Press Release

Rapid Diagnostics Proven in Medical Practice

Point-of-Care Technologies (POCT) for Environmental Diagnostics – Protecting Water, Soil, Air, and Responding to Hazardous Situations

The acronym POCT stands for point-of-care testing – patient-centered testing and diagnostics performed directly at the site of care rather than in a laboratory, for example, in a patient's home or in an ambulance. POCT is often the method of choice when fast, reliable results are required with minimal effort. Point-of-care technologies are now finding their way into environmental diagnostics as well. Examples include monitoring wastewater and surface waters, sensor-based systems to improve barn climate in livestock operations, and mobile soil analysis for more precise fertilizer application in agriculture. Rapidly available data can also help protect lives in a wide range of hazardous situations.

POCT focuses on individual measurements and spot assessments conducted directly on site, without the need for permanently installed systems. The emphasis is on fast, low-effort analyses that require minimal sample preparation and offer maximum flexibility for situational deployment. As the following examples illustrate, POCT is particularly well suited to changing operating environments and circumstances that require immediate decisions.

Sensor-Based On-Site Diagnostics as a Foundation for Real-Time Control in Wastewater Treatment

Decentralized wastewater treatment plants and small-scale treatment systems, such as those used at campgrounds, are subject to strict environmental regulations. At the same time, they must be operated efficiently and at low cost. Occasional measurements alone are generally insufficient to achieve optimal treatment performance.

POCT can play a key role in data-driven, automated wastewater management. Decentralized on-site analytics can continuously and rapidly provide essential process data such as flow rates, nutrient levels, and oxygen concentrations. Data acquisition can be achieved using highly accurate and cost-effective sensors, each with specific strengths and limitations.

The intelligent networking of these sensors opens up opportunities for remote monitoring and data-driven process control. If sufficiently smart – and robust – sensors are available, treatment processes can be controlled in real time, while maintenance activities can be planned proactively through accurate predictions of the optimal intervention time (predictive maintenance).

In addition, a digital twin of the treatment plant – a precise virtual representation of the physical system – enables a deeper understanding of process interactions and supports operation closer to optimal performance. Economic efficiency can be increased further by combining a limited number of low-cost sensors with suitable AI models. In many cases, good measurement quality is sufficient; laboratory-grade accuracy is not always necessary.

Sensor-Based Water Wall for Improved Barn Climate in Pig Farming

Agricultural livestock production generates greenhouse gases such as methane and nitrous oxide. Ammonia emissions originating from animal waste also contribute indirectly to an unfavorable environmental footprint. Farms face increasing regulatory pressure to reduce emissions while simultaneously maintaining animal welfare, energy efficiency, and economic viability.

One promising approach is a sensor-based water wall system that captures harmful gases and dust particles from the barn air while also improving the indoor climate through water evaporation (adiabatic cooling). Such a system is controlled by a network of sensors – for example, measuring ammonia, CO_2, temperature, and humidity – combined with intelligent algorithms that provide the foundation for targeted emission reduction. The conflict between emission control, animal comfort (e.g., avoiding drafts), and energy efficiency can be mitigated through adaptive, data-driven operation that continuously establishes favorable environmental conditions. As a result, significant reductions in ammonia and dust levels, along with lower microbial loads, can be achieved while maintaining more stable temperature and humidity conditions within the barn.

Successful practical deployment requires robust sensor technology capable of withstanding harsh barn environments, as well as customized control systems. An additional benefit of collecting sensor data is the ability to identify correlations between barn climate and animal behavior, such as preferred resting areas. The sensor system can therefore also serve as an indirect indicator of animal welfare.

Mobile Soil Analytics for More Targeted Fertilizer Application

Modern agriculture must address the challenges of climate change and resource scarcity. Conventional laboratory analyses are often too time-consuming and expensive when rapid responses are required. By contrast, direct on-site approaches allow data to be collected immediately in the field.

Technology and Operating Principles
Mobile, miniaturized electrochemical sensors and IoT networks are the basis. The sensor systems and connected IT infrastructure enable continuous monitoring of critical soil parameters, including:

- Nutrients: especially nitrate, which is crucial for both crop yield and environmental protection.
- Soil properties: pH value and temperature.
- Water balance: soil moisture.

