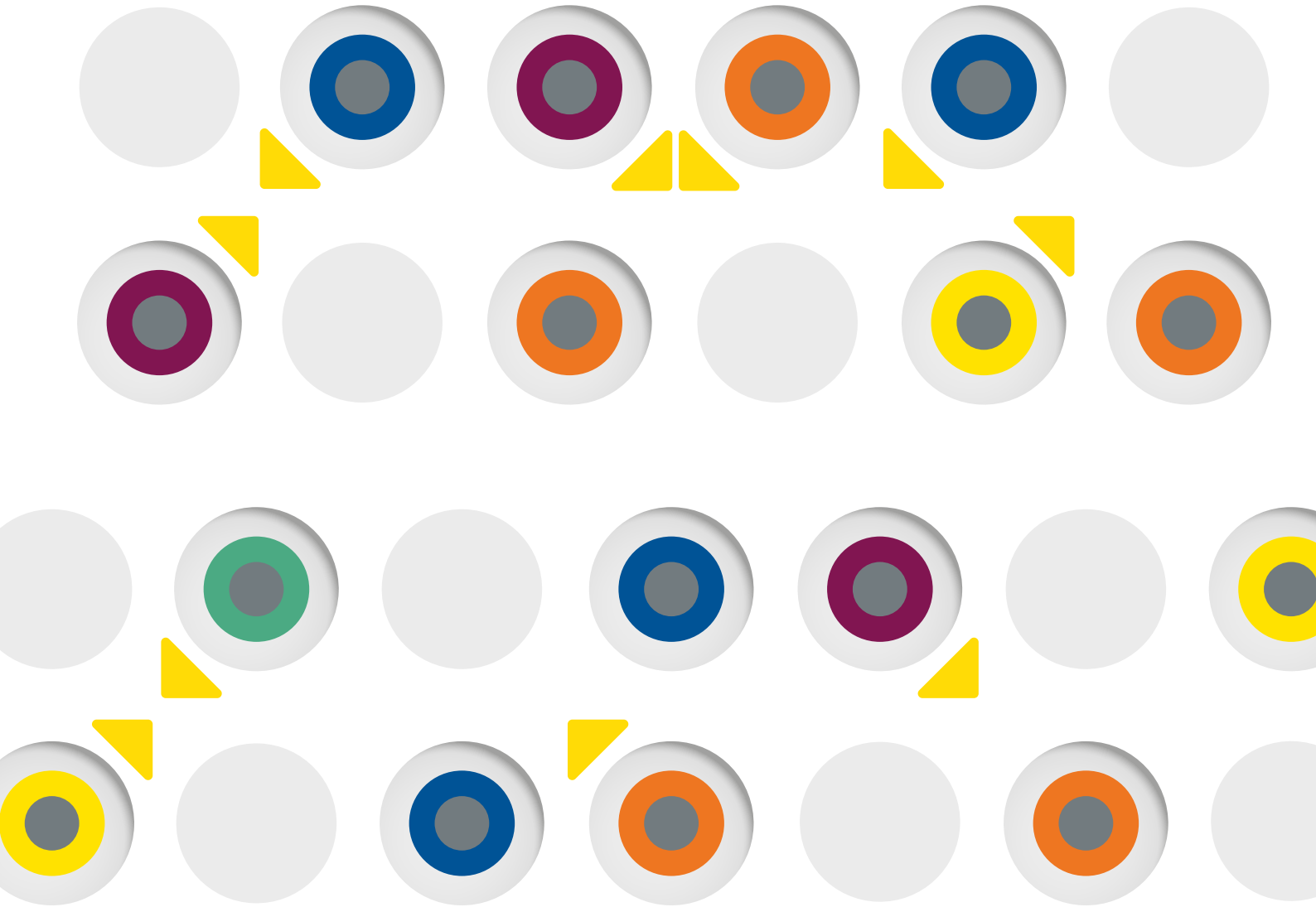
BIOMÉRIEUX

BACT/ALERT® VIRTUO® & BACT/ALERT® FAN® PLUS MEDIA

Selection of Publications

2019 EDITION



PIONEERING DIAGNOSTICS

A world leader in the field of *in vitro* diagnostics for over 50 years, bioMérieux has extensive experience in the rapid detection and diagnosis of microbial infections.

Our diagnostic solutions for sepsis management include automated blood culture systems (BACT/ALERT® 3D and BACT/ALERT® VIRTUO®), an automated Gram stainer (PREVI® Color Gram), culture media (CHROMID®), immunoassays (VIDAS® B.R.A.H.M.S. PCT™) and systems for organism identification and antimicrobial susceptibility testing (VITEK® MS, VITEK® 2, BIOFIRE® FILMARRAY®, ETEST®, RAPIDEC® CARBA NP).

To ensure optimized processing of blood culture bottles, bioMérieux Lab Consultancy services support a more streamlined workload, faster turnaround times and increased productivity for microbiology laboratories. And MYLA®, an integrated connectivity solution linking multiple lab instruments with multiple LIS*, provides rapid reporting of complete, reliable information to clinicians for enhanced patient-care decisions.

bioMérieux Lab Consultancy

MYLA® - IT Performance Management Solutions**

* LIS: Laboratory Information System
** IT: Information Technology

BIOMÉRIEUX BLOOD CULTURE SOLUTIONS FOR DIAGNOSING BLOODSTREAM INFECTIONS AND SEPSIS

Bloodstream infections and sepsis are life-threatening conditions that are often associated with long hospital stays, and high morbidity and mortality. When time is critical to initiate appropriate patient care, you need the most accurate diagnostic results – and you need them fast.

At bioMérieux, we believe breakthrough blood culture technologies are essential for faster, accurate results that can support clinical decisions and truly impact better patient management.

BACT/ALERT® VIRTUO®: The fastest patient results. Delivered.

BACT/ALERT VIRTUO is the unique blood culture system with start-to-finish automation. This ground-breaking system offers labs and clinicians the rapidity they've been looking for with reliable results for **life-threatening disease, including sepsis**.

BACT/ALERT VIRTUO redesigns lab workflows by **reducing hands-on time** and **increasing efficiency**:

- **Easy bottle loading** so any personnel can load 24/7.
- **Intuitive touchscreen design** for enhanced ease of use.
- **Negative bottles automatically unloaded.**
- **Blood Level Detection capability** to measure the sample volume in each BACT/ALERT bottle*.

BACT/ALERT® FAN® PLUS MEDIA: Faster Time to Detection and Recovery

- **Antimicrobial neutralization** provides improved environment for organism growth and faster time to detection.
- **Colorimetric technology and instrument algorithms** minimize false negatives due to samples delayed in entry.
- **FDA cleared** for blood and sterile body fluid specimens.
- Clear, **easy to read Gram stains**.

* Level sensing is not available on the pediatric bottle (PF) due to the low fill volume

CONTENTS

BACT/ALERT® VIRTUO®

ACTA CLINICA BELGICA
2018;73(1):16-2

Implementation of the new VIRTUO blood culture system: evaluation and comparison to the 3D system using simulated blood cultures

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(2) Laboratory of Microbiology, Cliniques de l'Europe, Brussels, Belgium.

This study compares the BACT/ALERT VIRTUO blood culture system with the BACT/ALERT 3D system in the recovery of eight common bloodstream pathogens in simulated blood culture specimens. Criteria for evaluation include rate of culture positivity, the time-to-detection (TTD) and the effects of delayed entry.

Table 1. Time to detection in the different types of blood culture bottles incubated in the 3D and the VIRTUO systems.
Adapted from Miller N., et al. Acta Clinica Belgica 2018;73(1):16-2

		3D				VIRTUO		
Strain	CFU inoculated per bottle	FA Plus	SA	SN	Ped	FA Plus	FN Plus	PF Plus
Bacteroides fragilis	60	–	–	71.45	–	–	24.78	–
Escherichia coli	235	11.60	11.93	11.42	12.60	8.60	7.93	8.60
Haemophilus influenzae	455	14.02	16.03	14.22	16.03	11.07	11.57	10.92
Pseudomonas aeruginosa	415	15.75	16.58	17.25	16.58	12.72	–	12.40
Enterococcus faecalis	95	11.77	12.08	11.92	13.43	9.08	8.93	8.93
Staphylococcus aureus	95	13.28	12.62	12.95	13.43	10.28	9.43	10.62
Streptococcus pneumoniae	90	13.88	15.13	15.38	14.88	9.87	10.62	10.18
Candida krusei	165	25.95	27.27	22.25	26.92	22.45	–	22.43

All positive simulated blood cultures in the study were detected on both platforms with no false positive results. Overall median TTD for all samples was 10.11 hours for VIRTUO and 16.06 hours for the 3D. The time to detect aerobic and facultative microorganisms was significantly shorter using VIRTUO, reducing TTD by about 3 hours. The difference in TTD was greatest for *B. fragilis*, with a median improvement of 46.67 h.

Delayed entry of 4, 8 and 12 hours showed no false negatives and shortened the TTD once placed on the instrument. Longer delays decreased TTD across all three sample sets.

"The reduction in time to detection is potentially crucial for the management of septic patients since delays […] lead to increased mortality."

KEY POINTS

- The new detection algorithm improved temperature stability of the BACT/ALERT VIRTUO system and significantly reduced the TTD for aerobic and anaerobic microorganisms compared to samples run on the 3D.
- Delayed entry of blood culture bottles to incubation shortened TTD once placed in the incubator.

CLINICAL MICROBIOLOGY AND INFECTION
2018;24(9):992-996

Performance of the BACT/ALERT VIRTUO Microbial Detection System for the culture of sterile body fluids: prospective multi-centre study

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The use of continuous monitoring blood culture systems is common for the culture of sterile body fluids (SBF). This multicenter study compared the performance of the BACT/ALERT VIRTUO system to that of the BACT/ALERT 3D and conventional culture for the recovery of microorganisms from sterile body fluids.

Peritoneal, cerebrospinal, pericardial, pleural and synovial fluids from adult patients submitted for routine bacterial cultures were collected from three different centers. Specimens were inoculated into two bottles of the same bottle type (SA, SN, FA Plus or FN Plus) in equal volumes for simultaneous incubation in the BACT/ALERT VIRTUO and BACT/ALERT 3D instruments. Each specimen was also Gram stained and seeded to solid media.

A total of 811 specimens were inoculated to 1257 bottle pairs. The BACT/ALERT VIRTUO and BACT/ALERT 3D showed equivalent recovery of clinically significant microorganisms (127/155, 81.9%, vs. 126/155, 81.3%, respectively). Fewer pathogens were recovered with solid media cultures than with either BACT/ALERT VIRTUO or BACT/ALERT 3D (95/155, 61.3%, $p<0.001$), including significantly fewer Enterobacteriaceae and enterococci. The BACT/ALERT VIRTUO was significantly faster than the BACT/ALERT 3D in median time to detection of isolates from the same specimen (12.5 (range, 2.8 - 101.5) hours vs.15.5 (range, 4.3 - 78.5) hours, $p <0.001$).

Direct specimen Gram stain detected the eventual pathogen in 30 (26.1%) of 115 significant positive specimens.

The BACT/ALERT VIRTUO system proved to be equivalent to the 3D system in terms of organism recovery from SBF cultures, but positive cultures flagged earlier with the BACT/ALERT VIRTUO due to the specific design enhancements on the new system.

"The BACT/ALERT VIRTUO system performed equally well to the current generation BACT/ALERT 3D system in recovery of organisms from SBF. Positive cultures on the BACT/ALERT VIRTUO system were detected about 3 hours sooner than bottles on the BACT/ALERT 3D system. Both systems were superior to solid media culture in time to detection of growth and recovery of clinically significant organisms from SBFs."

KEY POINTS

- The BACT/ALERT VIRTUO system demonstrated faster time to detection of organism growth than the 3D system, likely due to advances in software algorithms and temperature stability.
- Use of a continuous monitoring system in addition to solid media should continue as standard practice for the culture of sterile body fluids.

JOURNAL OF CLINICAL MICROBIOLOGY
2017;55(8):2413-2421

Multicenter Clinical Evaluation of BACT/ALERT VIRTUO Blood Culture System

Jacobs M.R.[1], Mazzulli T.[2,3], Hazen K.C.[4], Good C.E.[5], Abdelhamed A.M.[5], Lo P.[3], Shum B.[3], Roman K.P.[5], Robinson D.C[4].
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(2) Department of Laboratory Medicine and Pathobiology, University of Toronto, Toronto, ON, Canada.
(3) Department of Microbiology, Mount Sinai Hospital/University Health Network, Toronto, ON, Canada.
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This multicenter study performed in a clinical setting compared the BACT/ALERT VIRTUO system to BACT/ALERT 3D (BTA3D) for detection of bacteremia/fungemia in four blood culture bottle types, SA and FA Plus (aerobic) and SN and FN Plus (anaerobic).

Out of 5,709 bottle sets (52.5% aerobic pairs and 47.5% anaerobic pairs), 430 (7.5%) sets were found to be positive for bacterial or fungal growth, 342 (6.0%) were clinically significant and 83 (1.5%) were contaminated. A total of 3,539 sets (62.0%) were volume compliant, and 203 sets (5.7%) were clinically significant.

Positivity rates for volume-compliant bottle pairs were comparable between the two systems. Both instruments detected 68.7% of clinically significant isolates, with 15.7% detected by BACT/ALERT VIRTUO only, and 15.7% by BTA3D only.

Overall, BACT/ALERT VIRTUO detected microbial growth 2 hours sooner than BTA3D, with shorter time-to-detection related to organism group.

"This large clinical study demonstrated that the VIRTUO blood culture system produced results comparable to those seen with the long-established BTA3D system, with significantly shorter time to detection."

KEY POINTS

- The BACT/ALERT VIRTUO system produced comparable results to the BACT/ALERT 3D system, with significantly shorter time to detection.
- Significantly faster time-to-detection was observed for Gram negative bacilli (mean 11.1 h vs. 14.7 h; median 8.6 h vs. 11.4 h) and enterococci (mean 10.6 h vs. 12.9 h; median 11.4 h vs. 13.4 h).

BACT/ALERT® VIRTUO®

INTERNATIONAL JOURNAL OF INFECTIOUS DISEASES
2017;62:1-5

Comparison of 'time to detection' values between BACT/ALERT VIRTUO and BACT/ALERT 3D instruments for clinical blood culture samples

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(2) DIMES, University of Bologna, Bologna, Italy

This study compares the time-to-detection (TTD) of clinical blood culture samples run on the BACT/ALERT VIRTUO and the BACT/ALERT 3D using over 3,000 routine samples. All positive samples from FA PLUS, FN PLUS and PF Plus bottle types run on either system during a 3 month and 4 month period for the BACT/ALERT 3D and BACT/ALERT VIRTUO respectively were used in the study. Samples showing polymicrobial growth on Gram staining were excluded. Microbial identification was made using MALDI-TOF MS.

