How new fabric technology is improving the speed and accuracy of POC diagnostics

Test strips are a significant tool in point-of-care (POC) diagnostics for blood, urine, and glucose analysis. The rising demand for rapid diagnostics in healthcare has led to the research and development of numerous POC technologies in recent years, with researchers across the globe studying and reporting new techniques with the potential to become POC diagnostic devices. In fact, since 2009, the sector has experienced almost continuous funding increases, with investment for test strip applications in 2021 sitting at almost USD 2.5 billion.

According to research, North America holds the largest share in the diagnostic test strip market but could soon be overtaken by the Asia Pacific market which it's expected to see the highest growth in the next five years. The global test strips market meanwhile is predicted to enjoy a 3.8% CAGR from 2019 to 2025.

Behind this rising demand for diagnostic test strips are several factors: the rising prevalence of infectious diseases in developing countries, for example, as well as the increase in cardiac-related diseases and diabetes. And while opportunities to implement successful POC facilities have continued to expand as technology has improved over time, the COVID-19 pandemic has played a key role in the recent rapid acceleration of the POC diagnostics market.

Throughout 2020, pharmaceutical firms the world over prioritised the development of rapid, accurate diagnostic test strips for the detection of coronavirus. The pandemic provided many lessons about how the diagnostics sector should respond to large-scale public health incidents and brought the pursuit of improved POC diagnostics into sharper focus. Today, pharmaceutical manufacturing firms continue in the race to make the next generation of POC diagnostic tests faster, simpler, and more reliable.

Application and benefits

The most common POC diagnostic tests are used in blood glucose testing, rapid cardiac marker testing, and screening for infectious diseases. Developments in these devices have significantly enhanced the diagnostic abilities for a number of diseases and disorders, and the reduction in the turnaround time (TAT) of results is widely regarded as the biggest benefit.

With studies finding that result time is shorter for point-of-care diagnostics than TATs associated with central or satellite laboratory testing, POC diagnostics is now considered one of the most important tools in blood, urine, and glucose analysis. This ability to obtain a test result quickly can help to avoid costly delays as patients progress through hospital stays or outpatient visits. Furthermore, rapid TATs allow physicians to begin implementing appropriate treatment early, especially for patients in critical care where delays can be fatal.

This rapid diagnosis can lead to improved clinical outcomes for the patients as well as reductions in costs, particularly as POC diagnostics can help to reduce the length of hospital stays. And, as the administering of rapid COVID testing has recently proved, the ease of POC diagnostics means they can be performed by people who are not trained in clinical laboratory sciences.

Material selection

When it comes to the choice of materials used in the manufacturing of diagnostic testing, the selection of the appropriate fabric type and coating depends on the test's functionality. The phenomenon of wetting or non-wetting of a solid by a liquid is better understood by studying what is known as the contact angle of a liquid drop on a condensed surface. The lower the contact angle between a liquid drop and fabric surface, the better the hydrophilic action of the fabric.

According to Marcel Rutz, corporate market manager (medical) at leading manufacturer of precision fabrics Sefar: "When necessary, and as an alternative or a complementary process in addition to the finishing processes, wet-chemical or plasma treatments can give the fabric the physical or chemical properties required for its intended application. It can be made water-repellent (hydrophobic) or be made absorbent (hydrophilic) so that liquids will quickly and evenly spread out in it.

"Testing strips made of fabric are hydrophilic treated. The strips are used as blood markers as well as for measuring blood sugar or blood ketone, for example. However, they are not only used in the field of blood testing, but with common uses also in drug testing, urine, or saliva. In other words, all bodily fluids."

Overcoming reliability hurdles

The key challenge associated with the current dominating POC technology, lateral flow immunoassays, is limited sensitivity. In infectious diseases, for example, existing lateral flow assay technology has shown to be not sufficiently sensitive, resulting in a high false-negative rate, and the need for further lab tests.

But thanks to developments in the fabric technology used in diagnostic testing strips, gains are being made in improving test sensitivity. At Sefar, for example, its high-precision woven fabrics represent an important component of diagnostic test strips with the ability to increase the speed and reliability of results.

Sefar's Meditex® line offers a range of solutions for healthcare providers with properties including hydrophilic surfaces (HPL), specific colours (COL), multiple layers (ACC), or structures such as knitted fabrics (KNT), with all functional and biocompatible properties tailored according to the customer's requirements. Meditex has been designed with a homogeneous structure and hydrophilic surface to guarantee a rapid and even distribution,

allowing for maximum flexibility in the design of test strips and guaranteeing accurate and reproducible test results.

Sefar fabrics can also be modified by plasma activation or wet chemical procedures to achieve specifically functionalised surfaces, with functional groups such as amino and carboxy enhancing the binding of antigens (or antibodies) onto the surface of the fabric. Spacer molecules may also be bound onto the functionalised fabric surfaces. These facilitate the immobilisation of antigens or antibodies onto the fabric's surface.

By utilising a woven fabric, the overall performance of a test strip can be enhanced, helping to increase the lateral flow rate and decrease response time, as well as playing a role in the reduction of sample volume. Consequently, user acceptance is increased, along with the homogeneity of sample distribution and accuracy of results.

According to Rutz: "Meditex offers a great advantage for market admission. It also offers high stability of fabric which translates into reduced waste when compared with non-woven materials.

"Our product line is ideally suited to a range of clinical needs, and we work together with our customers to develop individual fabrics to solve problems and deliver accurate, reliable results."

For further questions please contact medical@sefar.com