Benefits of On-Site Analytics

Because soil conditions vary significantly across both space and time, high measurement density is essential. Mobile diagnostics offer several key advantages:

- Real-time data: Results are available immediately, without having to send samples to an external laboratory.
- Precision: Fertilization and irrigation can be tailored precisely to the needs of individual field zones.
- Sustainability: Targeted interventions reduce costs and minimize environmental impacts, such as nitrate leaching.

Moving analytics from the laboratory directly into the field is therefore a key enabler of data-driven agriculture. It combines economic efficiency with environmental responsibility and supports highly precise, real-time farm management.

Mobile Analytics Can Save Lives in Hazardous Situations

A critical application area for mobile analytical systems is the rapid detection of chemical, biological, radiological, and nuclear (CBRN) hazards. Such threats may arise from industrial accidents, fires, or deliberate attacks. In crisis situations, hazardous substances must be identified on site and without delay, enabling emergency responders to take immediate action rather than waiting for time-consuming laboratory analyses.

A range of portable technologies is available for this purpose. Handheld ion mobility spectrometers (IMS), for example, can detect toxic industrial chemicals in the air within seconds at concentrations down to the ppm (parts per million) or ppb (parts per billion) range and automatically trigger alarms. Mobile mass spectrometers and infrared spectrometers can be used to identify more complex substances.

Mobile analytics is highly versatile. It supports both the continuous monitoring of critical infrastructure and the reliable assessment of hazardous situations directly at the incident site. To ensure reliable operation under extreme conditions, these systems must feature a compact, rugged design and intuitive user interfaces that enable effective use by non-specialist personnel.

Combined with automated data analysis that converts measurement results directly into actionable recommendations, mobile analytical technologies significantly enhance emergency response capabilities and disaster management.

Driving Force Behind POCT in Saxony: DIANA

The ability to obtain and evaluate health-related measurement data directly at a patient's location—simply, cost-effectively, and reliably—can provide a decisive time advantage in many situations. To advance such technologies, **DIANA** has established a network in Saxony dedicated to the development and manufacturing of innovative point-of-care diagnostics. While the **primary focus** is **on human healthcare applications**, the alliance also sees significant demand for rapid and reliable diagnostic solutions in **nursing care**, **veterinary medicine**, and **environmental engineering**.

DIANA stands for DIAgnostics and Sustainability (NAchhaltigkeit) and currently brings together approximately 80 partners, including small and medium-sized enterprises, research institutions, and supporters from education and civil society. Established as an alliance in 2022, the partners founded the association "DIANA Point-of-Care Technology Central Germany" in 2023. The alliance and the association are coordinated by Fraunhofer IWU, Fraunhofer IZI, and EKF-diagnostic GmbH. VEMASinnovativ is also an important partner within the DIANA network.

The examples presented here were showcased during the DIANA Workstation held on April 28, 2026, at the Kurt Schwabe Institute for Measurement and Sensor Technology (KSI) in Meinsberg.

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Fig. 1 POCT diagnostics: individual measurements and spot assessments directly on site – without permanently installed systems – for rapid, low-effort analyses. © Fraunhofer IWU I AI generated

Fig. 2 "From Measurement to Decision – The Future of Diagnostics in Wastewater Engineering." Presentation by Lars Bergmann, VIADUCT TECHNOLOGIES GmbH, at the DIANA Workstation, April 28, 2026, Meinsberg. © VIADUCT TECHNOLOGIES GmbH, created using OpenAI ChatGPT (image generation), 2026

Fig. 3 "ION+ Sensor-Based Water Wall for Improved Indoor Climate in Finishing Pig Production." Presentation by Anna-Luise Böhm, Frankenförder Forschungsgesellschaft mbH, DIANA Workstation, April 28, 2026. © Kurt Schwabe Institute for Measurement and Sensor Technology Meinsberg e.V. (Jens Zosel)

Fig. 4 “From the Laboratory to the Field – Mobile Soil Analytics as a Building Block of Precision Agriculture.” Dr. Alfred Kick, Kurt Schwabe Institute, DIANA Workstation, April 28, 2026. © iStock | Maksym Belchenko

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