Rapid identification and antimicrobial susceptibility testing of bacteria in bloodstream infections using the Accelerate ID/AST technology

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OBJECTIVES: To evaluate the performance of the Accelerate ID/AST Technology for identification and antimicrobial susceptibility testing directly on clinical blood culture specimens.

METHODS: Fourteen clinical specimens (8 Gram-negative, 3 Gram-positive and 3 non-target) and six spiked blood cultures (6 Gram-negative) were tested. Twenty identification tests were performed and 113 susceptibility tests were performed using a panel of five Gram-positive (ceftaroline, doxycycline, erythromycin, linezolid, trimethoprim-sulfamethoxazole) or seven Gram-negative (amikacin, ceftazidime, ceftriaxone, ciprofloxacin, gentamicin, piperacillin-tazobactam, tobramycin) antibiotics. Remnant clinical positive blood culture specimens were obtained from Denver Health Medical Center, Denver Veterans Affairs Eastern Colorado Health Care System, and Washington Hospital Center (Washington, DC). Spiked samples were prepared by seeding 10 to 100 colony forming units into simulated blood culture bottles (1 part of healthy donor blood + 4 parts of BD BACTEC Standard Aerobic media), and incubating for approximately 20-24 h. After a sample aliquot was loaded onto the Accelerate ID/AST Technology, part of the sample was subjected to a 1 hour growth step, while the remaining sample underwent automated gel electro-filtration to reduce sample debris prior to pipetting it into independent flowcells of a disposable multichannel cassette. Electro-kinetic concentration immobilized cells onto the transparent lower surface of each flowcell channel. Immobilized cells were identified using cocktails of fluorescently labeled oligonucleotide probes and *in situ* hybridization. After the identification phase of the assay, the remaining sample was cleaned and immobilized in separate flowcells as previously described followed by exposure to a single concentration solution of each appropriate antibiotic in cation-adjusted Mueller-Hinton broth with 0.94% agar. An algorithm converted bacterial growth or inhibition in the presence of antibiotic into a minimum inhibitory concentration (MIC) value. The results were compared to Vitek 2 for identification and disk diffusion for susceptibility testing as comparator methods.

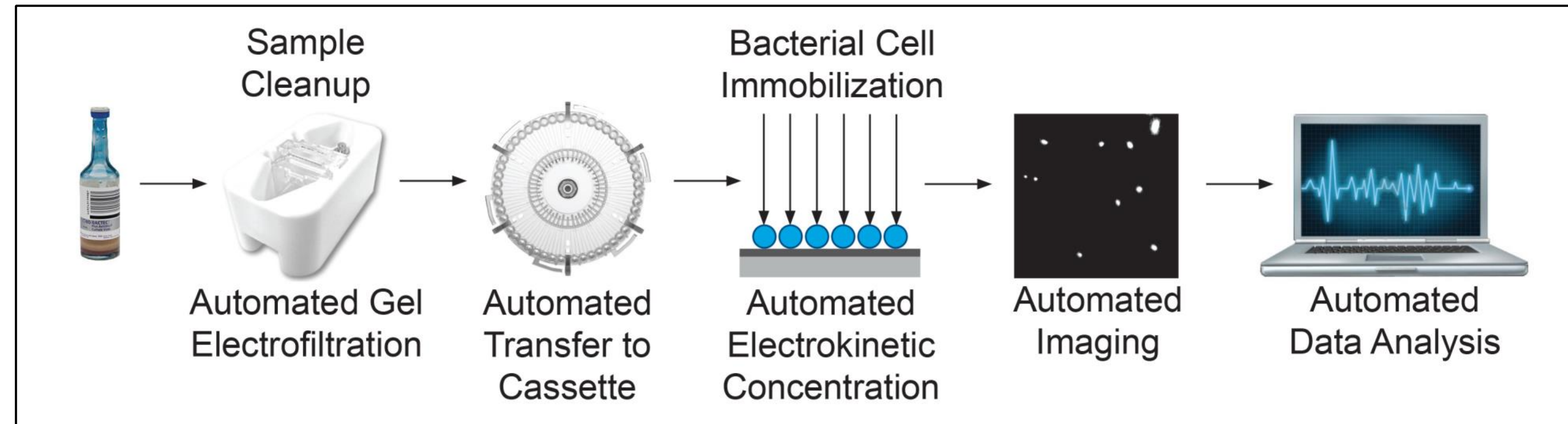


Figure 1. Accelerate ID/AST Technology process flow.