Coagulase negative staphylococcus, Enterobacteriaceae, *S. aureus* and streptococci all had statistically significant faster median TTD on VIRTUO. BACT/ALERT VIRTUO detected positive results 2 and 4 hours faster than BACT/ALERT 3D for each of these 5 groups. These organisms represented 84% and 81% of identified microorganisms for the BACT/ALERT VIRTUO and BACT/ALERT 3D respectively.

Table 2. Median difference in time to detection (TTD) between the BacT/ALERT VIRTUO (VIRTUO) and BacT/ALERT 3D (BTA-3D) systems and variation expressed as a percentage, forthe eight groups of microorganisms.

Adapted from Congestri F., et al. Int J Inf Dis. 2017;62:1-5

Microorganism categories	BTA-3D			VIRTUO			Median TTD difference between VIRTUO and BTA-3D)	Variation (%)	*p*-Value
	Number positive bottles	Frequency of isolation over the total number of bottles evaluated	Median TTD	Number positive bottles	Frequency of isolation over the total number of bottles evaluated	Median TTD			
CoNS	590	36.9%	22 h 42 min	451	30.8%	18 h 35 min	4 h 7 min[a]	−18.1%	<0.0001
Escherichia coli	423	26.4%	10 h 36 min	376	25.7%	8 h 35	2 h 1 min[a]	−20.8%	<0.0001
Enterobacteriaceae (other than *E. coli*)	124	7.7%	11 h 02 min	252	17.4%	8 h	3 h 2 min[a]	−29.8%	<0.0001
Staphylococcus aureus	163	10.2%	13 h 54 min	139	9.5%	12 h 50 min	1 h 4 min[a]	−12.2%	0.035
Viridans group streptococci	89	5.6%	13 h	97	6.6%	11 h	2 h[a]	−16%	0.0303
Enterococcus species	103	6.6%	10 h 42 min	65	4.4%	11 h 54 min	−1 h 12 min	11.2%	0.96
Pseudomonas aeruginosa	42	2.5%	16 h 30 min	46	3.1%	14 h 10	2 h 20 min	−13.9%	0.14
Candida species	65	4.1%	22 h 48 min	37	2.5%	20 h 47 min	2 h 1 min	−9.2%	0.431

CoNS, coagulase-negative staphylococci.
[a] Statistically significant difference, $p < 0.05$.

"The present study showed a reduced TTD for blood cultures incubated with the BACT/ALERT VIRTUO system compared to the predecessor… This enables earlier management of patients with clinically positive blood cultures, thereby allowing appropriate targeted antibiotic therapy in the case of suspected bloodstream infection and sepsis and improving overall patient outcomes"

KEY POINTS

- The BACT/ALERT VIRTUO system provided a faster TTD for the majority of important microorganisms.
- Four other groups had faster median TTD on the BACT/ALERT VIRTUO system, but the difference was not statistically significant.
- Enterococcus species showed a 1 hour slower TTD on the BACT/ALERT VIRTUO system, but this difference was not significantly significant.

EUROPEAN JOURNAL OF CLINICAL MICROBIOLOGY & INFECTIOUS DISEASE
2017;36(10):1795-1800

A controlled comparison of the BACT/ALERT 3D and VIRTUO™ microbial detection systems

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(3) Scientific Office, bioMérieux, Inc., Durham, NC, USA.

In this study, the instrumentation and growth-based algorithms of the automated BACT/ALERT 3D and VIRTUO blood culture systems were compared by using a panel of compatible blood culture bottles seeded with tightly controlled inoculum levels at or near the level of detection (LoD) limits and with multiple blood volumes. The LoD was defined for each organism, bottle, and system as the lowest inocula that resulted in at least 95% of the bottles being detected as positive.

For each organism–inocula evaluated, 60 bottles were seeded with a target suspension of 10 CFU per mL. Prior to inoculation, bottles were supplemented at three blood volumes: 0 mL, representing sterile body fluid; 4 mL, representing a pediatric sample; and 10 mL, representing an adult blood culture. Uninoculated bottles containing 0, 4, or 10 mL of blood served as negative controls. Thirty-two aerobic microorganisms and 14 anaerobic microorganisms were used to evaluate the performance of the detection systems. A single inoculum was prepared for each microorganism and tested in FA PLUS, PF Plus, FN PLUS, SA, and SN bottles. In total, 2242 bottles were tested in the BACT/ALERT VIRTUO system and 2248 bottles were tested in the BACT/ALERT 3D system.

The BACT/ALERT VIRTUO algorithm improved positive blood culture time-to-detection (TTD) on average by 3.5 hours as well as reduced false-negative results, demonstrating a significantly improved detection rate of 99.9% compared to 98.8% when directly compared to the current 3D system. Gram positive organisms had the greatest reduction in time-to-detection with BACT/ALERT VIRTUO.

"Overall, VIRTUO™ exhibited an improved detection rate of 99.9% compared to the 98.8% detection rate of 3D, with an average decrease in TTD of 3.48 h."

KEY POINTS

- The BACT/ALERT VIRTUO system algorithm improved positive blood culture TTD on average by 3.48 hours.
- The BACT/ALERT VIRTUO system demonstrated a significantly improved detection rate compared to the BACT/ALERT 3D system.

JOURNAL OF CLINICAL MICROBIOLOGY
2016;54(4):1148-51

Controlled evaluation of the new BACT/ALERT VIRTUO blood culture system for detection and time to detection of bacteria and yeast

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In this study, the performance of the new BACT/ALERT VIRTUO system was compared to the performance of the BACT/ALERT 3D system. In total, almost 800 simulated blood culture (BC) bottles were used, and more than 100 clinical bacterial and fungal isolates were included in the study. On average, the time to detection (TTD) was shortened by approximately 20% using the VIRTUO system.

False negative BC results were not observed on either of the systems. No difference was observed in the number of negative bottles per BC system. The total of 379 bottle pairs (signaled positive in both systems) were used to compare the TTD difference. On average, VIRTUO demonstrated significant improvement in terms of TTD, in comparison with BACT/ALERT 3D (12 vs. 15 hours).

For bacterial cultures (325 bottle pairs), 90% of the bottles reached positivity in 16 hours in the VIRTUO system, while this took approximately 21 hours in the 3D system.

Among cultures with Candida (54 bottle pairs), 90% reached positivity after 71 hours in the VIRTUO system, while this took 81 hours in the 3D system. The two Candida species (*C. albicans* and *C. glabrata*) included in this, demonstrated significant improvements in TTD (14.7% for *C. glabrata* and 9.1% for *C. albicans*) with the VIRTUO system.

The results of the study revealed that the VIRTUO system allowed significantly faster TTD of pathogens from bloodsteam infections, which is critical in clinical microbiological diagnostics.

"… 90% of the bottles reached positivity within 21 hours in the 3D system, while this was achieved already after 16 hours in the VIRTUO system"

KEY POINTS

- Significantly faster TTD of pathogens from bloodstream infections with BACT/ALERT VIRTUO vs. BACT/ALERT 3D system (12 hours vs. 15 hours, on average)
- The BACT/ALERT VIRTUO system was shown to be 3 to 5 hours faster on average for bacterial detection, and up to 10 hours faster for yeast detection in comparison with the BACT/ALERT 3D system.

Identification of Bloodstream Pathogens from an Enhanced Blood Culture Instrument using a Multiplex Molecular Diagnostic System

Green J.[1], Clark A.[1], Carter C.[1], Chandler C.[1], Miller E.[1], Katzin B.[1], Doel P.[1], Spaulding U.[1], Rogatcheva M.[1], Amiott E.[1], Thatcher A[1].

(1) BIOFIRE Diagnostics, LLC, Salt Lake City, UT, USA. [2]bioMerieux Inc., Durham, NC, USA.

BACKGROUND

Life threatening bloodstream infections (BSI) require fast and reliable identification of causative pathogens to positively impact patient outcomes. Advancements in blood culture instrumentation are leading to faster times to positivity (TTP) and when paired with rapid molecular diagnostics can significantly reduce turnaround time for identification. Faster TTP may result in lower organism titers that may impact molecular detection. However organism titers in positive blood culture (PBC) are rarely characterized. The bioMérieux BACT/ALERT VIRTUO system is a high-throughput automated blood culture instrument providing faster TTP for many BSI organisms. PBCs generated by the VIRTUO system were tested on the BIOFIRE® FILMARRAY® Blood Culture Identification (BCID) Panel to evaluate if faster TTP, and potentially lower titers, affect pathogen detection and identification by a molecular system.

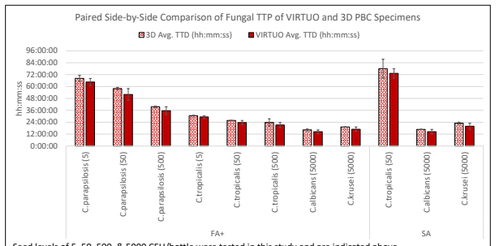
METHODS

BSI organisms, 5 fungi and 12 bacteria, were independently added to blood samples, seeded into bioMérieux BACT/ALERT SA, SN, FA PLUS, and FN PLUS blood culture bottles, and incubated in the VIRTUO system; fungal samples were also incubated in the bioMérieux BACT/ALERT 3D system for direct comparison. TTP was recorded for all PBCs and testing performed on the BIOFIRE FILMARRAY BCID Panel for PBCs collected ≤1 hour of positivity. Titers were determined for 4/5 fungal and 5/12 bacterial PBCs; fungal titers from both systems were directly compared and all titers were compared to 3D system data from previous studies.

RESULTS

During the evaluation period, a total of 25786 blood culture bottles were received. Of these, 2097 were positive. There were 17410 bottles loaded in the 3D, of which 1362 were true positives (7.82%) and 49 (0.28%) were false positives. There were 8376 bottles loaded in the VIRTUO, of which 735 were true positives (8.76%), and 31 (0.37%) were false positives (Table 1).

COMPARISON OF TIME TO POSITIVITY (TTP) ON VIRTUO & 3D



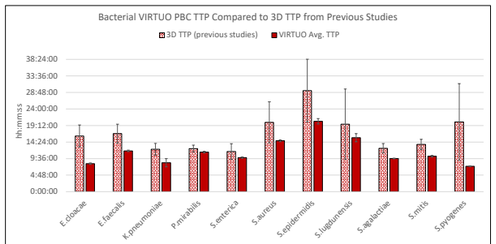
Seed levels of 5, 50, 500, & 5000 CFU/bottle were tested in this study and are indicated above.

Additional TTP data for the above fungi as well as *C. krusei* and *C. glabrata* was collected, however inconsistent positivity between systems resulted so no comparison is available.

For the fungi tested in this study, TTP on the bioMérieux VIRTUO system was generally faster when compared side-by-side to the 3D system.

The VIRTUO system was 1 to 6 hours faster with an average improvement of 3.1 hours when compared side by side.

Despite faster TTP and lower titers as compared to the 3D, all fungal PBCs were correctly detected by the BIOFIRE FILMARRAY BCID Panel.



Historical average titers are compiled from data with FA+, FN+, SA, & SN bottles on 3D instrumentation as well as Aerobic Plus and Anaerobic Plus bottles on BD 9050 instrumentation. Not all strains used for VIRTUO testing correlated to strains represented in the historical data.

For bacteria tested in this study, TTP on the bioMérieux VIRTUO system was generally faster when compared to 3D TTP data collected in previous studies.

The VIRTUO system was 1 to 13 hours faster with an average improvement of 5.2 hours as compared to 3D TPP data from previous studies.

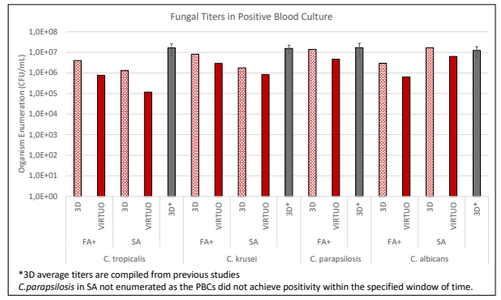
Despite TTPs faster and lower titers as compared to previous studies, all bacterial PBCs were correctly detected by the BIOFIRE FILMARRAY BCID Panel.

TITERS IN POSITIVE BLOOD CULTURE SPECIMENS

Fungal titers were generally lower in VIRTUO® PBCs; 4.5 fold lower on average with *C. tropicalis* displaying the largest difference (11.3 fold lower).

VIRTUO comparisons to 3D data from previous studies indicate an overall 54-fold difference in titers for fungi represented in this study with *C. tropicalis* again displaying the largest (141-fold lower) difference.

While lower titers (4.5 fold lower) and faster TTPs (2 hours faster) were observed, no loss of detection on the BIOFIRE® FILMARRAY® BCID Panel was observed



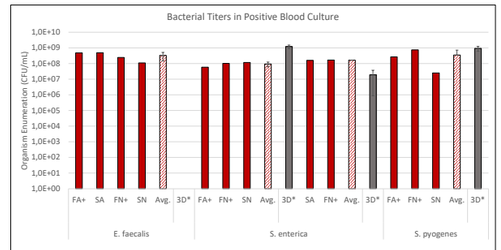
*3D average titers are compiled from previous studies

C.parapsilosis in SA not enumerated as the PBCs did not achieve positivity within the specified window of time.

Bacterial titers were generally lower in VIRTUO PBCs; 5.3-fold lower on average.

Data from previous studies (not shown) indicate Gram negative bacteria were on average present at 9.0E+8 CFU/mL in 3D PBCs, and Gram positive bacteria were on average present at 6.0E+8 CFU/mL in 3D PBCs.

While lower titers (5.3-fold lower) and faster TTPs (5 hours faster) were observed, no loss of detection on the BIOFIRE FILMARRAY BCID Panel was observed.



*3D average titers are compiled from previous studies

S.enterica (SA), *S.aureus* (FA+), and *S.pyogenes* (SA) were not enumerated as the PBCs did not achieve positivity within the specified window of time. No previous data for *E. faecalis* was available.

BIOFIRE FILMARRAY BCID PANEL DETECTIONS FROM BIOMÉRIEUX VIRTUO PBC SPECIMENS

The BIOFIRE FILMARRAY BCID Panel detected 100% (67/67) of PBC bottles tested in this study. 100% (17/17) fungal PBC specimens generated by the bioMérieux VIRTUO system and 100% (15/15) fungal PBC specimens generated by the bioMérieux 3D system were detected by the BIOFIRE BCID Panel. 100% (19/19) Gram Negative bacterial PBC specimens were correctly detected by the BIOFIRE BCID Panel. 100% (16/16) Gram Positive bacterial PBC specimens were correctly detected by the BIOFIRE FILMARRAY BCID Panel.

