Using wasted time: How a portable culture device can reduce the impact of transportation times in antimicrobial susceptibility testing

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Background

Timely antimicrobial therapy is paramount to improve sepsis patient outcomes and reduce costs. Extremely resistant Gram-negative species are strongly associated with mortality[1, 2]. It is recommended that patients receive antibiotic treatment within one hour of admission[3]. Transportation time is the main factor that delays the detection of bacterial pathogens in blood cultures[4]. Figure 1 shows time until the blood samples were loaded in incubation cabinets from sampling, in a hub and spoke hospital system in Scandinavia.

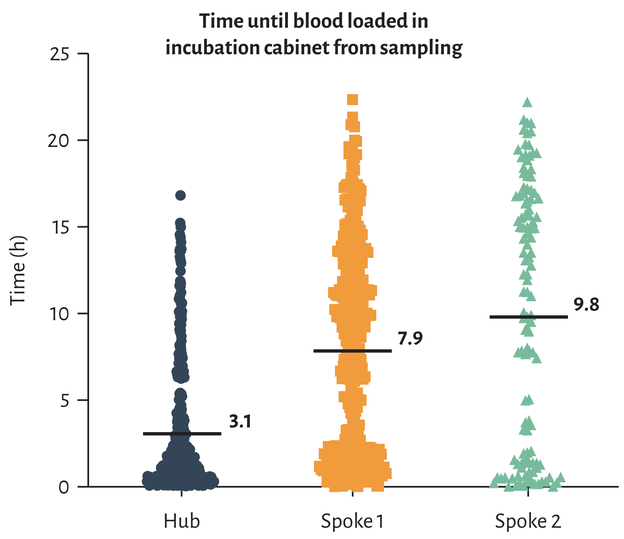


Fig 1. Data showing time until blood loaded in incubation cabinet from sampling for a hub and spoke hospital system. Average time was 3 hours for the hub hospital, and 8 and 10 hours for the two spoke hospitals. 43% of all samples had a sampling-to-load time greater than 6 hours, and 28% of all samples had a sampling-to-load time greater than 10 hours. 2 hours was removed from the values to represent order to sampling time.

Podler® – the world's first portable blood culture device

Podler is a portable culture device (PCD), capable of incubation, agitation, and continuous detection of bacteria in blood samples, developed by Q-linea. The device is currently in the prototype stage of development. With the use of Podler, incubation can begin immediately following blood draw. Podler utilises wasted transportation time to be used incubating the sample, therefore reducing the time taken for a result. The Podler Unit is shown to the right.

The workflow of Podler versus standard of care is shown in Figure 2.

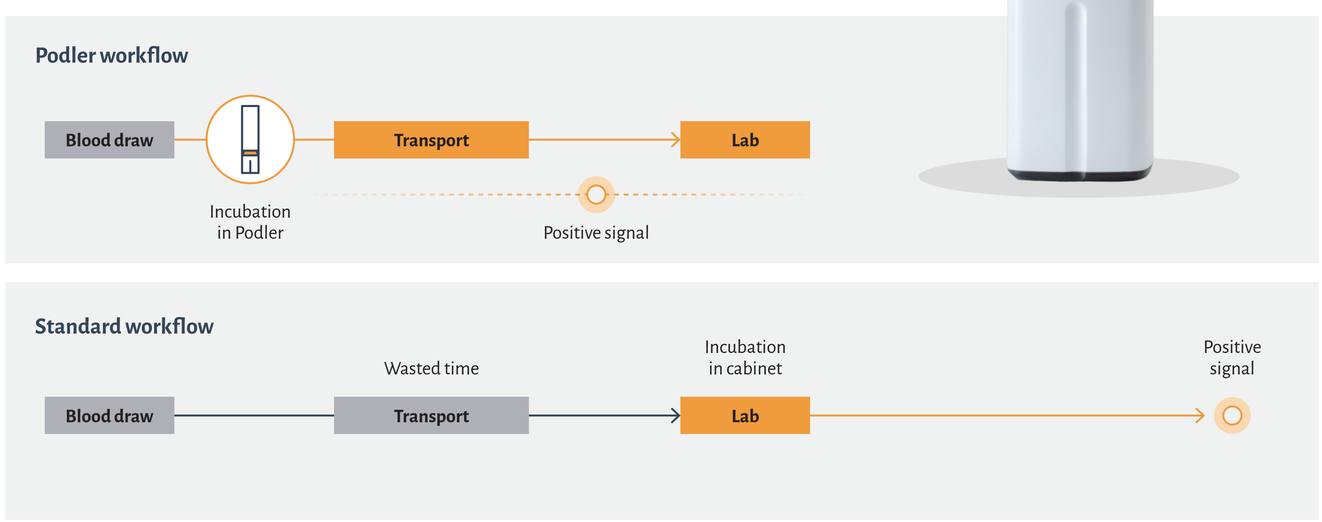


Fig 2. Podler vs standard of practice workflow.