RESULTS: The Accelerate ID/AST Technology exhibited 95% overall agreement with Vitek 2 for identification (Table 1) and 91% categorical agreement with disk diffusion for susceptibility testing (Table 2). Four tests were excluded from analysis due to technical errors and 10 minor errors were observed. Identification results were produced in 1 hour and susceptibility results within 5 hours.

Table 2. Susceptibility test results for the Accelerate ID/AST Technology compared to disk diffusion.

Antimicrobial	Tests (n)	Total Test Failures (n)	Total Positive Matches (n)	Total Errors (n)
Ceftaroline	3	0	3	0
Doxycycline	3	0	2	1*
Erythromycin	3	0	2	1*
Trimethoprim-Sulfamethoxazole	3	0	3	0
Linezolid	3	0	3	0
Piperacillin-Tazobactam	14	0	11	3*
Ceftazidime	14	0	14	0
Ceftriaxone	14	1	11	2*
Amikacin	14	0	14	0
Gentamicin	14	2	11	1*
Tobramycin	14	0	13	1*
Ciprofloxacin	14	1	12	1*
TOTAL	**113**	**4**	**99**	**10***

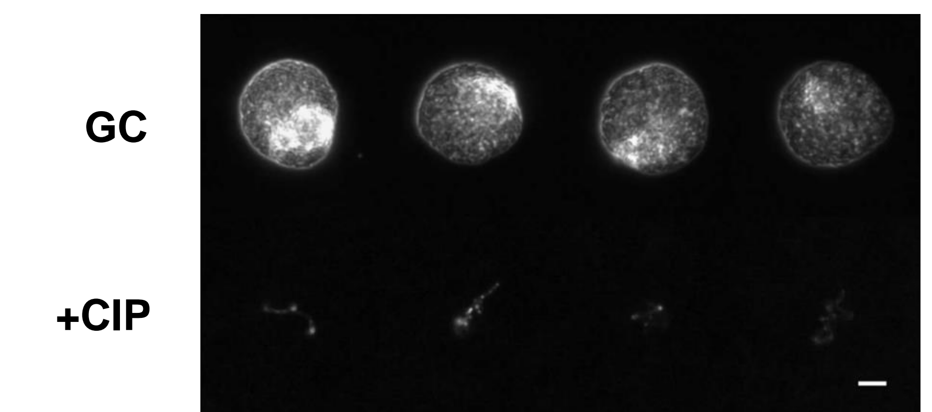
*minor error(s)

Table 1. ID results for the Accelerate ID/AST Technology compared to Vitek 2.

Organism	Total Tests (n)	Clinical Specimen (n)	Spiked Specimen (n)	Detected (n)	Not Detected (n)
E. coli	7	3	4	7	0
Klebsiella spp.	5	3	2	5	0
Proteus spp.	1	1	0	1	0
S.aureus	3	3	0	3	0
Non-Target	4	4	0	3	1*
TOTAL	**20**	**14**	**6**	**19**	**1**

*False positive result. *Shigella* spp. detected by *E. coli* probe

Video 1. Ciprofloxacin-susceptible *E coli* progenitor cells growing into clones of daughter cells from 0 to 4 hours. Clones show continuous growth in the growth control channel (GC), but lyse in 1 µg/mL ciprofloxacin (+CIP). Scale bar at lower right is 10 µm.



CONCLUSION: This study showed the technical feasibility of using the Accelerate ID/AST Technology for identification and antimicrobial susceptibility testing directly on clinical blood culture specimens. Further studies are needed to demonstrate the performance of the technology on additional clinical specimen types.

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