Fungal BIOFIRE BCID Panel Detections of VIRTUO Positive Blood Cultures		
Organism	**Media Bottle Type**	**BIOFIRE BCID Panel Detections**
C. albicans (ATCC 14053)	FA+	2/2
	SA	2/2
C. krusei (ATCC 14243)	FA+	2/2
	SA	2/2
C. parapsilosis (ATCC 22019)	FA+	3/3
	SA	NA
C. tropicalis (ATCC 13803)	FA+	3/3
	SA	1/1
Gram Negative Bacterial BIOFIRE BCID Panel Detections of VIRTUO Positive Blood Cultures		
Organism	**Media Bottle Type**	**BIOFIRE BCID Panel Detections**
E. cloacae (ATCC 107839)	FA+	FA+
	FN+	FN+
	SA	SA
	SN	SN
E. faecalis (ATCC 29212)	FA+	FA+
	FN+	FN+
	SA	SA
	SN	SN
K.pneumoniae (ATCC 700603)	FA+	FA+
	FN+	FN+
	SA	SA
	SN	SN
Proteus (ATCC 33946)	FA+	FA+
	FN+	FN+
	SA	SA
	SN	SN
S. enterica (ATCC 33946)	FA+	1/1[B]
	FN+	1/1[B]
	SN	1/1[B]

Fungal BIOFIRE BCID Panel Detections of 3D Positive Blood Cultures		
Organism	**Media Bottle Type**	**BIOFIRE BCID Panel Detections**
C. albicans (ATCC 14053)	FA+	2/2
	SA	2/2
C. krusei (ATCC 14243)	FA+	2/2
	SA	3/3
C. parapsilosis (ATCC 22019)	FA+	4/4
	SA	NA
C. tropicalis (ATCC 13803)	FA+	3/3
	SA	1/1
Gram Negative Bacterial BIOFIRE BCID Panel Detections of VIRTUO Positive Blood Cultures		
Organism	**Media Bottle Type**	**BIOFIRE BCID Panel Detections**
S. aureus (ATCC 43300)	FA+	1/1
	FN+	1/1
	SA	1/1
S. epidermidis (ATCC 12228)	FN+	1/1[C]
	SA	1/1[C]
	SN	1/1[C]
S. lugdunensis (ATCC 10357)	SA	1/1[C]
S. agalactiae (ATCC 13813)	FA+	1/1
	FN+	1/1
	SN	1/1
S. mitis (ATCC 15914)	FA+	1/1D
	FN+	1/1D
	SN	1/1D
S. pyogenes (ATCC 19615)	FA+	1/1
	FN+	1/1
	SN	1/1

A BCID detection of Enterococcus
B BCID detection of Enterobacteriaceae
C BCID detection of Staphylococcus
D BCID detection of Streptococcus

Not all bottles seeded with organisms resulted in positive blood culture growth within the time constraints of the study. No positive SA bottles were available to be tested for C. albicans, S. enterica, S. agalactiae, S. mitis, & S. pyogenes. No positive SN bottles were available to be tested for S. aureus, & S. lugdunensis. No positive FA+ bottles were available to be tested for S. epidermidis, S. lugdunensis. No positive FN+ bottles were available to be tested for S. lugdunensis

Identification of Bloodstream Pathogens from an Enhanced Blood Culture Instrument using a Multiplex Molecular Diagnostic System

RESULTS & CONCLUSIONS

On average fungal TTP on the VIRTUO® system was 3.1h faster (range of 1.3-6h) compared to the 3D system. Bacterial TTPs were 5.2h faster on average (range of 1- 13h) compared to historical 3D data. Fungal titers from VIRTUO PBCs were on average 4.5-fold lower compared to the 3D system; bacterial titers from VIRTUO PBCs were 5.3-fold lower as compared to historical 3D titers. The BIOFIRE® FILMARRAY® BCID Panel detected 100% (67/67) of seeded organisms in PBC for both VIRTUO and 3D; all titers were above thresholds for sensitivity.

The VIRTUO system results in faster TTP than the 3D system in this study. Faster TTP resulted in reduced fungal titers; no significant difference in bacterial titers. Faster TTP and lower organism titers did not impact molecular identification of PBCs (67/67 PBCs correctly identified) by the BIOFIRE FILMARRAY BCID Panel as titers remain above the limits of detection of a molecular system. Advancements in blood culture instrumentation coupled with a robust molecular test, like the BIOFIRE FILMARRAY BCID Panel, can provide actionable results faster for critically ill patients.

Conflicts of Interest:
This study was performed as an independent laboratory evaluation of the BACT/ALERT® VIRTUO®. No external funding was received for performing this study.

References
1.Altun, O., Almuhayawi, M., Lüthje, P., Taha, R., Ullberg, M., Özenci, V. (2016). Controlled evaluation of the new BACT/ALERT VIRTUO blood culture system for the detection and time to detection of bacteria and yeast. Journal of Clinical Microbiology, doi:10.1128/JCM.03362-15
2. bioMérieux, Inc. BACT/ALERT® VIRTUO® Microbial Detection System User Manual. (2014). Marcy-l'Etoile - France

KEY POINTS

- The BACT/ALERT VIRTUO system results in faster TTP than the 3D system in this study. Faster TTP resulted in reduced fungal titers; no significant difference in bacterial titers.
- Faster TTP and lower organism titers did not impact molecular identification of PBCs (67/67 PBCs correctly identified) by the BIOFIRE FILMARRAY BCID Panel as titers remain above the limits of detection of a molecular system.
- Advancements in blood culture instrumentation coupled with a robust molecular test, like the BIOFIRE FILMARRAY BCID Panel, can provide actionable results faster for critically ill patients).

Laboratory Evaluation of the BACT/ALERT VIRTUO Automated Blood Culture System

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BACKGROUND

Throughout the world, the number of patients at risk with bloodstream infections (BSIs) continues to rise [1]. BSIs are associated with high rates of morbidity and mortality, and they markedly increase the costs of hospital care [1, 2]. Prompt identification of the causative agent(s) and rapid initiation of appropriate antimicrobial therapy are critical for reducing mortality, especially in patients with septic shock [2–4].

Blood culture (BC) remains the gold standard for diagnosing BSIs [5, 6]. Various continuously monitoring BC systems, based on the colorimetric (BACT/ALERT, bioMérieux, Marcy l'Etoile, France) or fluorescence (BACTEC, Becton Dickinson Instrument Systems, Sparks, MD) technology for detection of CO^2 produced by growing microorganisms, are extensively used in order to increase the rapidity of detection of BSIs, and paired aerobic and anaerobic BC bottles are commonly employed in order to obtain better recovery of microorganisms.

Over the decades, improvements in culture media and the availability of software-assisted, automated growth detectors have enhanced the recovery of bloodstream pathogens and decreased the time to detection (TTD) of microbial growth [7-10]. The BACT/ALERT VIRTUO (VIRTUO) Microbial Detection System (bioMérieux) is a commercially available automated BC instrument which uses a new algorithm for the colorimetric detection of microbial growth.

We performed an *in vitro* study to evaluate the TTD of VIRTUO in the detection of the most common bacterial species implicated in BSIs in comparison to those of the BACTEC FX and BACT/ALERT (BACT) systems.

MATERIALS AND METHODS

The study was conducted between July 2015 and January 2016 in the clinical microbiology laboratory of the Catholic University Medical Center, Policlinico Gemelli, Rome.

Three automated blood culture systems were evaluated in this study, the BACTEC FX (BACTEC) and the BACT/ALERT 3D (BACT) and VIRTUO. Aerobic, anaerobic and pediatric media were evaluated in each automated BC system. The media used with the BACTEC system were the Plus Aerobic/F (BD AE), Plus Anaerobic/F (BD AN), and Peds Plus/F (BD PED), while BACT FA PLUS (aerobic, BM FA), FN PLUS (anaerobic, BM FN) and PF Plus (pediatric) were used with the BACT and VIRTUO systems.

Fresh, whole blood was drawn from healthy volunteers after obtaining written informed consent. All bottles were inoculated with 8 ml of blood, while pediatric bottles were inoculated with 4 ml of blood, as per the manufacturer's recommendations.

We used 90 clinical blood isolates, including 8 species of Gram-negative bacteria and 10 species of Gram-positive organisms. For each species, 5 strains were tested in duplicate. A suspension of each specimen was made in 3 ml of normal saline and adjusted to a 1.0 McFarland standard (https://clinmicro.asm.org/cumitech-31a). The resulting suspension contained approximately 3x 10^8 CFU/ml.

A series of three 1:100 dilution of each bacterial suspension was then performed to produce a density of 3x 10^2 CFU/ml. A 0.1-ml aliquot of each final suspension was introduced into each of the nine bottles to produce a final inoculum density of approximately 30 CFU/bottle. After the addition of 0.1 ml of the bacterial suspension, BC bottles were immediately incubated in the BACTEC, BACT/ALERT and VIRTUO instruments. Uninoculated sterility control vials, and vials with added human blood and no organism of both the test and comparison vials were included.

Individual BC bottles were removed from the automated BC systems when growth was detected and TTD was recorded. A 0.1-ml aliquot was withdrawn from each positive bottle and plated onto solid medium, incubated at 37°C, and read daily for up to 3 days to confirm growth and species-level identification. BC bottles in which no growth was detected were removed from the automated system after 5 days.

TTDs were measured (in hours) from the time bottles were placed in the automated BC system. For each species and subgroup and overall, VIRTUO, BACT and BACTEC instruments were compared at four levels, aerobic bottles versus aerobic bottles, anaerobic bottles versus anaerobic bottles, pediatric bottles versus pediatric bottles and complete sets (considering the first detected as positive) versus complete sets. Differences between the mean TTDs for the three BC systems were assessed with the Wilcoxon matched-pairs signed-rank tests. Differences were considered statistically significant at P values of 0.05. All statistical analyses were performed with the Intercooled Stata program, version 11, for Windows (Stata Corporation, College Station, TX).

A workflow analysis was performed by hands-on time and motion studies (amount of time and number of steps for loading and unloading BC bottles, respectively) for the BACTEC and the VIRTUO. The analysis was conducted on 200 BC bottles that were incubated in each system.

RESULTS

Time to isolate recovery from BC bottles.

The TTD varied greatly, depending on bacterial species, medium, and instrument. Overall, growth was detected earlier in the VIRTUO instrument than in other systems, and it was often detected more quickly in anaerobic bottles than in aerobic media ($P< 0.001$).

In particular, the mean TTDs for the VIRTUO AE, AN and PED bottles were 11.71 h, 12.36 h, and 11.61 h, respectively, while those of the BACT and BACTEC AE, AN and PED bottles were 13.58 h and 13.46 h, 14.63 h and 14.57 h, and 13.55 h and 13.27 h, respectively. Means and interquartile ranges of TTDs of Gram-negative bacteria and Gram-positive cocci are presented in Tables 1-2 and Figure 1. Reproducibility was excellent.

Laboratory Evaluation of the BACT/ALERT® VIRTUO® Automated Blood Culture System

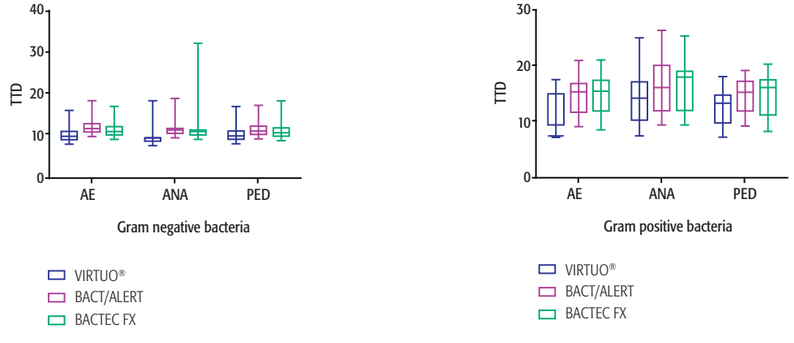
Table 1. Mean time to growth detection(h,±SD) of Gram-negative bacteria stratified by bottle type and system

Microorganism	VIRTUO			BACT/ALERT			BACTEC		
	AE	ANA	VPED	AE	ANA	PED	AE	ANA	PED
E.coli	9.22±0.26	8.35±0.26	9.07±0.35	11.19±0.50	10.64±0.40	11.27±0.67	10.86±0.52	10.61±0.50	10.74±0.57
K.pneumoniae	10.26±2.27	10.74±3.83	10.26±2.30	12.29±2.54	12.52±3.29	12.01±2.49	11.78±2.44	14.85±8.24	11.08±1.90
P.aeruginosa	13.88±2.25		13.55±2.31	15.58±2.23		15.13±2.07	14.73±2.38		15.40±2.66
P.mirabilis	11.73±0.82	10.15±1.14	11.34±1.03	13.48±0.94	12.3±0.64	13.08±0.58	13.24±1.05	12.22±0.60	12.76±0.81
A.baumanii	9.62±0.61		9.70±0.68	11.41±0.59		11.32±0.64	11.28±0.86		11.24±0.87
E.cloacae	10.53±0.53	9.17±0.46	9.84±0.59	12.37±0.38	11.39±0.38	11.71±0.53	10.90±0.51	10.81±0.40	10.50±0.24
C.freundii	10.08±3.19	9.70±0.32	10.80±0.42	11.59±0.33	11.59±0.32	12.38±0.13	11.76±0.29	11.57±0.36	11.48±0.22
S.marcescens	9.31±0.16	9.63±0.35	9.46±0.33	11.23±0.14	11.36±0.24	11.28±0.11	10.40±0.14	10.83±0.35	9.98±0.30
Total	10.70±1.82	9.62±1.76	10.50±1.82	12.40±1.87	11.64±1.48	12.27±1.70	11.87±1.86	11.82±3.57	11.65±2.02

Table 2. Mean time to growth detection (h, ±SD) of Gram-positive bacteria stratified by bottle type and system

