Automated analyser

An **automated analyser** is a medical laboratory instrument designed to measure different chemicals and other characteristics in a number of biological samples quickly, with minimal human assistance.

These measured properties of blood and other fluids may be useful in the diagnosis of disease.

Many methods of introducing samples into the analyser have been invented. This can involve placing test tubes of sample into racks, which can be moved along a track, or inserting tubes into circular carousels that rotate to make the sample available. Some analysers require samples to be transferred to sample cups. However, the effort to protect the health and safety of laboratory staff has prompted many manufacturers to develop analysers that feature closed tube sampling, preventing workers from direct exposure to samples.[1],[2]

Samples can be processed singly, in batches, or continuously.

The automation of laboratory testing does not remove the need for human expertise (results must still be evaluated by medical technologists and other qualified clinical laboratory professionals), but it does ease concerns about error reduction, staffing concerns, and safety.

Routine biochemistry analysers

These are machines that process a large portion of the samples going into a hospital or private medical laboratory. Automation of the testing process has reduced testing time for many analytes from days to minutes. The history of discrete sample analysis for the clinical laboratory began with the introduction of the "Robot Chemist" invented by Hans Baruch and introduced commercially in 1959[1].

The types of tests required include enzyme levels (such as many of the liver function tests), ion levels (e.g. sodium and potassium), and other tell-tale chemicals (such as glucose, serum albumin, or creatinine).

Simple ions are often measured with ion selective electrodes, which let one type of ion through, and measure voltage differences.[3] Enzymes may be measured by the rate they change one coloured substance to another; in these tests, the results for enzymes are given as an activity, not as a concentration of the enzyme. Other tests use colorimetric changes to determine the concentration of the chemical in question. Turbidity may also be measured.

Examples of these types of machines are:

- Abbott Aeroset
- Abbott Axsym
- Beckman-Coulter LX
- Selectra Series
- Berkman Astra
- Cobas Mira
- Siemens Dimension® integrated chemistry systems
- DuPont Automated Clinical Analyzer
- Hitachi 917
- Hitachi 912
- Kodak Ektachem 700
- MicroLab Series

Immuno-based analysers

Antibodies are used by some analysers to detect many substances by immunoassay and other reactions that employ the use of antibody-antigen reactions.

When concentration of these compounds is too low to cause a measurable increase in turbidity when bound to antibody, more specialised methods must be used.

Recent developments include automation for the immunohaematology lab, also known as transfusion medicine.

Examples include:

- ADVIA Centaur XP
- Immulite 2000

Haematology analysers

These are used to perform complete blood counts, erythrocyte sedimentation rates (ESRs), or coagulation tests.

Cell counters

Automated cell counters sample the blood, and quantify, classify, and describe cell populations using both electrical and optical techniques. Electrical analysis involves passing a dilute solution of the blood through an aperture across which an electrical current is flowing. The passage of cells through the current changes the impedance between the terminals (the Coulter principle).[4] A lytic reagent is added to the blood solution to selectively lyse the red cells (RBCs), leaving only white cells (WBCs), and platelets intact. Then the solution is passed through a second detector. This allows the counts of RBCs, WBCs, and platelets to be obtained. The platelet count is easily separated from the WBC count by the smaller impedance spikes they produce in the detector due to their lower cell volumes.

Optical detection may be utilised to gain a differential count of the populations of white cell types. A dilute suspension of cells is passed through a flow cell, which passes cells one at a time through a capillary tube past a laser beam. The reflectance, transmission and scattering of light from each cell is analysed by sophisticated software giving a numerical representation of the likely overall distribution of cell populations.

Reticulocyte counts can now be performed by many analysers, giving an alternative to time-consuming manual counts. Many automated reticulocyte counts, like their manual counterparts, employ the use of a supravital dye such as new methylene blue to stain the red cells containing reticulin prior to counting. [5] Some analysers have a modular slide maker which is able to both produce a blood film of consistent quality and stain the film, which is then reviewed by a medical laboratory professional.

Examples of full blood count machines are:

- Abbott Cell-Dyn product line
- Sysmex XE-2100
- Beckman Coulter LH 700 series
- Medonic M Series

Coagulometers

Automated coagulation machines or Coagulometers measure the ability of blood to clot by performing any of several types of tests including Partial thromboplastin times, Prothrombin times (and the calculated INRs commonly used for therapeutic evaluation), Lupus anticoagulant screens, D dimer assays, and factor assays.

Coagulometers require blood samples that have been drawn in tubes containing sodium citrate as an anticoagulant. These are used because the mechanism behind the anticoagulant effect of sodium citrate is reversible. Depending on the test, different substances can be added to the blood plasma to trigger a clotting reaction. The progress of clotting may be monitored optically by measuring the absorbance of a particular wavelength of light by the sample and how it changes over time.

Coagulation machines include:

- Sysmex CA-1500
- BioMérieux MDA

Other haematology apparatus

Automatic ESR readers, while not strictly analysers, hold a rack of samples for a set period of time, after which the reader determines how far the red cells have fallen by detecting levels with light beams.

ESR analysers include:

- StaRRsed III, Compact, Auto-Compact
- InteRRliner

As ESR tests become less popular they are being replaced by plasma viscosity tests. The advantage of this test over ESR is that fewer variables can affect the result, so it can give a more direct impression of the plasma protein content of a sample. Analysers that measure plasma viscosity commonly work by drawing a small sample of plasma through a narrow capillary using a constant pressure and measuring the time taken for the sample to move a known distance.

Miscellaneous Analysers

Some tests and test categories are unique in their mechanism or scope, and require a separate analyser for only a few tests, or even for only *one* test. Other tests are esoteric in nature--they are performed less frequently than other tests, and are generally more expensive and time-consuming to perform. Even so, the current shortage of qualified clinical laboratory professionals [6] has spurred manufacturers to develop automated systems for even these rarely performed tests.

Analysers that fall into this category include instruments that perform:

- DNA labeling and detection
- Osmolarity and osmolality measurement
- Measurement of Glycosylated haemoglobin (Haemoglobin A1C), and
- Aliquotting and routing of samples throughout the laboratory

Notes

1)Rosenfeld, Louis. Four Centuries of Clinical Chemistry. Gordon and Breach Science Publishers, 1999. ISBN 90-5699-645-2. Pp. 490-492

See also

- Medical technologist
- Olympus Corporation
- Abbott Laboratories
- Beckman Coulter
- Bayer
- Sysmex
- Biomerieux
- Roche
- DuPont

External links

- LabAutopedia [7]

References

[1] http://www.beckman.com/literature/ClinDiag/AU%209389%20Tanner%20Case%20Study.pdf
[2] http://www.bd.com/ds/aboutUs/news/News-05227.asp
[3] http://www.nico2000.net/Book/Guide1.html
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