European Journal of Clinical Microbiology & Infectious Diseases (2019) 38:1199–1202
https://doi.org/10.1007/s10096-019-03522-1

LETTER TO THE EDITOR

Adoption of new technologies in laboratory workflow practices for positive blood culture bottles: a cross-sectional survey among hospitals in the Autonomous Community of Valencia, Spain

Juan Carlos Rodríguez[1] · Emilio Borrajo[2] · Montserrat Bosque[3] · Juan José Camarena[4] · Javier Colomina[5] · Ma. Victoria Domínguez Márquez[3] · Encarnación Fuentes[6] · José María García-Aguayo[7] · Adelina Gimeno[1] · Nieves Gonzalo[8] · Remedios Guna[9] · Olalla Martínez[10] · Rosario Moreno[11] · José Miguel Nogueira[4] · Nieves Orta[12] · Josep Prat[13] · Alberto Yagüe[14] · Concepción Gimeno[9] · David Navarro[5,15] · on behalf of the Working Group of the Autonomous Community of Valencia (ACV) for Optimization of Microbiological Diagnostic Processes

Received: 19 February 2019 / Accepted: 25 February 2019 / Published online: 2 March 2019

To the Editor,

Shortening turnaround times for positive blood culture (BC) identification (ID) and antimicrobial susceptibility testing (AST) may result in improved outcomes in patients with bloodstream infections [1–3]. To this purpose, a number of new rapid technologies (NRT), including mass spectrometry (MALDI-TOF MS), nucleic acid amplification-based tests (NAAT), and immunoassays for direct ID/AST and rapid detection of genotypic resistance [4–6] are available. Nevertheless, to what extent these had been adopted across European centers remains uncertain. Here, we conducted a cross-sectional Internet-based survey on laboratory workflow practices regarding positive blood culture bottles among 14 hospitals from the Autonomous Community of Valencia (ACV) to address this issue. Five out of the participating hospitals were large (> 500 beds). A 15-item questionnaire was developed by JCR and reviewed by CG and DN. No incentives (financial or otherwise) were provided to participants. A total of 107,538 blood cultures from 41,343 patients were processed in these hospitals from January 2017 to December 2017. The data for each participating center are shown in Table 1. Direct ID was performed by MALDI-TOF MS analysis in six laboratories (in the largest hospitals); two additional centers used a commercial immunoassay for *Streptococcus pneumoniae* identification; nevertheless, no center used multiplexed NAAT assays for this purpose. Direct phenotypic AST for both Gram-positive cocci and Gram-negative bacilli was performed at all centers, the majority using commercially available broth microdilution panels. Direct detection of genotypic resistance traits in Gram-negative bacilli (extended spectrum beta-lactamases, carbapenemases, or both) was performed in five laboratories by NAAT ($n = 4$) or immunoassays ($n = 1$); in turn, MRSA detection was

✉ David Navarro
david.navarro@uv.es

[1] Microbiology Service, Hospital General Universitario, Alicante, Spain

[2] Microbiology Unit, Hospital Vega Baja, Orihuela, Spain

[3] Microbiology Service, Hospital Arnau de Vilanova, Valencia, Spain

[4] Microbiology Service, Hospital Universitario Dr. Peset, Valencia, Spain

[5] Microbiology Service, Instituto de Investigación INCLIVA, Hospital Clínico Universitario, Valencia, Spain

[6] Microbiology Unit, Hospital Virgen de los Lirios, Alcoi, Spain

[7] Microbiology Unit, Hospital de Requena, Requena, Spain

[8] Microbiology Service, Hospital General Universitario, Elche, Spain

[9] Microbiology Service, Consorcio Hospital General Universitario, Valencia, Spain

[10] Hospital Universitario de la Ribera, Alzira, Spain

[11] Microbiology Service, Hospital General Universitario, Castellón, Spain

[12] Microbiology Unit, Hospital Francesc de Borja, Gandía, Spain

[13] Microbiology Unit, Hospital de Sagunto, Valencia, Spain

[14] Microbiology Unit, Hospital de La Plana, Castellón, Spain

[15] Microbiology Service, and Department of Microbiology, School of Medicine, Hospital Clínico Universitario, Av. Blasco Ibáñez 17, 46010 Valencia, Spain

Table 1 Workflow practices for blood culture bottles across hospitals in the Autonomous Community of Valencia (Spain)