Microorganism	VIRTUO			BACT/ALERT			BACTEC		
	AE	ANA	V PED	AE	ANA	PED	AE	ANA	PED
S.aureus	13.36±0.27	12.88±0.93	13.37±0.50	15.07±0.29	14.73±0.44	15.13±0.33	15.18±0.81	18.15±0.61	16.01±0.53
E.faecalis	8.31±0.81	8.76±1.41	8.22±0.79	10.35±0.85	10.98±0.82	10.10±0.79	9.81±1.00	10.64±0.97	9.23±0.83
S.epidermidis	13.95±0.37	18.33±2.90	13.93±1.27	15.96±0.64	21.34±2.29	15.85±1.12	17.17±1.03	22.66±2.76	16.90±0.97
E.faecium	9.98±0.24	10.03±0.25	9.81±0.32	11.86±0.34	12.10±0.06	12.03±0.26	12.08±0.08	12.18±0.08	11.90±0.25
S.hominis	16.77±0.70	17.25±0.44	17.05±0.79	19.34±0.86	20.25±1.26	18.41±0.44	19.21±0.99	18.82±0.05	18.90±0.81
S.haemoliticus	14.41±0.89	16.22±0.68	14.16±0.47	16.57±0.60	18.47±0.64	16.81±0.65	17.30±0.12	17.87±0.42	17.83±0.63
S.agalactiae	8.48±0.44	8.44±0.37	8.13±0.43	10.38±0.33	10.78±0.45	10.35±0.29	9.91±0.45	10.25±0.20	9.45±0.34
S.capitis	14.59±0.46	22.21±1.62	14.55±0.44	17.44±0.21	25.45±0.93	17.53±0.41	17.45±0.09	21.49±0.91	17.59±0.40
S.pyogenes	9.88±0.44	10.05±0.30	10.17±0.16	12.23±20	12.29±0.27	12.36±0.10	12.07±0.29	12.16±0.16	11.34±0.12
L.monocytogenes	15.61±0.53	15.89±0.49	15.60±0.53	17.25±0.48	17.86±0.50	17.13±0.51	17.21±0.52	18.04±2.14	16.58±0.47
Total	12.54±2.99	14.01±4.60	12.50±3.08	14.65±3.10	16.43±4.87	14.57±3.00	14.74±3.36	16.23±4.49	14.58±3.56

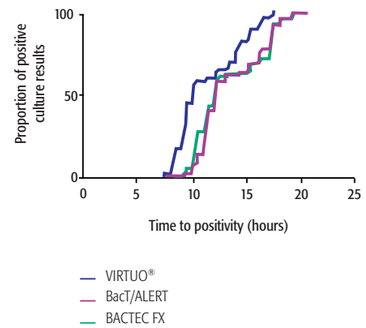
Figure 1. Times to detection (TTD) of Gram-negative bacteria (A) and Gram-positive (B) stratified according to bottle type and system. Boxes represent interquartile ranges (lower border, 25th percentile; upper border, 75th percentile), with horizontal lines indicating the medians (50th percentile).



Time to isolate recovery from BC set.

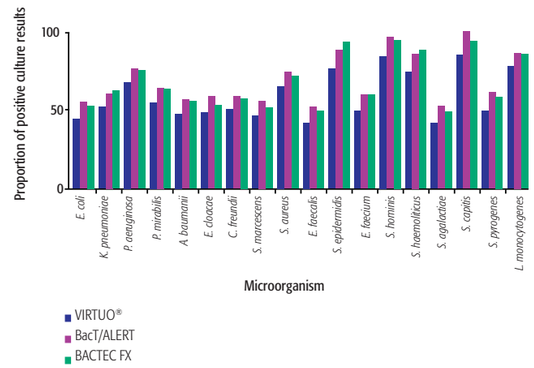
The TTDs of BC sets (considering the first detected as positive) are shown in Figure 2. The mean ± SD TTD for the BM Plus bottles incubated in the VIRTUO instrument was 11.88 ±3.33 h, whereas that of BM Plus bottles incubated in the BACT instrument was 13.89 ±3.52 h and that of BD media incubated in the BACTEC instrument was 13.74 ±3.76 h (P< 0.001 for both). Analysis of TTD by bacterial species demonstrated a time saving of at least 2 h on the VIRTUO system (Figure 3).

Figure 2. Kaplan-Meier curve representing the time to positivity of BC results



The BACTEC required more hands-on time than the VIRTUO (31.2 min vs. 13 min) for loading and unloading 200 bottles. The total processing steps for VIRTUO and the BACTEC were 4 and 11, respectively.

Figure 3. Analysis of mean time to detection by bacterial species



CONCLUSION

BSIs have a significant impact on mortality rates and hospital costs. Therefore, microbiological data must be reported to the physician as soon as possible, especially in high-risk cases.

Overall, the VIRTUO system has an excellent ability to detect earlier bacterial growth at low inocula, compared with those of the other two systems.

In conclusion, the VIRTUO system appears to be a reliable, timesaving tool for routine detection of BSIs in the setting of simulated BCs we studied, although further studies are needed to evaluate their performance in various clinical settings.

The VIRTUO performed better than the BACTEC in terms of TTD, hands-on time, and number of steps for loading and unloading bottles, although further efforts are needed to evaluate its overall performance in different settings.

References

1. Goto M, Al-Hasan MN. 2013. Overall burden of bloodstream infection and nosocomial bloodstream infection in North America and Europe. Clin. Microbiol. Infect. 19:501–509.
2. Tumbarello M, Sanguinetti M, Montuori E, Trecarichi EM, Posteraro B, Fiori B, Citton R, D'Inzeo T, Fadda G, Cauda R, Spanu T. 2007. Predictors of mortality in patients with bloodstream infections caused by extended-spectrum–lactamase-producing Enterobacteriaceae: importance of inadequate initial antimicrobial treatment. Antimicrob. Agents Chemother. 51:1987–1994.
3. Funke DJ, Kumar A. 2011. Antimicrobial therapy for life-threatening infections: speed is life. Crit. Care Clin. 27:53–76.
4. 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 CD. 2008. Decreased mortality associated with prompt Gram staining of blood cultures. Am. J. Clin. Pathol. 130: 870–876.
5. Versalovic J, Carroll KC, Funke G, Jorgensen JH, Landry ML, Warnock DW (ed). 2011. Manual of clinical microbiology, 10th ed. ASM Press,Washington, DC.
6. Weinstein MP, Doern GV. 2011. A critical appraisal of the role of the clinical microbiology laboratory in the diagnosis of bloodstream infections. J. Clin. Microbiol. 49:S26–S29.
7. Lee DH, Kim SC, Bae IG, Koh EH, Kim S. 2013. Clinical evaluation of BACT/ALERT FA PLUS and FN PLUS bottles compared with standard bottles. J. Clin. Microbiol. 51:4150–4155. http41.
8. Kirn TJ, Mirrett S, Reller LB, Weinstein MP. 2014. Controlled clinical comparison of BACT/ALERT FA PLUS and FN PLUS blood culture media with BACT/ALERT FA and FN blood culture media. J. Clin. Microbiol. 52:839– 843.
9. Doern CD, Mirrett S, Halstead D, Abid J, Okada P, Reller LB. 2014. Controlled clinical comparison of new pediatric medium with adsorbent polymeric beads (PF Plus) versus charcoal-containing PF medium in the BACT/ALERT blood culture system. J. Clin. Microbiol. 52:1898-900.
10. Fiori B, D'Inzeo T, Di Florio V, De Maio F, De Angelis G, Giaquinto A, Campana L, Tanzarella E, Tumbarello M, Antonelli M, Sanguinetti M, Spanu T. 2014. Performance of two resin-containing blood culture media in detection of bloodstream infections and in direct Matrix-Assisted Laser Desorption Ionization-Time of Flight Mass Spectrometry (MALDI-TOF MS) broth assays for isolate identification: clinical comparison of the BACT/ALERT Plus and Bactec Plus systems. J Clin Microbiol. 52:3558-3567

KEY POINTS

- The BACT/ALERT® VIRTUO® system performed better than BACTEC in terms of time to detection (11.8 ±3.3 hours vs. 13.7±3.7 hours).
- BACTEC required more hands-on time than the BACT/ALERT VIRTUO system (31.2 min vs. 13 min) for loading and unloading 200 bottles.
- The total number of processing steps for the BACT/ALERT VIRTUO and BACTEC systems were 4 and 11, respectively.

Rapid time to detection difference between the BACT/ALERT VIRTUO and the BACT/ALERT 3D

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ABSTRACT

The rapid detection of microorganisms in blood and sterile body fluids is essential for patient care. The BACT/ALERT (BTA) VIRTUO Microbial Detection System is the next generation of BACT/ALERT instrumentation providing automation of processes that were previously performed manually and an improved user interface. Most importantly, VIRTUO uses a new algorithm designed to significantly reduce the time to detection (TTD) while providing improved detection of microorganisms with BACT/ALERT FA Plus, PF Plus, FN Plus, Aerobic (SA), and Anaerobic (SN) bottles.

The performance of the BACT/ ALERT VIRTUO Microbial Detection System (BTA Virtuo) was compared against the BACT/ ALERT 3D Microbial Detection System (BTA 3D) using a panel of microorganisms grown in blood culture bottles.

The overall results showed an improved detection rate with the VIRTUO compared to BTA 3D. A detection rate of 99.9% was obtained from the VIRTUO versus 98.8% from BTA 3D.

Most importantly, the VIRTUO provided a mean reduction in TTD of 3.5 hours, overall. Of particular note, a TTD improvement of 3.9 hours, on average, was observed with FN Plus bottles.

INTRODUCTION

The BACT/ALERT VIRTUO is a new generation of BACT/ALERT instrumentation. The VIRTUO instrument consists of an incubator, agitation mechanism, robotic apparatus for automated loading and unloading of bottles, and a tactile graphical user interface. The BACT/ALERT VIRTUO Microbial Detection System, used in conjunction with existing BTA reagents and bottles, optically monitors the reflectance of each bottle over time[1]. Employing the same colorimetric technology used in previous generations of BTA instruments, the VIRTUO system measures the change in pH of the media via a change in the color of the colorimetric sensor in each bottle. The System stores and interprets these readings against algorithms which are imbedded in the firmware and/or software.

The new VIRTUO algorithm is uniquely designed to analyze the variation in readings from the system. Changes in values from read-to-read and changes in the area under the curve over time are evaluated simultaneously to differentiate between positive and negative samples. In combination, these two analytical methods allow for optimization of test sensitivity and specificity while effectively reducing TTD.

METHODS

To evaluate the performance of the VIRTUO system, a study was performed comparing results between the VIRTUO (version R2.0*) and the BACT/ALERT 3D Microbial Detection System (BTA 3D).

All testing was performed using three VIRTUO systems and one BTA 3D system. For the study, a panel of 32 microorganisms for aerobic blood cultures was tested in BTA FA Plus and SA bottles. A panel of 14 microorganisms for anaerobic blood culture bottles was tested in BTA FN Plus and SN bottles. Each microorganism was tested at a target inoculum of ≤ 30 CFU/bottle in triplicate in each appropriate bottle type and at each of three blood levels (0, 4, and 10 mL) on three BTA VIRTUO systems. Human blood was collected from individual donors into tubes containing sodium polyanethol sulfonate (SPS) and pooled prior to testing[2]. Bottles containing only 0, 4, or 10 mL pooled blood served as negative controls for each bottle and instrument type.

For comparison, each microorganism was tested nine times per bottle type, per blood level in a BTA 3D system. Plate counts were performed on inocula suspensions before and after each testing event to verify purity and appropriate microorganism density.

It was expected that bottles inoculated with microorganisms would be declared positive by the instruments and the positive signal produced was due to the seeded microorganism. Therefore, 2 positive bottles from each test event were randomly selected for subculture from each bottle and instrument type. Bottles that were not positive after 5 days were declared negative by the detection instruments. All negative bottles that had undergone inoculation were subcultured to verify the absence of microorganism.

Since the goal of the study is to compare growth performance between systems, only bottle type / organism / blood level combinations that had bottles available from both the BTA 3D and VIRTUO systems were included in the final analysis.

RESULTS

While the SA and SN culture bottles had similar detection rates on both instruments, the FA PLUS and FN PLUS culture bottles exhibited improved detection in the VIRTUO.

Table 1 summarizes the detection rate of positive bottles for each detection system. In some instances, bottles were inoculated at or near the limit of detection resulting in negative bottles due to non uniform distribution (Poisson distribution). Overall the VIRTUO had a detection rate of 99.91%, exceeding the 98.75% detection rate of the BTA 3D.

Table 1. Comparison of Detection Rates from BTA 3D and VIRTUO

Bottle Type	System	Number of Bottles	Number of (+) Bottles	Detection Rate (%)
FA PLUS	BTA 3D	789	771	97.7
	VIRTUO	787	787	100.0
FN PLUS	BTA 3D	329	320	97.3
	VIRTUO	327	327	100.0
SA	BTA 3D	761	761	100.0
	VIRTUO	768	768	100.0
SN	BTA 3D	369	368	99.7
	VIRTUO	360	358	99.4
Combined	BTA 3D	2248	2220	98.8
	VIRTUO	2242	2240	99.9

Table 2 describes the mean TTD differences between BTA 3D and BTA VIRTUO. The differences were calculated using pairwise differences between bottle results. Positive differences indicate the VIRTUO TTD is less than the BTA 3D TTD. Since the 95% confidence intervals for the VIRTUO algorithm do not contain the value of zero, there is sufficient evidence to say that, on average, the BTA VIRTUO system provides significantly shorter TTD as compared to BTA 3D.

Table 2. Time to detection Difference between BTA 3D and VIRTUO

Bottle Type	Mean TTD Difference (Hours)	95% CI for Mean TTD Difference	Median TTD Difference (Hours)
FA PLUS	3.59	(3.39, 3.80)	2.53
FN PLUS	3.90	(3.64, 4.17)	2.91
SA	3.14	(3.02, 3.25)	2.87
SN	3.65	(3.42, 3.88)	3.22
Combined	3.48	(3.38, 3.58)	2.83

FN PLUS bottles had the greatest mean TTD reduction of 3.90 hours followed by SN bottles with 3.65 hours. Both aerobic bottles FA PLUS and SA also had faster TTD with the VIRTUO by 3.59 hours and 3.14 hours respectively (Table 2).

TTD for all bottle types at each blood volume were faster in the VIRTUO. In the BTA 3D detection rates slightly decrease as the volume of blood increases from 4 mL to 10 mL most noteably in the Plus bottles, this blood volume effect was reduced in VIRTUO system (Table 3).

