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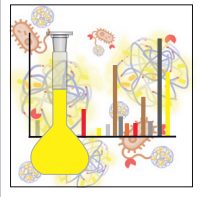

Highlights of Analytical Sciences in Switzerland

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Optical Point-of-Care Diagnostics Against Superbugs

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Antimicrobial resistance (AMR) is one of the most concerning health threats worldwide, with 4.95 million deaths reported in 2019. The spread of AMR is so rapid and challenging to handle that it is considered a 'silent pandemic'. Current diagnostic methods are based on time-consuming or expensive techniques. As a result, clinicians often prescribe broad-spectrum antibiotics, a practice that helps bacteria develop resistance mechanisms and is one of the main causes of AMR.

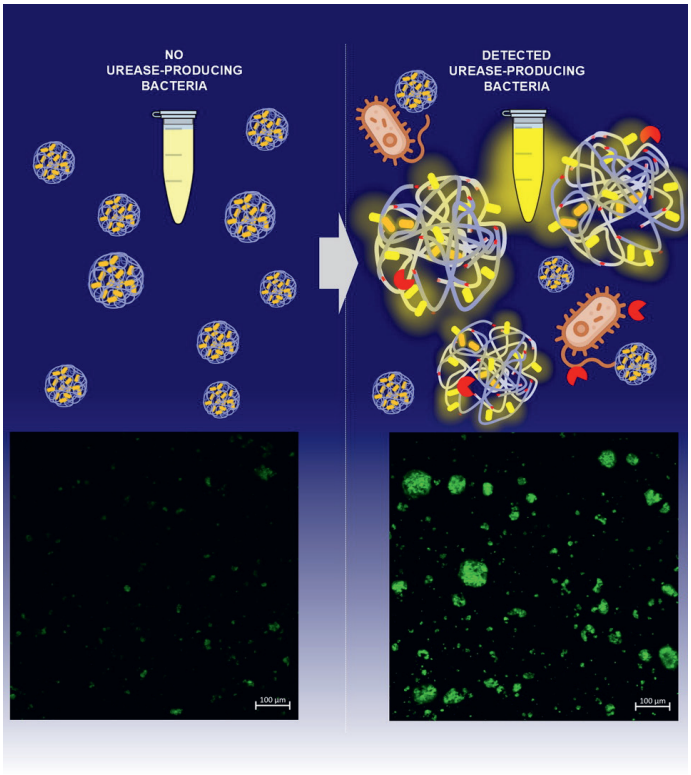

Fig. 1. Fluorescent particles enabling the selective detection of urease-producing bacteria. Confocal microscopy analysis confirmed the mechanism of detection: In the presence of urease-producing bacteria, the particle's matrix expanded, leading to an increase in the fluorescent signal, enabling the quantification of the bacteria in the sample.

Our research focuses on developing optical sensors based on bioresponsive nanomaterials suitable for the rapid and sensitive diagnosis of bacterial infections. Our strategy is to synthesize nanomaterials that react selectively with specific biomarkers released by the bacteria, leading to a variation of optical signals easily detectable without the need for sophisticated instrumentations. Such systems are also designed to be cost-efficient, easy-to-use, and equipment-free, meeting the ASSURED criteria (*i.e.* Affordable, Sensitive and Selective, User-friendly, Rapid, Equipment-free, and Delivered). For example, in collaboration with Prof. Dr. W. Albrich and PD Dr. med. C. Kahlert from the Cantonal Hospital St. Gallen KSSG, we recently developed fluorescent particles for the selective detection of urease-producing bacteria such as *K. pneumoniae*, which is relevant for respiratory tract infections and ranked with high priority in the WHO's 2024 Bacterial Priority Pathogens List. To note, the particles enable the detection of 10^3 bacteria/mL in 5 hours, which were not detectable using a standard pH-based method. We are also developing wearable devices enabling self-monitoring by patients based on fluorescent or color changes, supporting rapid and accessible care.[1] These are intended to detect bacteria causing urinary tract infections (*i.e. E. faecalis*) and wound infections (*i.e. S. aureus*), among others. By reducing the delay in the diagnosis, these approaches will enable the prompt administration of the appropriate treatment, limiting the misuse of antibiotics, but also significantly improving patient outcomes. Furthermore, thanks to the cost-efficacy and portability, these methods will be suitable for the ambitious but necessary goal of globally tackling AMR, also in countries where access to medical care is limited. **Such responsive materials will pave the way for the next generation of diagnostics, combining sensitivity, specificity, and cost-efficacy.**

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[1] W. C. Albrich, C. R. Kahlert, S. Nigg, L. F. Boesel, G. Giovannini, *Anal. Chem.* **2024,** *96*, 20578, https://doi.org/10.1021/acs.analchem.4c05182.

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