Hospital[a]	No. of beds	BC (aerobic bottles) in 2017	Introduction of bottles in BC automated systems	Gram stain reporting	Staphylococci in Gram stain	Streptococci in Gram stain	Gram-negative bacilli in Gram stain	Antimicrobial stewardship	Reporting
HGUA	716	14,603	7 days/week (morning and afternoon shifts)	7 days/week (morning and afternoon shifts)	Direct AST (commercial BMD) and MRSA detection (NAAT)	Direct ID (MALDI-TOF MS) and direct AST (commercial BMD)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD), NAAT for ESBL and Carbapenemases	Yes	LIS and telephone
HCGUV	592	7399	7 days/week (morning and afternoon shifts)	7 days/week (morning and afternoon shifts)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD), and MRSA detection (immunoassay)	Direct ID (MALDI-TOF MS) and direct AST (disk diffusion test)	Direct ID (MALDI-TOF MS) and direct AST (disk diffusion test). NAAT for ESBL and carbapenemases in high-risk patients[b]	No	LIS and telephone
HCUV	582	13,674	24/7	24/7	Direct ID (MALDI-TOF MS), direct AST (commercial BMD), and MRSA detection (immunoassay)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD), immunoassay for carbapenemases	Yes	LIS and telephone
HUPA	538	9903	24/7	24/7	Direct AST (commercial BMD) and MRSA detection by immunoassay	Direct ID (MALDI-TOF MS), direct AST (commercial BMD)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD). NAAT for ESBL and carbapenemases in high-risk patients[b]	No	LIS and telephone
HGUC	520	11,250	5 days/week. Saturday morning shift	5 days/week. Saturday morning shift	Direct AST (commercial BMD) and MRSA detection by NAAT in high-risk patients	Direct ID (MALDI-TOF MS), direct AST (commercial BMD)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD). NAAT for carbapenemases in high-risk patients[b]	Yes	LIS and telephone
HGUE	410	7608	7 days/week (morning and afternoon shifts)	7 days/week (morning and afternoon shifts)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD), and MRSA detection (immunoassay)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD) and *Streptococcus pneumoniae* (detection by immunoassay)	Direct ID (MALDI-TOF MS), direct AST (commercial BMD)	No	LIS and telephone
HAV	378	7887	5 days/week. Saturday morning shift	6 days/week morning shift	Direct AST (commercial BMD)	No	Direct AST (commercial BMD)	Yes	LIS and telephone
HVBO	336	7570	6 days/week morning shift	6 days/week morning shift	Direct AST (commercial BMD)	No	Direct AST (commercial BMD)	Yes	LIS
HFBG	316	5800	24/7	6 days a week (morning shift)	Direct AST (commercial BMD)	Direct AST (E-test)	Direct AST (commercial BMD)	No	LIS and telephone
HULR	300	3319	24/7	5 days a week (morning shift)	Direct AST (commercial BMD) and MRSA detection (immunoassay)	Direct AST (Disk diffusion test). *Streptococcus pneumoniae* (detection by immunoassay)	Direct AST (commercial BMD)	Yes	LIS and telephone
HPC	260	3000			Direct AST (commercial BMD)	Direct AST (commercial BMD)	Direct AST (commercial BMD)	Yes	LIS and telephone

Table 1 (continued)

Hospital[a]	No. of beds	BC (aerobic bottles) in 2017	Introduction of bottles in BC automated systems	Gram stain reporting	Staphylococci in Gram stain	Streptococci in Gram stain	Gram-negative bacilli in Gram stain	Antimicrobial stewardship	Reporting
			6 days a week (morning shift)	5 days a week (morning shift)					
HS	252	7592	6 days/week (morning and afternoon shifts)	5 days a week (morning shift)	Direct AST (commercial BMD) and MRSA detection (immunoassay)	Direct AST (commercial BMD)	Direct AST (commercial BMD)	Yes	LIS and telephone
HVLA	248	3747	24/7	5 days a week (morning shift)	Direct AST (commercial BMD)	Direct AST (disk diffusion test). *Streptococcus pneumoniae* (detection by immunoassay)	Direct AST (commercial BMD)	No	LIS and telephone
HR	82		24/7	5 days a week (morning shift)	Direct AST (commercial BMD) and MRSA detection (immunoassay)	Direct AST (disk diffusion test). *Streptococcus pneumoniae* (detection by immunoassay)	Direct AST (commercial BMD)	No	LIS and telephone

AST, antimicrobial susceptibility testing; *BC*, blood culture; *BMD*, broth microdilution assay; *ESBL*, extended-spectrum beta-lactamases; *HAV*, Hospital Arnau de Vilanova; *HCGUV*, Hospital Consorcio Hospital General Universitario, Valencia; *HCUV*, Hospital Clínico Universitario, Instituto de Investigación INCLIVA, Valencia; *HFBG*, Hospital Francesc de Borja, Gandía; *HGUA*, Hospital General Universitario, Alicante, Spain; *HGUC*, Hospital General Universitario, Castellón; *HGUE*, Hospital General Universitario, Elche; *HPC*, Hospital de La Plana, Castellón; *HR*, Hospital de Requena; *HS*, Hospital de Sagunto; *HULR*, Hospital Universitario de la Ribera, Alzira; *HUPA*, Hospital Universitario Dr. Peset, Valencia; *HVBO*, Hospital Vega Baja, Orihuela; *HVLA*, Hospital Virgen de los Lirios, Alcoy; *ID*, identification; *LIS*, laboratory information system; *MALDI-TOF MS*, matrix-assisted laser desorption/ionization time-of-flight mass spectrometry; *MRSA*, methicillin-resistant *Staphylococcus aureus*; *NAAT*, nucleic acid amplification test