Table 3. Detection Rates and TTD from BTA 3D and VIRTUO by Bottle and Blood Volume

		BTA 3D		VIRTUO	
Bottle Type	Blood Volume (mL)	Mean TTD (Hours)	Detection (%)	Mean TTD (Hours)	Detection (%)
FN PLUS	0	35.6	100.0	34.7	100.0
	4	28.2	96.7	25.5	100.0
	10	27.2	95.7	23.6	100.0
	Combined	30.0	97.3	27.6	100.0
SN	0	24.1	100.0	19.4	100.0
	4	27.2	100.0	21.4	99.1
	10	29.3	99.2	27.6	99.2
	Combined	26.8	99.7	22.7	99.4
FA PLUS	0	25.9	95.0	22.5	100.0
	4	26.4	99.6	22.9	100.0
	10	25.9	98.2	23.8	100.0
	Combined	26.2	97.7	23.1	100.0
SA	0	25.8	100.0	23.3	100.0
	4	25.5	100.0	22.2	100.0
	10	25.9	100.0	22.8	100.0
	Combined	25.7	100.0	22.7	100.0

CONCLUSION

VIRTUO showed an improved detection rate of 99.91% compared to the 98.75% detection rate of the BTA 3D.

VIRTUO improved time to detection for all bottle types compared to the BTA 3D by an average 3.5 hours.

FN PLUS bottles had the most noticeable average TTD improvement of 3.9 hours.

KEY POINTS

- The BACT/ALERT® VIRTUO® system demonstrated a higher level of detection (99.9%) when compared to the BACT/ALERT 3D system (98.7%)
- The BACT/ALERT VIRTUO system provided a significant reduction in time to detection (3.5 hours) vs. the BACT/ALERT 3D system.

BACT/ALERT VIRTUO vs. BACT/ALERT 3D

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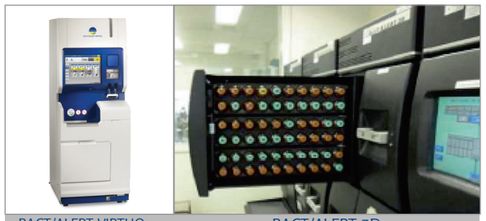
INTRODUCTION

To reduce the turnaround time of blood cultures, we compared the BACT/ALERT VIRTUO (VIRTUO) in a decentralized laboratory setting with the BACT/ALERT 3D (3D) in a centralized setting. This study was a simultaneous comparison of both systems focusing on the impact of the time to positivity and the time to result due to workflow optimization.

First, the time to positivity was examined using spiked blood cultures. Second, the VIRTUO was decentralized at a peripheral hospital. Due to a capacity problem because of the flu season, the VIRTUO system was loaded only outside of office hours. The turnaround time was compared for blood culture in this decentralized setting versus the routine centralized workflow of the 3D system.



BACT/ALERT VIRTUO BACT/ALERT 3D

METHODS

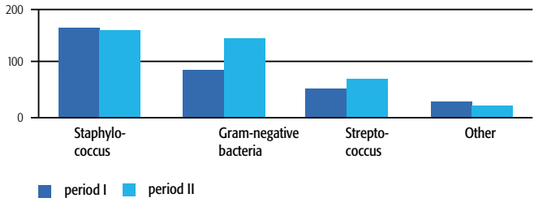
Blood culture medium BACT/ALERT FA PLUS for aerobes, FN PLUS for anaerobes and PF Pediatric bottles were used in the study.

1. The microorganisms (23 strains of which 17 were ATCC® strains) were chosen among frequently isolated species. Bacterial suspensions were inoculated into blood culture bottles and entered into the VIRTUO and 3D systems, then incubated up to 7 days. Culture positivity expressed as average time to positivity (TTP) for each microorganism in relation to the blood culture system was compared.
2. Over two periods of four months, we compared the time between blood culture collection and culture positivity, defined as Gram stain result ready to report to the physician. For incubation during the first period (I) the 3D system was used in the central laboratory with specimen transport five times a day. During period I we used 3D only and during the second period (II) we used 3D during daytime and VIRTUO outside of office hours.

Number of included blood cultures

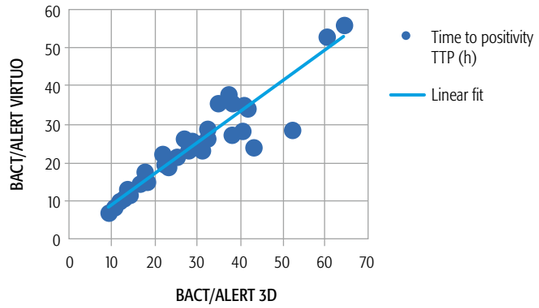
period I		period II	
Office hours 112	Outside of office hours 248	Office hours 119	Outside of office hours 312
Total 360			431

Species detected in positive blood cultures



Results 1

The VIRTUO detects on average three hours faster than the 3D



Average TTP (h)

	3D	VIRTUO
Anaerobes	27.18	26.35
E. coli	10.64	8.55
Haemophilus/Neisseria species	14.73	13.39
P. aeruginosa	14.46	12.78
S. maltophilia	43.26	27.14
Gram-positive cocci	12.53	10.76
Candida species	32.40	28.22
All incubated microorganisms	20.58	17.60

Results 2

Table 1. Average time between period I (44.4) - period II (35.5) Total

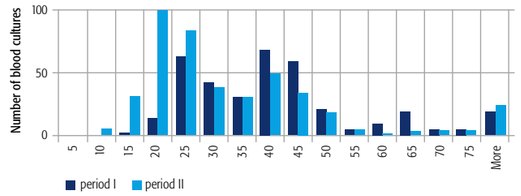


Table 2. Average time between period I (50.4) - period II (35.0) Outside of office hours

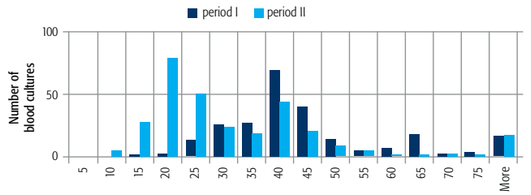


Table I reflects the total average time to positivity of both periods, Table II narrows the time to positivity when exclusively VIRTUO is used outside of office hours.

CONCLUSIONS

- Using spiked blood cultures, the BACT/ALERT VIRTUO exhibits, on average, a 3 hour faster detection time compared to the BACT/ALERT 3D system.
- The average time to first results ready to report to the physician of all positive blood cultures, using the BACT/ALERT 3D system in a centralized setting was 50 hours (transport five times a day).
- Due to introduction of the BACT/ALERT VIRTUO system in the hospital, blood cultures are incubated sooner and therefore the first results are 15 hours faster.

KEY POINTS

- The BACT/ALERT® VIRTUO® system demonstrated a 3 hour faster time to detection compared to the BACT/ALERT 3D system.
- The average time to result (TTR) improvement was 15 hours with the BACT/ALERT VIRTUO system vs. the BACT/ALERT 3D system.

BACT/ALERT® FAN® PLUS MEDIA

VS.

BACTEC™

EUROPEAN JOURNAL OF CLINICAL MICROBIOLOGY AND INFECTIOUS DISEASES
2016; 35(12):2033-2036

Antimicrobial binding and growth kinetics in BACT/ALERT FA PLUS and BACTEC Aerobic/F Plus blood culture bottles

Lovern D[1], Katzin B[1], Johnson K[1], Broadwell D[1], Miller E[1], Gates A[1], Deol P[1], Doing K[1], van Belkum A[2], Marshall C[3], Mathias E[3], Dunne WM Jr[2]

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(3) bioMérieux, Inc., St. Louis, MO, USA.

Rapid isolation and identification of microorganisms causing bloodstream infection (BSI) is critical for the survival of the patient, and for the selection of appropriate antimicrobial therapy.

This study compared the capacity of adsorbent polymeric beads contained within BACT/ALERT FA PLUS and BACTEC Aerobic Plus blood culture bottles to neutralize a variety of antimicrobial agents. Reverse phase HPLC was used to establish the binding kinetics, and antimicrobial neutralization was based on the recovery of susceptible test stains from spiked bottles containing 10ml of blood and elevated serum concentrations of each antimicrobial.

Significant differences were observed in the binding kinetics and residual free drug concentrations between the two bottle types: BACT/ALERT FA PLUS and BACTEC Aerobic Plus. The rate and overall reduction of free antimicrobial favored the BACT/ALERT FA PLUS bottles for each antibiotic. Major differences in binding kinetics were observed with Levofloxacin, Linezolid, Ceftaroline, Daptomycin, Oxacillin and Piperacillin.

The FA PLUS bottles demonstrated faster and better total binding kinetics for each antibiotic resulting in shorter detection time and also recovery of test strains in the presence of select antimicrobials.

BACT/ALERT FA PLUS bottles generated greater recovery for *E. faecalis* with Ampicillin (5/5 vs. 0/5); *E. coli* with Ceftaroline (5/5 vs. 2/5), Levofloxacin (5/5 vs. 0/5), and Piperacillin (5/5 vs. 3/5); *S.aureus* with Daptomycin (5/5 vs. 1/5); and *P. aeruginosa* with Piperacillin. Additionally, BACT/ALERT FA PLUS bottles generated faster time to detection (TTD) compared to the BACTEC Plus bottles even in cases where no difference in recovery was noted.

"… improved binding kinetics of the BACT/ALERT® FA PLUS bottles for a variety of antimicrobial agents translates into improved overall recovery and or TTD of susceptible challenge strains relative to the BACTEC™ Plus bottle"

KEY POINTS

- BACT/ALERT FA PLUS medium demonstrated more rapid and better total binding kinetics for each drug tested.
- With BACT/ALERT FA PLUS bottles, 80% of microorganisms were recovered (60 out of 75 total), while BACTEC bottles only recovered 46% of microorganisms (35 out of 75 total).
- On average, with BACT/ALERT FA PLUS bottles, the Time to Detection was 24.5 hours shorter when compared with BACTEC bottles.

JOURNAL OF CLINICAL MICROBIOLOGY
2014; 52(10): 3558-3567

Performance of Two Resin-Containing Blood Culture Media in Detection of Bloodstream Infections and in Direct Matrix-Assisted Laser Desorption Ionization–Time of Flight Mass Spectrometry (MALDI-TOF MS) Broth Assays for Isolate Identification: Clinical Comparison of the BACT/ALERT Plus and BACTEC Systems

Fiori B.[1], D'Inzeo T.[1], Di Florio V. [1], De Maio F. [1], De Angelis G. [1], Giaquinto A. [1], Campana L. [2], Tanzarella E., [3] Tumbarello M. [2], Antonelli M. 3, Sanguinetti M. [1], and Spanu T.[1]

(1) Institute of Microbiology and Infectious Diseases,
(2) Department of Clinical Anesthesiology and Intensive Care,
(3) Catholic University of the Sacred Heart, Gemelli Hospital, Rome, Italy

The clinical performance of the BACT/ALERT FAN PLUS (bioMérieux) and BACTEC Plus (Becton Dickinson) aerobic and anaerobic blood culture (BC) media was compared in this study. Patients in intensive care units and infectious disease wards with suspected bloodstream infections (BSIs) were enrolled. A 40 ml blood sample was collected from each patient and used to inoculate 10 ml of blood into one set of BACT/ALERT FAN PLUS bottles and one set of BACTEC Plus bottles, each set consisting of one aerobic and one anaerobic bottle. Cultures were incubated up to 5 days in BACT/ALERT 3D and BACTEC FX instruments respectively.

A total of 128 unique BSI episodes were identified based on the recovery of clinically significant organisms in 212 aerobic cultures (106 BACT/ALERT; 106 BACTEC) and 151 anaerobic cultures (82 BACT/ALERT; 69 BACTEC). The BACT/ALERT aerobic medium had higher recovery rates for Gram positive cocci (P=0.024), whereas the BACTEC aerobic medium had higher recovery rates for Gram negative bacilli (P=0.006). BACT/ALERT anaerobic medium recovery rates exceeded those of the BACTEC anaerobic medium for total organisms (P=0.003), Gram-positive cocci (P=0.013), and *Escherichia coli* (P=0.030).

BACT/ALERT and BACTEC blood culture sets were comparable in diagnosing the 128 septic episodes, although the BACT/ALERT diagnosed more BSIs caused by Gram positive cocci (P=0.008). The mean time to detection (TTD) of the BSI episodes diagnosed by the BACT/ALERT (N=123) and BACTEC (N=118) sets were not significantly different (16.1 h vs. 16.9 h). In the 112 cases diagnosed by both sets, coagulase-negative staphylococci (CNS) were detected faster by the BACT/ALERT (mean 2.8 h; P=0.003). There was no significant difference between BACT/ALERT and BACTEC in time to detection when cultures were drawn after initiation of antimicrobial therapy, but the BACT/ALERT provided diagnoses 1.3h earlier in treatment-negative cases (P<0.001).

"In our study, the performance displayed by BACT/ALERT Plus media was similar to that of resin-containing media in the BACTEC line. […] our experience indicates that the new BACT/ALERT FA PLUS and FN PLUS media are reliable, time saving tools for routine identification of BSIs in patients in ICUs and infectious disease wards."

KEY POINTS

- The FN PLUS outperformed the BACTEC anaerobic bottle in total microorganism recovery (*E. coli*: 90.9% vs. 63.6%, Gram-positive bacteria: 95.9% vs. 79.6%)
- Diagnostic capability of the aerobic/anaerobic blood culture sets was comparable; 95.3% for the BACT/ALERT 3D system vs. 91.4% for BACTEC.
- The mean TTD of BSI episodes by BACT/ALERT (N=123) and BACTEC (N=118) was comparable (16.1 hours vs. 16.9 hours).

BACT/ALERT® FAN® PLUS MEDIA vs. BACTEC™

ECCMID 2018 – Poster 1950

Comparison of Performance of the BACT/ALERT VIRTUO™ and BACTEC FX Blood Culture Systems using Simulated Blood Cultures Containing Therapeutic Levels of Antibiotics

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Institutes of Microbiology, Università Cattolica del Sacro Cuore, Fondazione Policlinico Universitario Agostino Gemelli, Rome, Italy

BACKGROUND

Blood culture (BC) remains the gold standard for diagnosing bloodstream infections (BSIs). Improvements in culture media and the availability of automated growth detectors enhance the recovery of bloodstream pathogens and decrease the time to detection (TTD) of microbial growth. Limitations, however, persist. One of the most important limits involves the diagnostic performance of BCs collected from patients who are already on antimicrobial therapy. In up to 87% of patients with severe sepsis, empirical antimicrobial treatment is started before blood samples for cultures are drawn, and this practice can reduce or delay pathogen recovery. Increasing the diagnostic yield of positive BCs in this setting would allow more effective patient management. To this end, several manufacturers have designed BC media containing adsorbant polymeric beads designed to adsorb antimicrobial drugs present in the blood.

The aim of this study was to compare the performances of the BACT/ALERT® VIRTUO® (bioMérieux) and the BACTEC™ FX (Becton Dikinson) systems, in terms of microbial recovery and TTD, using simulated BCs containing therapeutic levels of antibiotics and strains susceptible to the drug tested.

