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Title: VERI-5®: a compact hardware and single use cartridge system for rapid detection of Urinary Tract Infections

Introduction

Urinary Tract Infections are one of the most common bacterial infections, resulting in an estimated 404 million cases, 236,790 deaths and 520,000 disability-adjusted life years across the world in 2019. The absence of fast and sensitive diagnostic tests at the point of care, significantly impacts care delivery by delaying treatments or un-necessary use of empirical antibiotics.

To address this challenge, we have developed a compact hardware and single use cartridge system (VERI-5®) to identify Urinary Tract Infections in just 15-minutes. In this work, we prove feasibility of our latest prototype via automated processing of TSB and spiked-urine samples to accurately determine their bacterial composition.

Materials and Methods

A combination of reference and clinical isolates *E. coli, K. pneumoniae, P. mirabilis* and *E. cloacae* were standardised to concentrations between 10^5– 10^8 CFU/mL. All analysts were blinded to sample identity and results confirmed via comparison to traditional colony counting techniques.

10uL of NANOPLEX® probes were pre-loaded into VERI-5® cartridges and sealed for use. 20uL of the sample was introduced to the microfluidic cartridge into each capillary line. Sample and probes were pushed pneumatically into each chamber for mixing, imaging and analysis using proprietary software.

Results

A total of 30 cartridges were tested against probes relevant for 4 bacterial species.

Images were analysed for unique features including 2-bead, 3-bead, large clusters, cluster to beads ratio and background entropy. Using a combination of these features it was possible to discern positive samples at $\geq 5.0 \times 10^5$ CFU/mL in TSB and $\geq \times 10^6$ CFU/mL for spiked urine for all species tested.

Discussion

VERI-5® was able to successfully detect the top 4 common gram-negative pathogens in UTI at clinically relevant concentrations. Larger clinical studies are ongoing to validate these results and further optimise the workflow to increase the limit of detection.
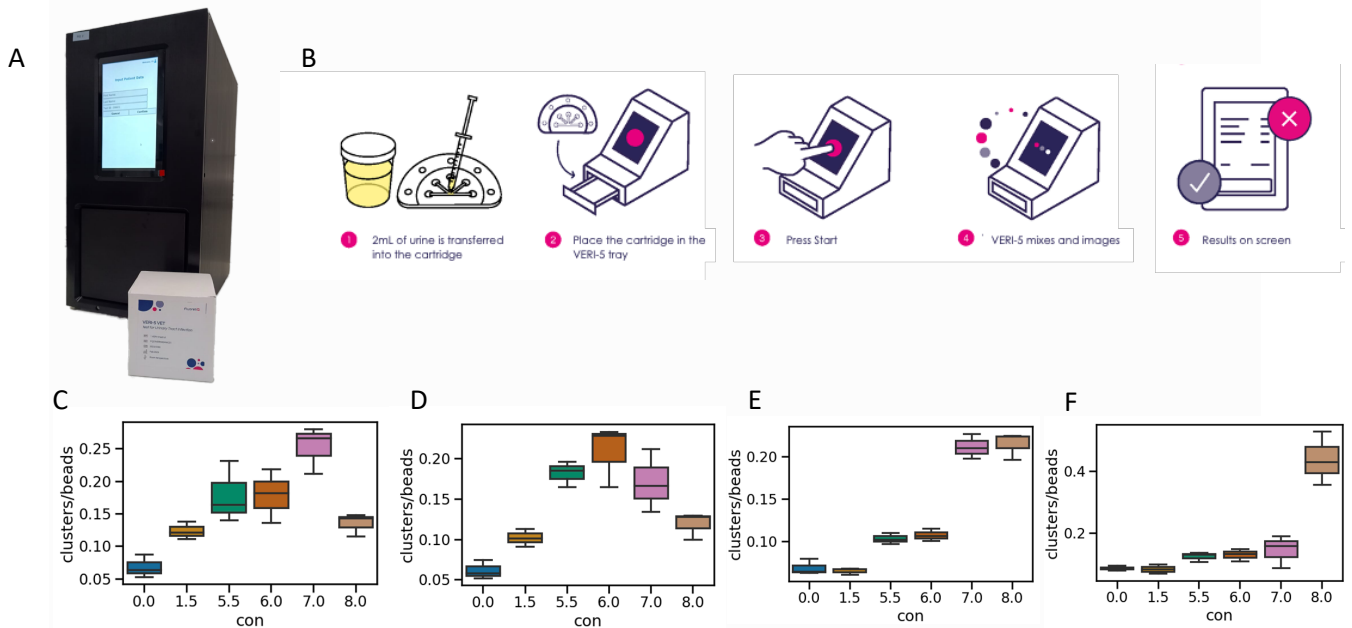
Figures 1

Figure 1: Overview of VERI-5® protocol and results

A: Picture of latest VERI-5® instrumentation and cartridge packag

B: Schematic of workflow used in VERI-5® testing

C: Cluster to bead ratio for *Enterobacter cloacae* in TSB

D: Cluster to bead ratio for *Escherichia coli* in TSB

E: Cluster to bead ratio for *Klebsiella pneumoniae* in TSB

F: Cluster to bead ratio for *Proetus mirabilis* in TSB

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