Sample Stability: Transport and Storage

Note: The comments in this discussion relate to blood and blood derivatives. Other types of sample will be addressed in a later topic in the “In Focus” section of this website.

Stability has been defined by the International Standards Organisation (ISO) as the capability of a sample material to retain the initial property of a measured constituent for a period of time within specified limits when the sample is stored under defined conditions (ISO Guide 30, 1992). Instability is present when there are important changes in one or more of those measurements.

Even before a collection tube is filled with blood, the empty tubes must be stored according to manufacturers instructions. Failure to comply with these can influence the stability of the blood sample that is subsequently collected into that tube.

It is important to keep in mind that sample transport and storage conditions, together with the time interval between collection and testing, can have an important effect on the quality of test results.

Despite increased point-of-care testing in many areas of laboratory medicine, the vast majority of specimens are collected in one place and transported to another for analysis. Some tests are available only in certain reference centres, requiring samples to be transported over long distances.

Further, in many countries, testing is increasingly consolidated in fewer but larger laboratory facilities with more and more centralisation of the pathology laboratory service. This centralisation has increased the focus on controlling variabilities around the sample transport and storage aspects of the preanalytical phase. Consideration of the effects of sample transport and storage, and requiring evidence of sample stability are particularly important, since this pivotal aspect of lab testing is not normally assessed by proficiency testing programmes.

A number of studies have carefully evaluated the changes in test results which may occur over time and which are influenced by storage conditions. These studies may detail statistically significant changes in test results over time, but it is important take into account whether these differences are clinically relevant. Small differences may be tolerated if there is clearly no impact on patient management.

Data relating to sample stability may also depend on the tube type used for blood collection, (including any separation gels, anticoagulants and other additives present) the temperature of storage prior to testing, and the laboratory method used for determination. This is particularly true in relation to haemostasis.

The mode of transporting samples to the laboratory may be relevant, as well. Rapid sample delivery via pneumatic tube transportation is attractive for reducing transport times and is an acceptable method of sample transport for some types of laboratory tests. In some cases, however, such as blood gas measurement, at least some pneumatic transfer systems may be unsuitable. In relation to Blood Gas measurements it is essential that any air bubbles are eliminated from the collection device on collection and prior to transport.

For some lab tests, samples may be stored in the laboratory prior to analysis, when tests are performed in batches for efficiency reasons or when a test is added after completion of the original group of analysis. Such storage conditions may critically affect the results obtained, and findings based on one set of study conditions cannot always be safely extrapolated to other conditions. Further, storage temperature options such as refrigeration or deep-freezing should not automatically be assumed acceptable without supporting data. Both can induce changes in test results.

Access to data relating to the effects of specific modes of transport and storage is critical. Laboratories should keep control of these important preanalytical variables and use only validated approaches to these aspects of the preanalytical phase.

Footnote 1: A number of reviews and guidelines have addressed this aspect of the preanalytical phase. References associated:


Footnote 2: Blood samples used for some molecular genetic tests (e.g., factor V Leiden) are stable for many days over a wide range of ambient temperatures. In contrast, many plasma or serum based measurements can incur deterioration and instability. (Storage of serum or whole blood samples? Effects of time and temperature on 22 serum analytes. Heinis M, Neel W & Withol W. Eur J Clin Chem Clin Biochem 1995; 33(4): 251-259).


Footnote 5: Adding on an activated partial thromboplastin time (APTT) test for which the sample had been left for 8 hours over spun down blood sample at room temperature was shown to be acceptable for some patient groups. (Stability of plasma for add-on PT and APTT tests. Neofotistos D, Orpeza M & Tsao CH. Am J Clin Pathol 1996; 106(6): 759-63). However, this would be completely unacceptable if such a sample were collected from a patient receiving unfractionated heparin therapy, where a substantial component of the activity can be lost in 4 hours of storage.

Footnote 6: Storage of whole blood at 4°C can lead to loss of FVIII, and patients with von Willebrand’s disease will also benefit from this. The following authors demonstrated the stability of a number of chemistry analytes when frozen at -20°C in primary tube with a gel based separator: (An evaluation of the integrity of BD Vacutainer® SST™ II A test analysis stability when subject to freezing at -20°C. Baker J, Naidich C, Church S, Green S, van Deelen-Visser M & Bolkers E. Europas Congress of Clinical Chemistry and Laboratory Medicine 2009; poster H.4).