MATERIAL AND METHODS

Organism	Test drugs	MIC[a] (µg/ml)	Drug concentration[b] (µg/ml)		
			Cmax	C/2	C/4
Gram negative bacteria:					
***B.fragilis* ATCC25285**	Clindamycin	1	10	5	2.5
	Meropenem	0.12	50	25	12.5
	Metronidazole	0.5	25	12.5	6.3
	Pip-Tazo	0.06	368/23	184/11.5	92/5.8
***E.coli* ATCC 25922**	Amoxi/Clav	2	14.4/3.2	7.2/1.6	3.6/0.8
	Ceftaroline	0.06	39	19.5	9.75
	Ceftriaxone	0.06	275	137.5	68.75
	Ciprofloxacin	0.016	3.9	1.95	0.97
	Gentamicin	0.5	12	6	3
	Levofloxacin	0.06	9.5	4.75	2.38
	Meropenem	0.06	50	25	12.5
	Pip-Tazo	2	368/23	184/11.5	92/5.8
	Tigecycline	0.12	1.5	0.75	0.37
***P.aeruginosa* ATCC27853**	Ciprofloxacin	0.5	3.9	1.95	0.97
	Gentamicin	1	12	6	3
	Meropenem	0.25	50	25	12.5
	Pip-Tazo	4	368/23	184/11.5	92/5.75
Gram positive bacteria:					
***E.faecalis* ATCC29212**	Ampicillin	0.5	47	23.5	11.75
	Linezolyd	2	20	10	5
	Tigecycline	0.12	1.5	0.75	0.37
	Vancomycin	2	50	25	12.5
***S.Aureus* ATCC29213**	Amoxi-Clav	0.12	14.4/3.2	7.2/1.6	3.6/0.8
	Ceftaroline	0.12	39	19.5	9.75
	Daptomycin	0.25	57	28.5	14.25
	Linezolid	2	20	10	5
	Tigecycline	0.06	1.5	0.75	0.37
	Vancomycin	0.5	50	25	12.5
S.pneumoniae ATCC49619	Ceftriaxone	0.06	275	137.5	68.75
	Ciprofloxacin	0.12	3.9	1.95	0.97
	Linezolid	0.5	20	10	5
	Penicillin G	0.25	40	20	10
	Vancomycin	0.12	50	25	12.5

Table 1: Tested organisms, MICs and drug concentrations Amoxi-Clav, Amoxicillin-clavulanic Acid; Pip-Tazo, Piperacillin-Tazobactam.[a] MICs were determined using broth microdilution method (ISO 20776-1)[b] Drug concentrations were chosen as reported by EUCAST guidelines.

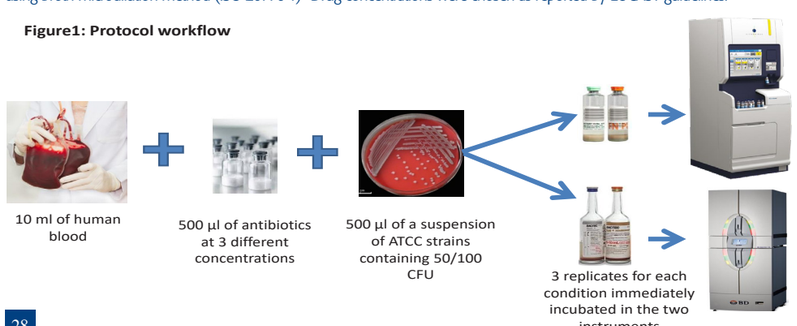
Organisms. ATCC strains used for the study are listed in Table 1.

Antibiotics. Antibiotics were diluted to yield final concentration consistent with peak therapeutic serum levels (Cmax), 1/2 and 1/4 of Cmax, tested for all microorganisms. Each antimicrobial substance was diluted in sterile water from stock solutions such that 0.5 mL contained the desired final amount of the drug. Antibiotics were measured and prepared on each day of use. The drug/organisms combination evaluated, the MICs and the concentrations of the antibiotic chosen are listed in **Table1**.

Bottle inoculation: 720 BACT/ALERT BC bottles and 720 BACTEC™ BC bottles were used. Overall 32 organismantimicrobial combinations were evaluated in triplicate for each concentration. For each combination, controls without added antimicrobials were included. **Figure 1** describes the protocol workflow.

Incubation and data analysis. All BC bottles were incubated at 37°C in the BACT/ALERT VIRTUO and BACTEC™ FX instruments for 5 days. Subcultures of bottles flagged as positive were performed. For each bottle detected as positive, the TTD was recorded.

Figure1: Protocol workflow



RESULTS

Recovery rate: A total of 1,440 BC bottles were inoculated. For all drug/organism combinations, the BACT/ALERT® FAN® PLUS bottles/ VIRTUO system showed a better overall recovery rate compared to Bactec F Plus medium/BACTEC™ FX (626/720, 86.9% and 501/720, 69.6%, respectively, p<0.001). In particular BACT/ALERT FA PLUS bottles demonstrated a statistically significant higher overall rate of recovery compared to the Aerobic/F Plus medium, 89.9% (302/336) and 75.3% (253/336) respectively. A higher overall rate of recovery is shown also for BACT/ALERT FN PLUS bottles (84.4%, 324/384) compared to the Anaerobic/F Plus medium(64.6%, 248/384). **(Fig.2)**

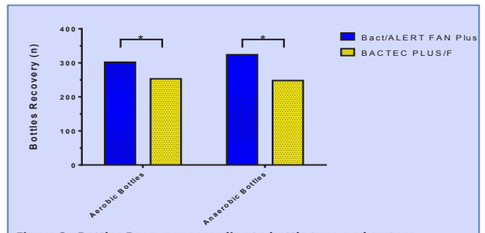


Figure 2. Bottles Recovery according to bottle type and system. *, *p*<0,001.

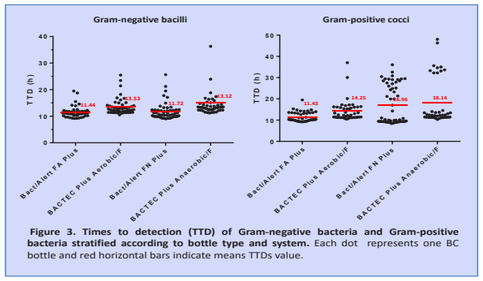


Figure 3. Times to detection (TTD) of Gram-negative bacteria and Gram-positive bacteria stratified according to bottle type and system. Each dot represents one BC bottle and red horizontal bars indicate means TTDs value.

Time to detection: The TTD varied greatly, depending on bacterial species, medium, and instrument. The total mean TTDs was calculated for BACT/ALERT FA PLUS vs BACTEC™ Plus Aerobic/F and BACT/ALERT FN PLUS vs BACTEC™ Plus Anaerobic/F. As highlighted in the graph **(Fig.3)** overall Gram-negative and Gram positive bacteria growth was detected earlier in the VIRTUO instrument than in the BACTEC system for both bottles types.

Neutralization: When antimicrobial substances were neutralized to some degree, a concentration-dependent nonlinear course of growth delay was observed. As reported in **(Figure 4a overleaf)**. A for Gram-positive bacteria BACT/ALERT FAN PLUS bottles showed better neutralization for all microorganism/drug combinations except for *E. faecalis*/Ampicillin and *S.pneumoniae*/Linezolid for which, at peak serum level, the TTD was faster for BACTEC Plus/F bottles. Amoxicillin-Clavulanic acid, Ceftriaxone and Vancomycin were not completely neutralized.

Also for Gram negative bacteria **(Figure 4b overleaf)** BACT/ALERT FAN PLUS bottles showed better neutralization for all microorganism/ drug combinations with faster TTD respect to BACTEC™ Plus/F bottles. Simulated BC containing *B. fragilis*/Metronidazole, *E.coli*/Meropenem and *E.coli*/Ceftriaxon never flagged as positive.

CONCLUSIONS

The present study is the first in vitro study performed in Europe comparing the ability of the two systems to neutralize the effects of antimicrobial agents and includes the largest number of combinations of bacterial species frequently isolated in bacteremia with commonly used antimicrobial agents. This initial evaluation of the BACT/ALERT versus BACTEC™ system in a simulated BC setting containing therapeutic levels of antibiotics suggests enhanced performance of the former in terms of recovery rate, and TTD with greater ability by BACT/ALERT FAN PLUS medium to neutralize the effects of antimicrobials; although further efforts are needed to evaluate its overall performance in different settings.

KEY POINTS

- This initial evaluation of the BACT/ALERT® VIRTUO® system versus the BACTEC system in a simulated blood culture setting suggests enhanced performance of the former in terms of recovery rate, with greater ability to neutralize the effects of antimicrobials and reduce time to detection.

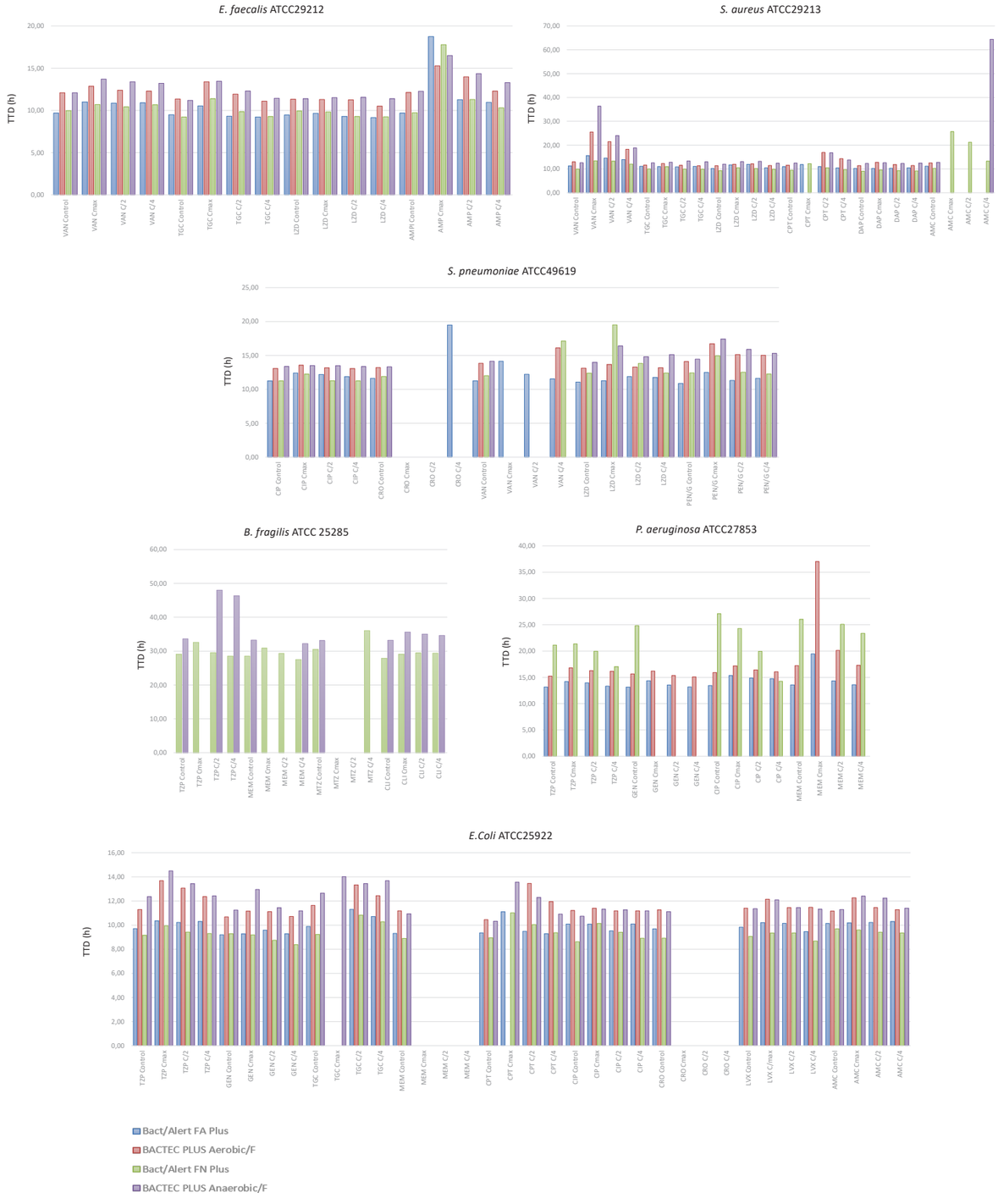


Figure 4: TTDs with and without antimicrobial substances for Gram positive (A) and Gram negative (B). Arithmetic means of triplicates were used for the graphic illustration. Each column illustrates the TTD of controls bottles and bottles containing antimicrobial substances at 3 different concentrations. AMC, Amoxicillin/Clavulanic acid; AMP, Ampicillin; CPT, Ceftaroline; CRO, Ceftriaxone; CIP, Ciprofloxacin; CLI, Clindamycin; DAP, Daptomycin; GEN, Gentamicin; LVX, Levofloxacin; LZD, Linezolyd; MEM, Meropenem; MTZ, Metronidazole; PEN/G, Penicillin G; TZP, Piperacillin /Tazobactam; TGC, Tigecycline; VAN, Vancomycin.

BACT/ALERT® FAN® PLUS MEDIA vs. BACTEC™

ID WEEK 2017

Comparison of BD BACTEC Plus Aerobic/F and bioMerieux BACT/ALERT FA PLUS blood culture bottles to remove antibiotics

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ABSTRACT

Successful detection of bloodstream pathogens in blood cultures is diminished when antibiotics are present in the blood. Blood culture bottles containing antibiotic adsorbent materials are recommended to address this problem. Recently bioMerieux introduced a new antibiotic adsorbing resin to replace activated charcoal in its blood culture bottles. The ability of this new resin to adsorb antibiotics and decrease time to detection (TTD) was compared with the resin bottles produced by Becton Dickenson (BD).

Methods: BD BACTEC Plus Aerobic/F bottles and bioMerieux BACT/ALERT FA PLUS bottles were compared for their ability to remove vancomycin (VANC), oxacillin (OXA), micafungin (MFN), and ampicillin (AMP), thus allowing the growth and detection of *Staphylococcus aureus, Candida albicans* or *Enterococcus faecalis*. After three time points, medium containing remaining antibiotic was removed from each bottle, serially diluted, and inoculated with organism in a 96 well plate. Adsorption of antibiotics was indicated by a decrease in the number of two-fold dilutions of medium containing antibiotic needed to allow microbial growth.

