Q-LINEA

Advantages of the ASTar System

Broad antimicrobial panel and true MIC results for early and optimal treatment of bloodstream infections

Current standards of care for patients with bloodstream infections are not always optimal. This is largely due to the time lag between blood sampling, blood culture positivity, and the delivery of reports from antimicrobial susceptibility testing (AST). ASTar is a fully automated rapid AST system delivering true MIC results over a broad panel of antimicrobials. The broad antimicrobial panel reduces the demand for follow-up testing and a comprehensive AST report is delivered in approximately six hours. Boosting workflow efficiency, reducing hands-on labour, delivering AST results faster, and facilitating the earlier start of optimal antimicrobial treatments, ASTar is a major boon for laboratory staff, clinicians, and patients.

Introduction

Informed treatment of care for patients with a bloodstream infection requires timely availability of antimicrobial susceptibility testing (AST) results and faster optimisation of therapies to reduce the risk of disease progression and to help improve patient outcomes. Additionally, to contend with growing rates of global antimicrobial resistance (AMR), rapid diagnostic methods are needed to govern the appropriate use of antimicrobials and support antimicrobial stewardship programs (ASPs). Together, there is the interwoven importance of ASPs and the involvement of rapid AST to ensure the continued success of antimicrobial therapies during the treatment of infections[1-3].

In the current standard of care, AST results for bloodstream infections are typically reported no earlier than the second day after a blood draw – though laboratory workflows may vary. Because of these potential delays, clinicians are forced to rely on empiric therapy during the first few days of a patient's treatment. This empiric, and potentially inappropriate, antimicrobial therapy not only drives the development of resistance but may also prolong patient hospitalisation and increase the risk of mortality[4,5].

Rapid AST can support a faster and more informed response for clinical intervention, reducing the extent of antimicrobial exposure and helping to enhance patient treatments, while concurrently reducing hospital and ICU length of stay, thereby contributing to cost savings[6-8].

ASTar – Rapid AST Results

ASTar is a fully automated system for rapid AST. The ASTar technology is based on broth microdilution (BMD) optimised for shortened time-to-result and conducting phenotypic AST based on continuous two-fold antimicrobial dilutions, delivering true minimum inhibitory concentration (MIC) results and SIR categorisation in approximately six hours. This saves approximately 24 hours to treatment optimisation when compared to conventional workflows. Automated testing is conducted directly on positive blood cultures without the requirement for any additional culturing steps, significantly reducing the amount of manual labour required and yielding substantial time savings for hospital personnel.

Controlled Inoculum

Accurate MIC is needed by clinicians in order to determine the correct antimicrobials and antimicrobial dosages to administer to patients. Some automated AST systems rely on a fixed dilution of positive blood cultures as input to the system. However, fixed dilution methods may result in an inconsistent inoculum. This can potentially affect the final MIC values reported and therefore the consequent treatment.

ASTar overcomes this inoculum effect by measuring actual bacterial content during sample preparation and consistently generating final inoculum concentrations that fall within EUCAST and CLSI guidelines. This enables high reliability and repeatability for each sample run. Samples can be tested up to 16 hours after signalling positive with retained performance[9].

Figure 1. The ASTar System covers a broad antimicrobial panel and range of dilutions. Packaged in a user-friendly and fully-automated rapid AST platform, the instrument delivers AST reports in ~6 hours.

Table 1. Antimicrobials and antimicrobial dilution ranges for the ASTar BC G– Kit. Reportable range is expressed as ≤ x to > y mg/L.

ASTar BC G–	Reportable range		Dilutions
Non-fastidious	(mg/L)	0.008 0.015 0.03 0.06 0.125 0.25 0.5 1 2 4 8 16 32 64 128 256	
Amikacin	0.5	128	9
Gentamicin	0.25	32	8
Tobramycin	0.06	32	10
Ertapenem	0.015	16	11
Meropenem	0.06	64	11
Meropenem-vaborbactam[1]	0.25	32	8
Cefazolin	0.25	16	7
Cefepime	0.25	64	9
Cefotaxime	0.015	128	14
Cefoxitin (screen)	1	64	7
Ceftazidime	0.25	64	9
Ceftazidime-avibactam[2]	0.125	32	9
Ceftolozane-tazobactam[3]	0.125	32	9
Ceftriaxone	0.015	128	14
Cefuroxime	1	64	7
Ciprofloxacin	0.06	8	8
Levofloxacin	0.125	16	8
Trimethoprim-sulfamethoxazole[4]	0.06	8	8
Aztreonam	0.25	64	9
Amoxicillin-clavulanic acid[5]	1	32	6
Ampicillin	1	64	7
Piperacillin-tazobactam[2]	0.25	256	11
Colistin	0.25	8	6
Tigecycline	0.03	16	10
Fastidious			
Meropenem	0.015	8	10
Cefotaxime	0.015	2	8
Ceftriaxone	0.03	2	7
Levofloxacin	0.03	8	9
Amoxicillin-clavulanic acid[5]	0.5	32	7
Ampicillin	0.03	4	8

[1] For susceptibility testing purposes, the concentration of vaborbactam is fixed at 8 mg/L
[2] For susceptibility testing purposes, the concentration of avibactam is fixed at 4 mg/L
[3] For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L
[4] Trimethoprim:sulfamethoxazole in the ratio 1:19
[5] For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L

The AST Disc

The ASTar Disc contains more than 330 culturing chambers, including those pre-filled with antimicrobials in various concentration ranges, growth control chambers, and chambers used to determine bacterial concentration for inoculum preparation. The antimicrobial panel and ASTar process includes the testing capacity for fastidious and non-fastidious pathogens in one kit, enabling testing to begin prior to the input of species ID, which is only required for the generation of the final report.

