMS



Metabolomic Analysis of Plasma Samples from Workers Exposed to TCE



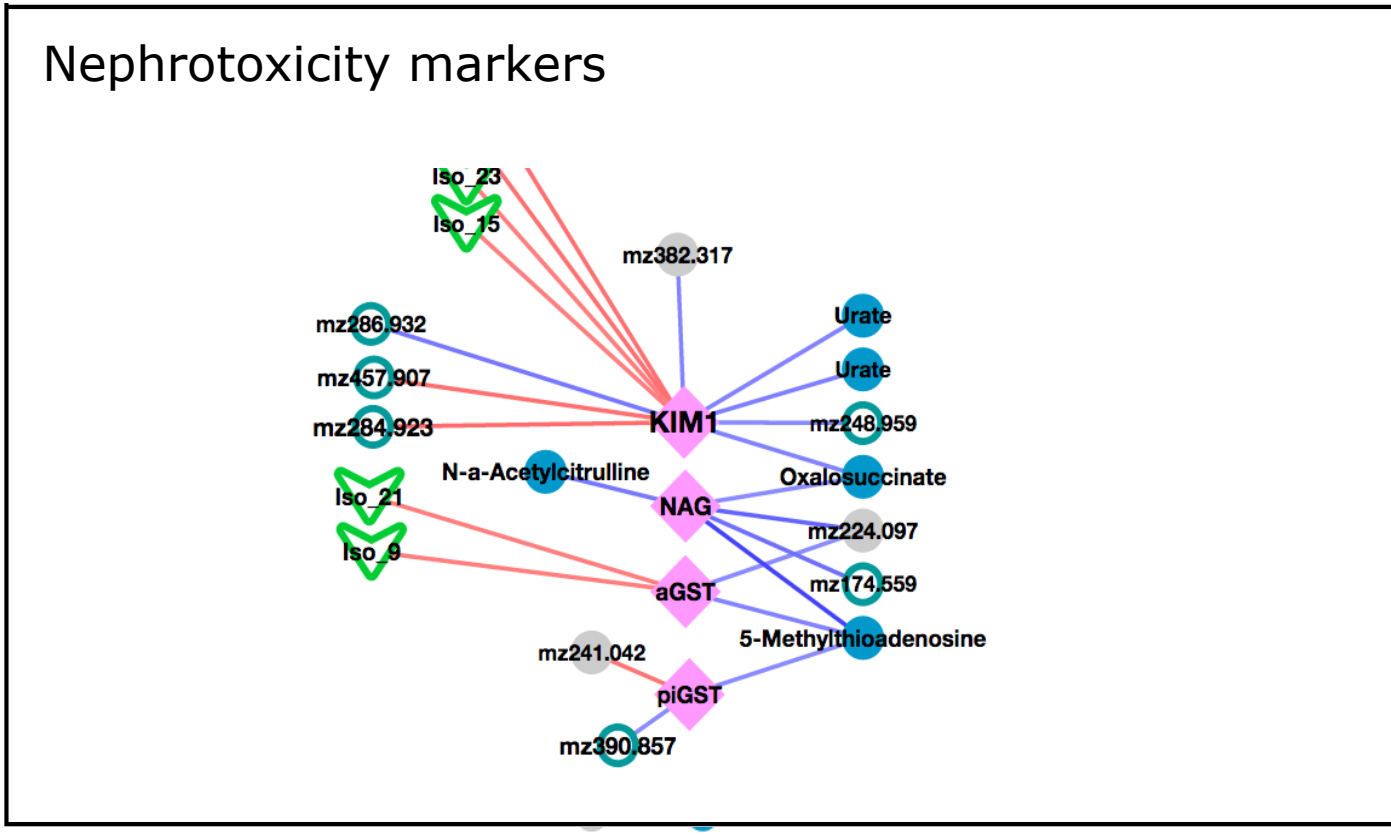
Universiteit Utrecht

Walker et al., submitted

Metabolome association network with molecular markers of TCE exposure

Urinary TCE exposure markers
Renal biomarkers
Immunological markers
Unidentifiable halogenated m/z, by isotopic pair
Identified metabolite
Unidentifiable m/z; pos mass defect
Unidentifiable m/z; neg mass defect

Correlation coefficient
-0.7 0 0.6



Universiteit Utrecht

Walker et al., submitted

Improved assessment of the Exposome Using OMICS

- New biotechnological advancements allow for a more comprehensive evaluation of (historical) exposures and associated biological responses at the individual level

  - Improved exposure assessment
  - Improved health impact assessment

  - Monitoring
  - Screening

Het exposoom en arbeidsgerelateerde gezondheid

- Beroepsmatige blootstellingen maken een belangrijk deel uit van de blootstellings-levenslijn (TWH)
- Technologieën die ontwikkeld worden binnen Exposoom-onderzoek kunnen worden ingezet in het beter kwantificeren van beroepsmatige blootstellingen
- Het op een meer individueel niveau kwantificeren van de blootstelling en biologische-effecten geeft de mogelijkheid tot precisie-risico assessment
- Geeft mogelijkheden voor de quantified-self

defensie.nl

Universiteit Utrecht Universiteitsbiblioth... | Using personal sensors to assess the ex... | IJERPH | Free Full-Text | Using Persona... | lycra dup

Actueel

Overzicht **Nieuws** Weblog Activiteiten Foto's Video's Defensiebladen

Onderzoek naar chroomhoudende verf uitgebreider

Nieuwsbericht | 18-09-2014 | 15:48

Defensie breidt de 2 onderzoeken naar chroomhoudende verf uit: een historisch onderzoek en een onderzoek naar de huidige veiligheid op voormalige POMS-sites. Het onderzoek wordt ook verbreed tot alle werkplaatsen bij Defensie waar gebruik is of wordt gemaakt van chroomhoudende verf. Dat heeft minister Jeanine Hennis-Plasschaert vandaag aan de Tweede Kamer laten weten.

nos.nl

Universiteit Utrecht Universiteitsbiblioth... | Using personal sensors to assess the ex... | IJERPH | Free Full-Text | Using Persona... | lycra dupont - Bing News | 'DuP

NOS Nieuws Sport Uitzendingen TELETEKST AEX

'DuPont-medewerksters kregen zwangerschapsproblemen'

ZATERDAG, 18:41 BINNENLAND, ECONOMIE

De vestiging van DuPont/Chemours in Drodrecht ANP

Universiteit Utrecht

Acknowledgements

Exposure Science Group

Gerard Hoek

Anke Huss

Marc Chadeau-Hyam

Lutzen Portengen

Jelle Vlaanderen

Max Leenders

Nahid Mostafavi

Virissa Lenters

Erik van Nunen

Marije Reedijk

Universiteit Utrecht

THANKS

R.C.H.Vermeulen@uu.nl