Results: The BACT/ALERT FA PLUS resin bottles were reproducibly better than the BD resin bottles at removal of VANC, OXA, and MFN as measured by at least one lower dilution needed to allow microbial growth. A statistically significant lower TTD ($p<0.05$) was observed in BACT/ALERT FA PLUS bottles compared to BACTEC Plus Aerobic/F bottles each containing *S. aureus*/OXA and *E. faecalis*/AMP. A lower mean TTD (but not statistically significant) was also seen in bottles containing *S. aureus*/VANC or *C. albicans*/MFN.

Conclusion: BACT/ALERT FA PLUS bottles demonstrated enhanced ability to remove antibiotics and allow microbial growth compared to the BACTEC Plus Aerobic/F bottles..

BACKGROUND

Successful detection of bloodstream pathogens in blood cultures is diminished when antibiotics are present in the blood. Blood culture bottles containing antibiotic adsorbent materials are recommended to address this problem. Several studies have suggested that the addition of resins in blood culture media can shorten the time to detection of positive blood cultures when antibiotics are present in the blood (Jorgensen et al, and Lelievre et al).

Recently bioMerieux introduced a new resin bottle to replace their activated charcoal blood culture bottle. BD already has a commercially available resin bottle and we chose to compare the ability of these two resins to adsorb antibiotics and decrease time to detection (TTD).

In one previous study of patients with sepsis, both culture bottles were comparable in their abilities to recover aerobic and facultative organisms (Jorgensen et al).

List of Ingredients

BD BACTEC Plus Aerobic/F		bioMerieux BacT/Alert FA Plus	
Processed water	30 mL	Processed water	30 mL
Soybean-Casein Digest Broth	3.0%	Casein peptone	1%
Yeast Extract	0.25%	Yeast Extract	0.45%
Amino Acids	0.05%	Soybean peptone	0.3%
Sodium Polyanetholsulfonate	0.05	Sodium Polyanetholsulfonate	0.3%
Vitamins	0.025%	Menadione	0.00005%
Antioxidants/Reductants	0.005%	Meat peptone	0.1%
Nonionic Adsorbing Resin	13.4%	Adsorbent polymeric beads	1.6g
Cationic Exchange Resin	0.9%	L-cysteine	0.03%
		Hemin	0.0005%
		Pyruvic acid 0.1%	
		Pyridoxine HCl	0.001%
		Nicotinic acid	0.0002%
		Pantothenic acid	0.0002%
		Thiamine HCl	0.0001%

MATERIALS AND METHODS

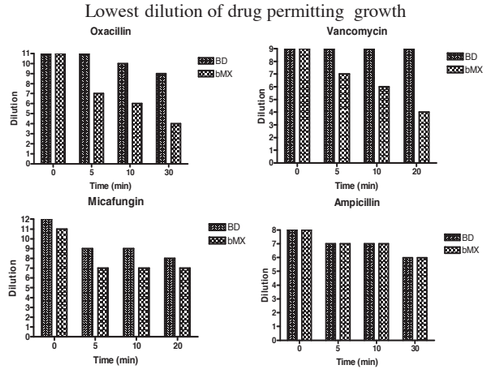
Adsorption of antibiotic by BD and bioMerieux resins: 0.5mL antibiotic was added to each bottle and mixed by hand. After three time points (5, 10, 20/30 minutes), medium containing remaining antibiotic was removed from each bottle, serially diluted, and inoculated with organism in a 96 well plate. Adsorption of antibiotics was indicated by a decrease in the number of twofold dilutions of medium containing antibiotic needed to allow microbial growth.

Time to detection in bottles seeded with antibiotic, microorganism and human blood: BD BACTEC Plus Aerobic/F bottles and bioMerieux BACT/ALERT FA PLUS bottles were compared for their ability to remove vancomycin (VANC), oxacillin (OXA), micafungin (MFN), and ampicillin (AMP) (at peak serum concentration for VANC, OXA, and MFN and ¼ peak serum concentration for ampicillin), thus allowing the growth and detection of *Staphylococcus aureus, Candida albicans* or *Enterococcus faecalis*. To determine how removal of antibiotics affected TTD we spiked each bottle (performed in technical triplicate) with 10 ml of whole blood, peak serum concentration of antibiotic, and approximately 60 CFU/ml of organism. Bottles were mixed and loaded into respective instruments for incubation. Adsorption of antibiotics was demonstrated by a decrease in TTD, indicating a more favorable environment for microbial growth.

EXPERIMENTAL OBSERVATION 1

Purpose: To compare the adsorption of antibiotics over time from BD and bioMerieux resin bottle media, allowing microbial growth.

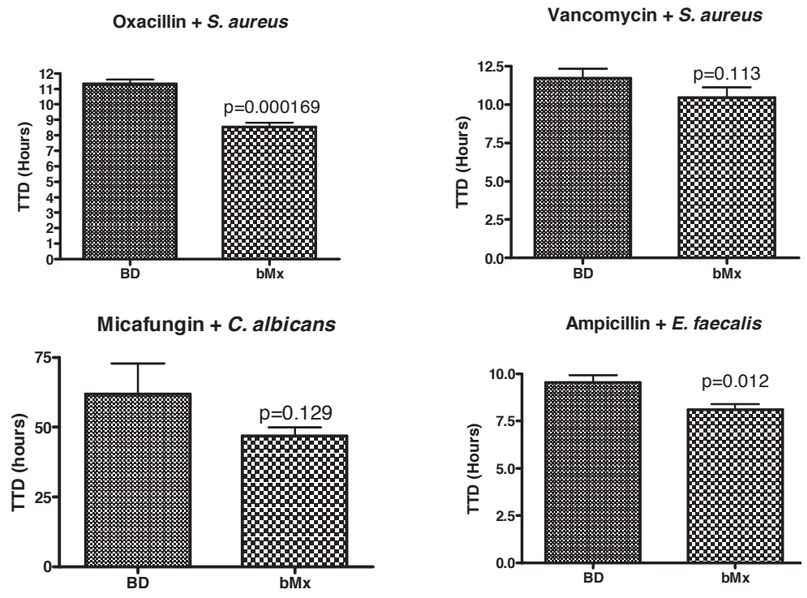
Results: The BACT/ALERT FA PLUS resin showed better reproducibility than the BD resin bottles at removal of VANC, OXA, and MFN as measured by at least one lower dilution needed to allow microbial growth.



EXPERIMENTAL OBSERVATION 2

Purpose: To determine how removal of antibiotics affected TTD of 4 respective pathogens in BD and bioMerieux resin bottles.

Results: A statistically significant lower TTD ($p<0.05$) was observed in BACT/ALERT FA PLUS bottles compared to BACTEC Plus Aerobic/F bottles each containing *S. aureus*/OXA and *E. faecalis*/AMP. A lower mean TTD (but not statistically significant) was also seen in bottles containing *S. aureus*/VANC or *C. albicans*/MFN.



CONCLUSIONS

BACT/ALERT FA PLUS bottles demonstrated enhanced ability to remove antibiotics and allow microbial growth compared to the BACTEC Plus Aerobic/F bottles.

FUTURE DIRECTIONS

- Compare TTD using a larger panel of microorganisms in BD and bioMerieux bottles
- Compare resin adsorption of additional antibiotics
- Compare TTD and antibiotic adsorption in pediatric resin bottles

REFERENCES

Jorgensen J., Mirrett S., McDonald L., Murray P., Weinstein M., Fune J, Trippy C., Masterson M., Reller L. Controlled clinical laboratory comparison of BACTEC plus aerobic/F resin medium with BACT/ALERT aerobic FAN medium for detection of bacteremia and fungemia. *J Clin Microbiol*. 1997;35(1):53-8

Lelievre, H., Gimenez, M., Vandenesch, F., Reinhardt, A., Lenhardt, D.,Just, H., Pau, M., Ausina, V., Etienne, J. Multicenter clinical comparison of resin-containing bottles with standard aerobic and anaerobic bottles for culture of microorganisms from blood. *Eur J Clin Microbiol Infect Dis*. 1997;16(9):669-74.

KEY POINTS

- BACT/ALERT® FA PLUS bottles demonstrated enhanced ability to remove antibiotics and allow microbial growth compared to the BACTEC™ Plus Aerobic/F bottles.

MEDLAB Asia Pacific 2016

Evaluation Study on Antimicrobial Neutralization with Automated Blood Culture Systems at Laboratory, Sunway Medical Centre

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ABSTRACT

This study compared the bioMeriéux BACT/ALERT blood culture (BC) system with Becton Dickinson BACTEC 9120 BC system for recovery and time to detection (TTD) of common isolates from Sunway Medical Centre (SunMed) in the presence of antimicrobial drugs in culture media. A total of 108 bottles were included in this study, which was carried out for a duration of two months from September till November 2014. 54 bottles were incubated at each BC system. In addition to that, a total of 108 bottles without adding antimicrobial drugs were also tested as controls. The results demonstrated that no isolates were detected for *Staphylococcus aureus* (SA) and Methicillin-resistant *Staphylococcus aureus* (MRSA) with presence of Vancomycin for both the evaluated systems. A substantial difference was noted between BACT/ALERT and BACTEC for recovery of seeded bacteria. Gram-Negative Bacilli (GNB) are the most recovered bacteria by both the systems as compared to Gram-Positive Cocci (GPC). Furthermore, the mean TTD of seeded bacteria with antimicrobial presence was substantially less with BACT/ALERT as compared to BACTEC.

BACKGROUND

Excellent Quality Management practice as set by the local requirement standard ; MS ISO 15189 requires evaluation of new method prior to introducing it in the existing system. Therefore, to comply with the standards, we performed an evaluation study on current BC system i.e. BACTEC with the new BC system from BioMeriéux i.e. BACT/ALERT. The BACTEC system uses a fluorescent method to detect bacteria growth in the BC bottle whereas BACT/ALERT uses a colorimetric method.

OBJECTIVE

This study compared the ability of BACT/ALERT Plus BC media and BACTEC™ Plus™ BC media to neutralize antimicrobial drugs such as Cefuroxime (CXM), Piperacillin-tazobactam (TZP) and Vancomycin (Va). The microorganisms used in this challenge are *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeroginosa* and MRSA. The selection of the antimicrobials and bacteria was based on common usage of the antimicrobial drugs and bacteria isolates at SunMed.

MATERIALS AND METHOD

A) Study overview

This is a comparative evaluation study of BACT/ALERT Plus media and BACTEC Plus media and their ability to remove various antimicrobial drugs from BC specimens (antimicrobial neutralization activity). The selected bacteria will be seeded in donor's whole blood that is less than 5 days old which is kept and stored at 2 – 8 °C. Combinations of bacteria and antimicrobials will form 5 cycles and the 6th cycle is the experiment to study less blood volume usage in blood culture bottle.

Test bottles were inoculated in triplicate for all cycles. Once the BC bottle are inoculated with bacterium and antimicrobial suspension, they will be placed immediately in their respective instruments to prevent delayed vial entry effects that may exist for either systems (Refer Flow Chart 1).

Cycles	1	2	3	4	5	6
Combi-nation	*E.coli* with CXM	*E.coli* with TZP	*P. aerugi-nosa* with TZP	*S.aureus* with VA	MRSA with VA	*E.coli* with CXM (less blood volume)

(B) Preparation at antimicrobial peak concentration

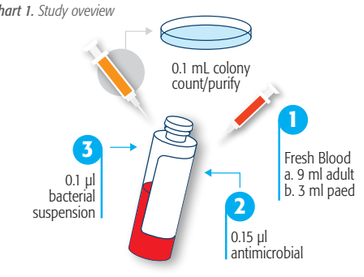
I. Antimicrobials used for testing: Cefuroxime (CXM), Piperacillin-tazobactam,Tazocin (TZP) and Vancomycin (Va).
II. Antimicrobial solution will be prepared from commercial drug powder.
III. Each antibiotic will be tested at peak concentration only as shown in table below:

No	Antibiotic (Generic)	Commercial Brand	Concentration	Peak Concentration tested
1	Cefuroxime	Zinacef	750 mg/ml	100 ug/ml
2	Piperacillin-Tazobactam	Tazocin	45 g/20ml	50 ug/ml
3	Vancomycin	Vancomycin	500 mg/10ml	75 ug/ml

(C) Preparation on bacterial suspension

I. Overnight growth for selected bacteria on the appropriate plated culture media.
II. Perform serial dilution to obtain 10 – 100 colony forming unit (CFU) inoculum range with the turbidity at 1.0 McFarland.
III. To get desired peak concentration, 0.15 µl final dilution added to each BC bottle.

Flow Chart 1. Study oveview



(D) Inoculum of BC bottle with antimicrobial and bacterial suspension

I. BC bottles used for testing:
  a. BACT/ALERT: FA PLUS (Aerobic); FN PLUS (Anaerobic) and PF Plus (Aerobic Paediatric).
  b. BACTEC™ Plus™ : Aerobic/F; Anaerobic/F and Paeds/F.
II. Fresh donor's blood was injected into each BC bottle (Adult: 9mL; Paeds: 3 mL). BC bottles were inverted to mix.
III. 0.15µL of final constituted antimicrobial drug was injected into each BC bottle.
IV. BC vial in triplicate were inoculated with 0.1µL of the organisms.
VI. BC bottle was inverted to mix and place them in the appropriate automated BC instruments immediately.
VI. All positive bottles were sub cultured to ensure purity.

EXPECTED RESULTS:

1. Successful antimicrobial neutralization is considered if growth is detected within 5 days .
2. Bottles in which no growth is detected after 5 days will be reported as Negative for growth.
3. Bottles in which growth is detected will be plated on blood agar media to check on purity and bacteria inoculum count.

RESULTS

The results demonstrated that no isolates were detected for *Staphylococcus aureus* (SA) and Methicillin-resistant *Staphylococcus aureus* (MRSA) with presence of Vancomycin in both the evaluated systems.

Overall TTD for control bottle is shown in Table 1 where there was no growth detected for *Pseudomonas aeruginosa* for both the evaluated systems.

Table 2 shows the overall mean TTD for tested seeded bacteria. Graphs 1 to 5 show the individual mean TTD results for each cycle. The mean of TTD of seeded bacteria with antimicrobial was substantially less with BACT/ALERT® than with BACTEC system. TTD with less blood volume is shown in Graph 6.

For recovery rate by type of blood culture bottle, 18/18 (100%) were from BACT/ALERT FA Plus (Aerobic) bottles and 11/18(61%) were from BACTEC™ Plus Aerobic/F; 9/15(60%) were from BACT/ALERTFN Plus (Anaerobic) bottles and 5/15(33%) were from BACTEC Plus Anaerobic/F bottle; 17/18(94%) were from BACT/ALERTPF Plus (Aerobic Paediatric) and 18/18(100%) were from BACTEC Paeds Plus/F [Table 3].