[a] The Autonomous Community of Valencia (ACV) per capita income/year is €22,055. The 14 participating hospitals attended 3,271,077 inhabitants in 2017, approximately 70% of registered residents in the ACV

[b] Detailed in Tormo et al. 2018 [10]

performed at nine centers (in seven by immunoassays and in two by NAAT). Differences across centers regarding the adoption of NRTs for microbial ID and genotypic resistance detection from positive BCs can be attributed to economic constraints, and perhaps to the scarcity of well-designed studies comparing different microbiological and workflow approaches from a cost-effectiveness perspective. Although harmonizing positive BC processing practices across laboratories is desirable, the above differences provide an opportunity to assess the impact of NRT adoption on patient outcomes, which awaits conclusive proof [7]. Of interest, only two centers processed blood culture bottles flagged as positive 24 h a day, 7 days a week (24/7), and only just over half of the centers (57%) had timely results reporting to an antimicrobial stewardship team. This situation can probably be extrapolated to many hospitals around the world. While NRTs for positive BCs find their place in the laboratory workflow, the clinical microbiology community should continue to push for systematic implementation of round-the-clock positive BC processing, with immediate Gram stain results reporting and timely antimicrobial stewardship interventions for antibiotic therapy counseling, all of which taken together notably improve patient outcomes [8, 9].

Acknowledgements We thank Merck Sharp & Dohme (MSD) for organizing the meetings of the Working Group of the Autonomous Community of Valencia (ACV) for Optimization of Microbiological Diagnostic Processes.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical statement The Ethical Committee of Hospital Clínico Universitario Fundación INCLIVA deemed unnecessary specific approval for this study.

Informed consent Not applicable (as discussed with the institutional medical Ethical committee).

References

1. Paul M, Shani V, Muchtar E, Kariv G, Robenshtok E, Leibovici L (2010) Systematic review and meta-analysis of the efficacy of appropriate empiric antibiotic therapy for sepsis. Antimicrob Agents Chemother 54:4851–4863
2. Tabak YP, Vankeepuram L, Ye G, Jeffers K, Gupta V, Murray PR (2018) Blood culture turnaround time in U.S. acute care hospitals and implications for laboratory process optimization. J Clin Microbiol 56:e00500–18
3. Thomson RB Jr, McElvania E (2018) Blood culture results reporting: how fast is your laboratory and is faster better? J Clin Microbiol 56:e01313–e01318
4. Miller JM, Binnicker MJ, Campbell S, Carroll KC, Chapin KC, Gilligan PH, Gonzalez MD, Jerris RC, Kehl SC, Patel R, Pritt BS, Richter SS, Robinson-Dunn B, Schwartzman JD, Snyder JW, Telford S 3rd, Theel ES, Thomson RB Jr, Weinstein MP, Yao JD (2018) A guide to utilization of the microbiology Laboratory for Diagnosis of infectious diseases: 2018 update by the Infectious Diseases Society of America and the American Society for Microbiology. Clin Infect Dis 67:813–816
5. Buehler SS, Madison B, Snyder SR, Derzon JH, Cornish NE, Saubolle MA, Weissfeld AS, Weinstein MP, Liebow EB, Wolk DM (2016) Effectiveness of practices to increase timeliness of providing targeted therapy for inpatients with bloodstream infections: a laboratory medicine best practices systematic review and meta-analysis. Clin Microbiol Rev 29:59–103
6. Faron ML, Buchan BW, Ledeboer NA (2017) Matrix-assisted laser desorption ionization-time of flight mass spectrometry for use with positive blood cultures: methodology, performance, and optimization. J Clin Microbiol 55:3328–3338
7. Clerc O, Prod'hom G, Vogne C, Bizzini A, Calandra T, Greub G (2013) Impact of matrix-assisted laser desorption ionization time-of-flight mass spectrometry on the clinical management of patients with Gram-negative bacteremia: a prospective observational study. Clin Infect Dis 56:1101–1107
8. Barenfanger J, Graham DR, Kolluri L, Sangwan G, Lawhorn J, Drake CA, Verhulst SJ, Peterson R, Moja LB, Ertmoed MM, Moja AB, Shevlin DW, Vautrain R, Callahan D (2008) Decreased mortality associated with prompt gram staining of blood cultures. Am J Clin Pathol 130:870–876
9. Doern CD (2016) The confounding role of antimicrobial stewardship programs in understanding the impact of technology on patient care. J Clin Microbiol 54:2420–2423
10. Tormo N, Albert E, Borrajo E, Bosque M, Camarena JJ, Domínguez V, Fuentes E, Gascón I, Gomila B, Gonzalo N, Jiménez M, Martínez O, Nogueira JM, Orta N, Prat J, Rodríguez JC, Gimeno C, Navarro D, Working Group of the Autonomous Community of Valencia (ACV) for Optimization of Microbiological Diagnostic Processes (2018) A survey on practices for active surveillance of carriage of multidrug-resistant bacteria in hospitals in the Autonomous Community of Valencia, Spain. Eur J Clin Microbiol Infect Dis 37:2069–2074