HBM4EU project

From data to information - adjustments conversions and calculations

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1. Lab results
2. Units
   - Per volume or time
   - Creatinine adjustment
   - Blood protein adducts
3. Unit conversions

From data to information

Lab results should be reported QA/QC:

- *Using provided sample codes (only)*
- *Including the raw data (non-adjusted, non-corrected)*
- *With accompanied calibration data*
- *Information on recovery from matrix*
- *With explanation/motivation of LOD and LOQ*
- *Information on precision: within day and day-to-day variability and/or badge-to-badge variability*

How to define a urine sample

24 h collection sample

'all urine collected during a day and following night'

Spot urine sample

Urine micturition 'between two toilet visits'

From data to information *Units per volume or time*

Urine excretion can be expressed in concentration or rate

1. Spot urine – unit of concentration

In µmol/L of a void (micturation between two toilet visits)

2. All urine collected (e.g. over 24 h) – excretion rate

In µmol/L per hour (or per day) if all urine is collected

Urine excretion can be expressed in concentration or rate

3. Reconstituted urine

Each subject collects small aliquots of urine from each toilet visit and measures (and registers!) the volume of each void. It can still be decided to reconstitute before analysis (one analysis) or do it by calculation (combine the results of analysis weighted by the volume of each void).

Compared to 24 h urine: subject carries less weight containers (6-8 small containers instead of 2-4 large bottles). Note that self registration of void volumes may introduce inaccuracy.

Free metabolites in solution can be expressed in

- Weight units per volume: mg/L (e.g. metals)
- Molar units per volume: mmol/L or mM (e.g. organics)

For homogenous (e.g. urine) volume calculations are trivial but for non-homogenous matrices the volume may be related to the original sample volume (e.g. full blood)

Blood protein adduct levels can be expressed in:

Molar units per g protein or lipid/triglyceride:

E.g. for haemoglobin adducts: µmol/g globin

E.g. for persistent organic pollutants: µmol/g lipid

The accuracy is determined by the adduct content and the determination of the protein concentration.

Note that for some commercial kits for the determination of proteins the accuracy can be much less compared to the analysis of your biomarker.

Creatinine to adjust for urine density

Creatinine is primarily originating from muscle tissue and is produced at a (more or less) constant rate.

Much used as a clinical marker for kidney function and it is known to be modified by:

- Heavy physical exercise or workload
- Tissue damage, e.g. following surgery or trauma
- High protein intake (meat and fish)
- Use of creatine monohydrate in dietary supplement

Creatinine to adjust for urine density

- Much used and some consider it better than adjustment by specific density or osmolality.
- If < 3 mmol/L or > 30 mmol/L it is recommend to ask for a replacement sample (creatinine adjustment is considered unreliable)
- It is a good practice to always present unadjusted data together with the creatinine adjusted results.

From	To	Conversion
µg/L	nmol/L	X 1000 / MW
µg/g creatinine	µmol/mol creatinine	÷ MW x 113.1
nmol/l	µg/L	X MW ÷ 1000
µmol/mol creatinine	mg/L	X MW ÷ 100 *

* Assuming a creatinine concentration of 1 mmol/L

Take home

Information requirement should be defined in the design stage

Adjustments are useful to express the data for different information purposes

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Speaker's information

Paul T.J. Scheepers PhD works as associate professor at the Radboudumc, Nijmegen, The Netherlands. He received training in toxicology and occupational hygiene. In HBM4EU he is responsible for training activities as task leader in WP2. He is a member of the ethics board in WP1.

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