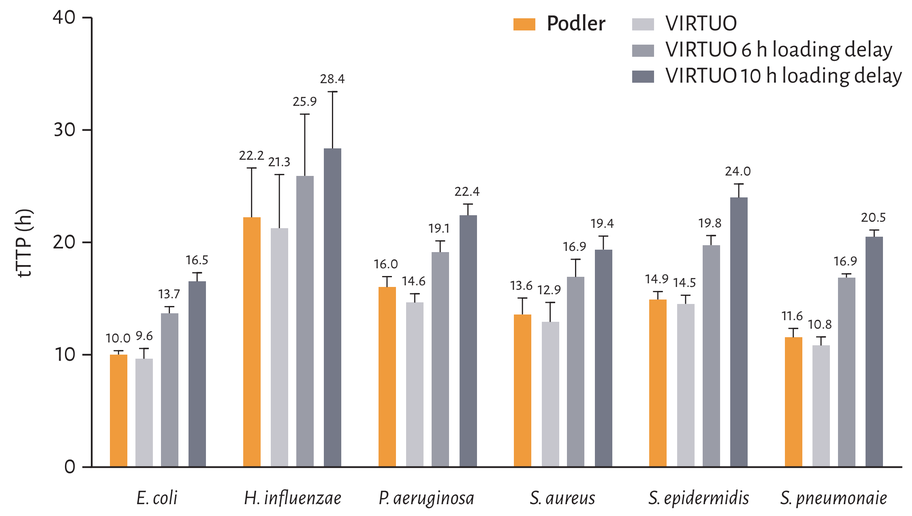
Materials and methods

Benchmarking was performed against BACT/ALERT VIRTUO® using immediate loading and 6 and 10-hour delayed entry testing to simulate delays caused by transportation time. The transportation times shown in Figure 1 was used as the basis for determining the delayed entry time. The total time to positivity (tTTP), the time between inoculation of bottles and positivity was examined. In this study, BACT/ALERT FAN® PLUS bottles were inoculated with common sepsis-causing pathogens at clinically relevant inoculum and 9 ml of human blood. In the delayed entry tests, inoculated bottles were stored at 20°C to 23°C for 6 hours or 10 hours before loading.

Results

Benchmarking showed that for the set of Gram-negative and Gram-positive bacteria included in the test, Podler had an overall average tTTP within 42 minutes when compared with BACT/ALERT VIRTUO. With a 6-hour delayed entry in BACT/ALERT VIRTUO, Podler demonstrated lower tTTP, signalling positive an average of 4 hours earlier. At a 10-hour delayed entry in BACT/ALERT VIRTUO, Podler had an average tTTP of more than 7 hours faster. Benchmarking and results for delayed entry in VIRTUO are shown in Figure 3, per bacteria species.

Fig 3. The effect of delayed entry on total time to positvity (tTTP) of six clinical pathogens. Simulated blood cultures were in parallell loaded in the Podler Prototype (Podler) and the VIRTUO cabinet (VIRTUO) directly after inoculation, or loaded in the VIRTUO cabinet with a delay of either 6 hours (VIRTUO 6 h loading delay) or 10 hours (VIRTUO 10 h loading delay). Flasks were stored in room temperature (20°C to 23°C) prior to loading. Error bars represent standard deviation. A total of 192 flasks were included (n = 8 per pathogen and condition).



Conclusion

A long tTTP increases the time for patients to be administered optimal therapy. Transportation time has a major impact on tTTP. Podler had a comparable tTTP to BACT/ALERT VIRTUO and when utilising a delayed entry to simulate transportation time, faster results for a set of Gram-negative and Gram-positive bacteria. Reducing TTP has been shown to improve the clinical outcome of patients. Podler from Q-linea has the potential to reduce the negative impact of transportation time on tTTP and improve clinical outcomes.

References

1. Gaieski, D. F., Mikkelsen, M. E., Band, R. A., Pines, J. M., Massone, R., Furia, F. F., Shofer, F. S., & Goyal, M. (2010). Impact of time to antibiotics on survival in patients with severe sepsis or septic shock in whom early goal-directed therapy was initiated in the emergency department. *Critical Care Medicine*, *38*(4), 1045–1053. https://doi.org/10.1097/CCM.0b013e3181cc4824
2. Kerremans, J. J., Van Der Bij, A. K., Goessens, W., Verbrugh, H. A., & Vos, M. C. (2009). Needle-to-incubator transport time: Logistic factors influencing transport time for blood culture specimens. *Journal of Clinical Microbiology*, *47*(3), 819–822. https://doi.org/10.1128/JCM.01829-08
3. Rhodes, A., Evans, L. E., Alhazzani, W., Levy, M. M., Antonelli, M., Ferrer, R., Kumar, A., Sevransky, J. E., Sprung, C. L., Nunnally, M. E., Rochwerg, B., Rubenfeld, G. D., Angus, D. C., Annane, D., Beale, R. J., Bellinghan, G. J., Bernard, G. R., Chiche, J. D., Coopersmith, C., … Dellinger, R. P. (2017). Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. *Intensive Care Medicine*, *43*(3), 304–377. https://doi.org/10.1007/s00134-017-4683-6
4. Santoro, A., Franceschini, E., Meschiari, M., Menozzi, M., Zona, S., Venturelli, C., Digaetano, M., Rogati, C., Guaraldi, G., Paul, M., Gyssens, I. C., & Mussini, C. (2020). Epidemiology and Risk Factors Associated With Mortality in Consecutive Patients With Bacterial Bloodstream Infection: Impact of MDR and XDR Bacteria. *Open Forum Infectious Diseases*, *7*(11), ofaa461. https://doi.org/10.1093/ofid/ofaa461

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