Broad Antimicrobial Panel and Adaptable Disc Space

There is a distinct need for comprehensive coverage of different antimicrobials and antimicrobial dilutions for use in AST. The ASTar BC G- Kit covers a broad range of dilutions of 24 different antimicrobials across 6—14 two-fold dilutions per antimicrobial. All 24 antimicrobials evaluate the susceptibility of non-fastidious organisms, and six of these can treat infections caused by fastidious organisms. In total, the ASTar BC G- Kit currently tests 14 species and supports 233 different bug/drug combinations.

There is room to add additional types of antimicrobials in the future, without the need to remove any of the existing antimicrobials.

The Disc design accommodates a testing capacity ranging from very low to very high MIC values. All dilutions are measured simultaneously at each time point, thereby removing the need for extrapolated values and instead reporting true MIC. The comprehensive MIC-driven optimal dosing regimen guided by ASTar can reliably support the prescription of appropriate treatments.

Figure 2. The Disc during AST reading. The unique proprietary technology allows automated time-lapse imaging of bacterial population growth in chambers containing different concentrations of antimicrobial agents .

Conclusion

AST is initiated directly from a positive blood culture and ASTar can be started independently of pathogen ID, which can be entered before, during, or after the AST run to create the final AST report. This shortens the total time to optimise antimicrobial treatment by approximately 24 hours in common laboratory workflows (but can save up to 48 hours) compared to conventional methodology. Full automation reduces hands-on time to just a few minutes and helps improve data quality. The disc design supports a comprehensive AST panel and the simultaneous measurement of a broad range of antimicrobial dilutions for MIC determination. A single ASTar test delivers both MIC and SIR data for a broad set of antimicrobials, increasing the likelihood that relevant treatment options are included in the initial AST report and minimising the need for follow-up testing. ASTar is a comprehensive solution to AST that offers rapid results, a high standard of reporting and clinical flexibility.

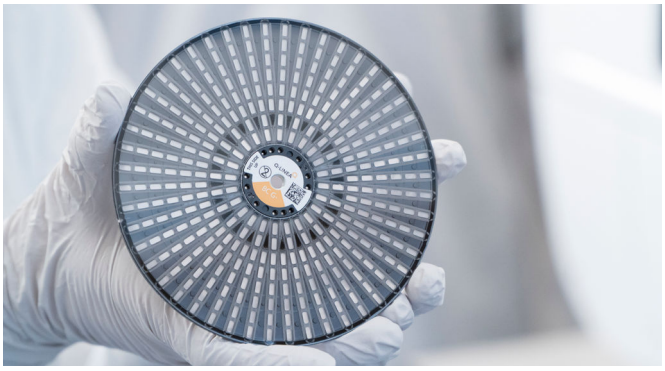

Figure 3. Optimised therapy in one run. The extensive antimicrobial susceptibility testing capabilities of the AST Disc deliver clinically actionable results in a single run.

References

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Q: In your opinion, what are the advantages for a microbiologist of having a broad antibiotic panel with extended ranges? Could you please provide some clinical examples in support of your statement?

A: When performing AST, accurate measurement of MIC values is essential for correct categorisation of antimicrobial susceptibility of bacterial isolates, which drives the selection of regimens and dosages for definitive antimicrobial therapy. When dealing with multidrug-resistant isolates, it is also important to test a broad panel of antibiotics to identify the few available options.

Systems that extrapolate MIC values from few data points may suffer from low accuracy, especially with multidrug-resistant isolates and drugs that are crucial to their treatment (e. g. carbapenems, polymyxins). For this reason, the availability of automated systems that can rapidly and accurately measure MICs for a broad antibiotic panel would be of great clinical interest.

Save lifetimes

At Q-linea, we design, develop, and deliver innovative technology to aid physicians and technicians to improve patient outcomes and save lives. We aim to vastly reduce the time to optimal therapy and ensure antibiotics continue to be an effective treatment for future generations. Q-linea helps to create sustainable healthcare, now and in the future. For patients, physicians, and society.

Q-linea was founded in 2008 by scientists from the Rudbeck Laboratory in Uppsala, Sweden. Today, Q-linea comprises an interdisciplinary, highly motivated team that operates out of state-of-the-art, customised facilities in Sweden, Italy, and the United States of America.

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