IVDr Research by NMR

- An Innovative Analytical Solution for Biobanking
  (for research use only)
NMR in the World of BioBanks

High Resolution NMR has rapidly developed into a leading tool for the analysis of body fluids and tissues. It is used in high-throughput push button automation to generate spectra, which are the input for automatic analysis to quantify markers or to be compared with statistical models of health or disease states. It also allows large scale epidemiological studies due to its outstanding instrumental reproducibility and transferability from lab to lab. Combining this with Standard Operation Procedures and a standardized instrumental platform allows to integrate data generated all over the world with data from a biobank network.

How Does NMR Relate to Biobanks and their Daily Work?

NMR can be used as QC for input of samples into the biobank and at the same time with the same measurement create additional value in terms of analytical information:

- Validate the type of sample e.g. EDTA Plasma (see Figure 1), Citrate Plasma and Quality Control to check for contamination and impurities (see Figure 2). Results are summarized in a Quality Control report (B.I.BioBankQC, see Figure 3)
- Produce NMR spectra for input into the biobank information for each sample, NMR spectra are produced under standard conditions and can be used for integrated spectral bases from different biobanks worldwide
- Generate a lipoprotein subclass panel with 114 parameters and with the same experiment generate a list of 41 quantified small molecules in plasma/serum
- Generate a list of 150 quantified parameters in urine including concentration ranges

The methods and solutions described here are for research use only and not for use in clinical diagnostic procedures.
Suitability of NMR for Spectral Database Usage and Data Exchange

Reproducibility and transferability of the NMR analysis under identical SOPs and using a standardized NMR platform is shown in Figure 4. Aliquots of Serum samples have been prepared and measured, showing in the upper part the overlay of spectra of 15 replicates prepared and measured individually on one instrument, while the lower spectrum shows the overlap of 8 spectra each measured in 2 locations on identical machines under the same SOPs using replicate samples. As can be seen there is a perfect overlap of all spectra. This is the proof that spectra from different biobanks can be used for integrated statistical analysis. For new studies therefore spectra can be used instead new aliquots to be taken from the biobank.

Add Value to the Biobank with Analytical Data

For every Biobank, the value also lies in the metadata associated to the samples stored. This can be patient data, lifestyle information, but also analytical data, like lipoprotein subclasses analysis (B.I.LISA) and concentration of small molecules (B.I.QUANT-PS 2.0) in plasma/serum and concentration of endogenous and disease related metabolites (B.I.QUANT-UR b,e,ne) in urine. Using directly the spectra acquired for quality control, these analytical results can be generated automatically including concentration distributions calculated from all biobank samples analyzed. Since many samples are analyzed in a biobank it is possible to define normal concentrations in the cohort investigated. Figure 5 shows an excerpt of the lipoprotein subclass analysis obtained from 2 samples, one from a healthy subject and one from a person who had a stroke 3 days after sample collection, clearly showing the deviations, which are indicative of a risk profile. Figure 6 shows an excerpt from the quantification of endogenous metabolites including the cohort concentration distribution with the actual sample shown in the profile as a stick.
NMR is an advantageous technique for metabolomic research, providing high reproducibility, simple sample preparation and the ability to measure different small molecule metabolites simultaneously. Today, new advances in software and hardware platforms have made NMR more effective, easier to use and more cost efficient. Discover for yourself how NMR can help illuminate metabolic networks.