Total of recovered vial on BC bottle by bottle type for both systems is shown in Graph 7 while total for recovered vial by system is shown in Graph 8, BACT/ALERT system yielded 44/51 (86%) and BD BACTEC 9120 system yielded 34/51 (67%).

Table 1. Time to Detection for Positive Control Bottles

Time to Detection, h - Positive Control Bottle							
	Date Tested	04.09.2014	09.09.2014	15.09.2014	17.09.2014	17.09.2014	25.09.2014
	Cycle#	1	2	3	4	5	6
	Drug	Cefuroxime	Pip/Tazo	Pip/Tazo	Vancomycin	Vancomycin	Cefuroxime
	Organism	*E.coli*	*Ps.aeruginosa*	*E.coli*	*S.aureus*	MRSA	*E.coli* (less blood vol)
Aerobic	BACT/ALERT	10.08	16.80	11.52	12.96	13.68	12.24
	BACTEC	9.71	18.88	13.54	12.42	13.21	12.54
Anaerobic	BACT/ALERT	9.12	No growth	10.80	13.92	13.44	11.28
	BACTEC	10.21	No growth	10.87	12.92	13.37	14.70
Aerobic Pediatric	BACT/ALERT	9.60	16.56	11.04	13.68	12.72	11.76
	BACTEC	9.21	16.04	10.37	15.25	15.05	11.20

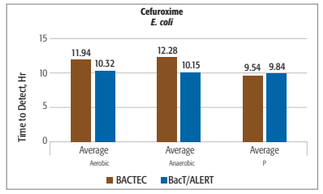
Table 2. Time to Detection for Bottles tested (Average)

Time To Detection(TTD), hour - Average							
	Date Tested	04.09.2014	09.09.2014	15.09.2014	17.09.2014	17.09.2014	25.09.2014
	Cycle#	1	2	3	4	5	6
	Drug	Cefuroxime	Pip/Tazo	Pip/Tazo	Vancomycin	Vancomycin	Cefuroxime
	Organism	*E.coli*	*Ps.aeruginosa*	*E.coli*	*S.aureus*	MRSA	*E.coli* (less blood vol)
Aerobic	BACT/ALERT	10.32	17.28	11.60	23.36	24.24	12.56
	BACTEC	11.94	22.47 (1)*	19.06 (2)*	45.41 (2)*	23.73 (2)*	14.54 (1)*
Anaerobic	BACT/ALERT	10.15	No growth	11.36	No growth	No growth	11.52
	BACTEC	12.28	No growth	16.04 (1)*	No growth	No growth	13.70 (1)*
Aerobic Pediatric	BACT/ALERT	9.84	18.48	11.44	14.00	14.64	12.12 (2)*
	BACTEC	9.54	18.74	12.09	19.44	20.86	13.31

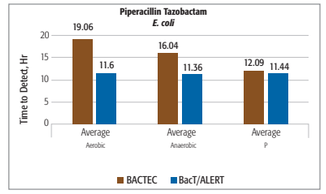
Table 3. Percentage (%) Positive for bottles tested

Recovery of Pathogen from Blood Culture Bottles With Addition of Antibiotic						
	BACTEC			BACT/ALERT		
	No. Tested	No. Positive	% Positive	No. Tested	No. Positive	% Positive
Aerobic	18	11	61%	18	18	100%
Anaerobic	15	5	33%	15	9	60%
Aerobic Pediatric	18	18	100%	18	17	94%
Total	51	34	67%	51	44	86%

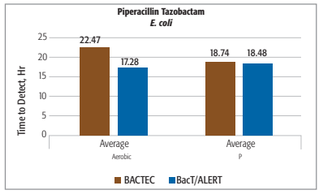
Evaluation Study on Antimicrobial Neutralization with Automated Blood Culture Systems at Laboratory, Sunway Medical Centre



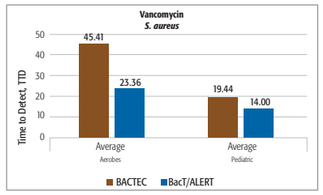
Graph 1: *E. coli* with CXM



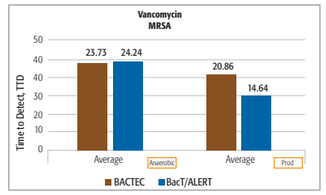
Graph 2: *E. coli* with TZP



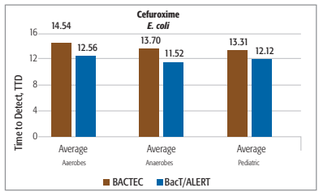
Graph 3: *Ps. aeruginose* with TZP



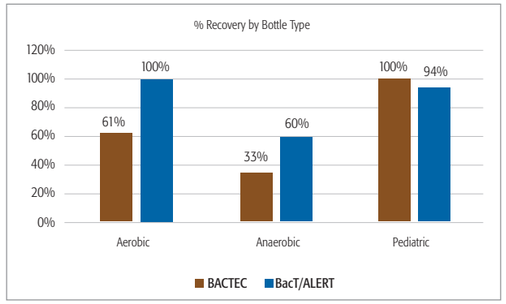
Graph 4: *S. aureus* with VA



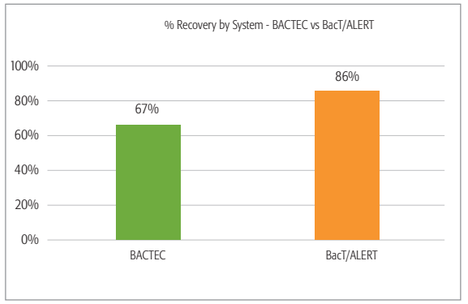
Graph 5: MRSA with VA



Graph 6: *E. coli* with CXM (Less blood volume)



Graph 7: % Positive by Bottle Type



Graph 8: % Recovery by System-BACTEC vs BacT/ALERT

DISCUSSION

The efficiency of the neutralization and absorption of antimicrobial agents by these substances is expected to significantly impact the time to detection (TTD) and recovery of microorganism(1).

Our comparison study demonstrated that mean TTD of seeded bacteria with antimicrobial agent tested was substantially shorter for BACT/ALERT and total recovery rate substantially more for BACT/ALERT.

The comparison study was done on small sample size due to time and cost restrictions.

Limitation on apparatus i.e. large and inaccurate scale on syringe and dilution tube; non sterile conical tube for dilution; variances in viability of bacteria suspension after preparation; uncertain on final peak concentration prepared; inconsistency of vial vacuum pressure on each vials will affect on the analysis findings and need to be considered.

CONCLUSIONS

The overall detection rate in BACT/ALERT Plus bottles is substantially higher than BACTEC Plus bottles (86% and 67% respectively) which is indicative of better antimicrobial neutralization in the BACTAlert Plus bottles.

References

1. Comparison of Antimicrobial Binding and Growth Kinetics in BACT/ALERT®FA Plus and BD BACTEC™ Plus Aerobic Media D. Lovern*, B. Katzin, K. Johnson, E. Miller, A. Gates, P. Deol, K. Doing, W. M. Dunne, Jr. bioMérieux Inc., Durham, NC, USA
2. Comparative Evaluation of BACTALERT® PLUS, Bactec® FX and VersaTREK® Blood Culture Systems with stimulated adult and paediatric bacteremia conditions Beaudoin MC[1,2,3], Gervais P[1,2,3], Ruest A[1], Loungnarath V[1], Longtin Y[4], Bédard C[1], Martineau P[2], St-Amand C1, Morin K[1], Longtin J[1,3] 1 CHU de Québec, 2 IUCPQ, 3 Centre de Recherche en Infectiologie de l'Université Laval, Québec City, 4 McGill University, Montréal ; (Québec) CANADA
3. Performance of Two Resin-Containing Blood Culture Media in Detection of Bloodstream Infections and in Direct Matrix-Assisted Laser Desorption Ionization–Time of Flight Mass Spectrometry (MALDI-TOF MS) Broth Assays for Isolate Identification: Clinical Comparison of the BACT/ALERT Plus and Bactec Plus Systems .Barbara Fioria, Tiziana D'Inzeoa, Viviana Di Florioa, Flavio De Maioa, Giulia De Angelisa, Alessia Giaquintoa, Lara Campanab, Eloisa Tanzarellac, Mario Tumbarellob, Massimo Antonellic, Maurizio Sanguinettia and Teresa Spanua. J.Clin.Microbial. 2014, 52(10):3558. DOI:10.1128/JCM.01171-14
4. Comparison of BACT/ALERT® FA and FN Blood Culture Bottles to BACT/ALERT FA PLUS and FN PLUS Bottles for Effectiveness of Antibiotic Neutralization and Time to Positivity. Christian M. Hill[1,2], Valerie Hadwell1, Heather Jewsbury[1], Edith M. Blondel-Hill[1,3] [1]Kelowna General Hospital, Interior Health, British Columbia, [2]University of British Columbia - Okanagan, [3]University of British Columbia – Vancouver
5. Neutralisation of Antimicrobial Subtances in New BACT/ALERT FA and FN PLUS Blood Culture Bottles Dieter Mitteregger, Wolfgang Baraousch, Marion Nehr, Michael Kundi, Markus Zeitlinger, Athanasios Makristathis and Alexander M.Hirsch J.Clin. Microbiol. 2013, 51(5):1534. DOI:10.1128/JCM.00103-13

KEY POINTS

- Mean time to detection (TTD) with presence of antimicrobial substances was substantially less with BACT/ALERT® bottles (14.2h) compared to BACTEC bottles (18.2h).
- Microorganism recovery rate was better with BACT/ALERT bottles compared to BACTEC bottles (86% vs. 67%).

BACT/ALERT® FAN® PLUS MEDIA

VS.

BACT/ALERT® FAN®

and

STANDARD MEDIA

BACT/ALERT® FAN® PLUS MEDIA vs. BACT/ALERT®FAN, AND STANDARD MEDIA

EUROPEAN JOURNAL OF CLINICAL MICROBIOLOGY & INFECTIOUS DISEASE
2015;34(5):1031-7

High medical impact of implementing the new polymeric bead-based BACT/ALERT FA PLUS and FN PLUS blood culture bottles in standard care

Amarsy-Guerle R., Mougari F., Jacquier H., Oliary J., Benmansour H., Riahi J., Berçot B., Raskine L., Cambau E
Service de Bactériologie, AP-HP, Hôpital Lariboisière, 75010 Paris, France

In this study, the positivity rates and time-to-detection (TTD) differences of two periods were examined after implementation of the FAN PLUS media. The FAN PLUS media contains a polymeric bead designed to adsorb antimicrobials. During the first ten-month period, the BACT/ALERT standard aerobic (SA) and standard anaerobic (SN) media were used, whereas during the second ten-month period, the BACT/ALERT FA PLUS and FN PLUS media were used. Each period had the same number of enrolled patients.

The FAN PLUS media period had a higher number of positive bottles compared to the standard media period (7.0% vs. 5.8%, P<0.0001) and also had more positive blood culture sets (9.6% vs. 7.8% with 995 and 832 positive BC sets respectively, P<0.0001).

The FAN PLUS media period isolated more cases of staphylococci (P<0.0001) and Gram-negative bacilli (P<0.005). The contamination rate was similar during both periods (2.4% with FAN PLUS vs. 2.3% with standard media).

The FAN PLUS media showed an overall 2.5 hour faster TTD (15.5 h vs. 18.0 h, P<0.01).

"In conclusion, the new BACT/ALERT FA PLUS/ FN PLUS BC bottles improved the diagnosis of BSI in our hospital, with an increased recovery rate and a decreased time to detection, particularly in patients at a high risk of concomitant administration of antimicrobials, such as ICU patients"

KEY POINTS

- FAN PLUS media outperformed Standard media in both recovery and time to detection.
- FAN PLUS bottle set positivity rate was 9.6% vs. 7.8% for the Standard media.
- FAN PLUS bottle positivity rate was 7.0% vs. 5.8%.
- FAN PLUS media had a 2.5 hours faster time-to-detection than Standard media (18.2 vs. 21.4).

BACT/ALERT® FAN® PLUS MEDIA vs. BACT/ALERT®FAN, AND STANDARD MEDIA

JOURNAL OF CLINICAL MICROBIOLOGY
2013; 51(12): 4150-4155

Clinical Evaluation of BACT/ALERT FA PLUS and FN PLUS Bottles Compared with Standard Bottles

Lee DH.[1], Kim S.C.[2], Bae IG.[3], Koh EH.[1], Kim S.[1]
(1) Departments of Laboratory Medicine,
(2) Emergency Medicine, and Internal Medicine,
(3) Institute of Health Sciences, Gyeongsang National University School of Medicine, Jinju, South Korea

This study compared the BACT/ALERT FA PLUS and FN PLUS to the standard aerobic (SA) and standard anaerobic (SN) bottles. 20 ml of blood was drawn from each adult patient enrolled in the study and was divided equally between the four bottle types. Organism recovery and time-to-detection (TTD) were determined for clinically significant pathogens. Blood volume was measured by weight and any blood culture set which contained bottles with fill volumes less than 4 ml was excluded from the study to limit bias. During the six month study period there were 3,103 sets of blood cultures drawn throughout the institution, of which 1,481 met the inclusion criteria.

Overall, the performance of the FA PLUS and FN PLUS media was superior to that of the standard media. The FA PLUS media had two hour faster TTD (11.1) compared to the SA bottle (13.1). The FA PLUS isolated significantly more pathogens than the SA bottles. The FN PLUS media had a 0.8 hour faster TTD (12.0) compared to the SN bottle (12.8). The FN PLUS isolated significantly more pathogens than the SN bottle, especially with Gram negative organisms (22 vs. 6, respectively).

In conclusion, the authors found that the FAN PLUS media isolated more clinically significant bacteria and had a faster TTD than the standard media.

"This study showed that clinically significant bacteria were isolated more frequently from the resin bottles than from the standard bottles, both overall and in the subgroup of patients who had received antibiotics prior to specimen collection. […] Clinically significant bacteria were detected faster using the aerobic resin bottles than using the standard aerobic bottles."

KEY POINTS

- FA PLUS had a 2 hours faster TTD vs. the SA bottle, and the FN PLUS had a 0.8 hours faster TTD vs. the SN bottle.
- The FA PLUS bottle isolated more organisms than the SA bottle (38 vs. 14; P=0.001).
- The FN PLUS bottle isolated more organisms than the SN bottle (27 vs. 10; P=0.008).

Other “Selection of Publications” available

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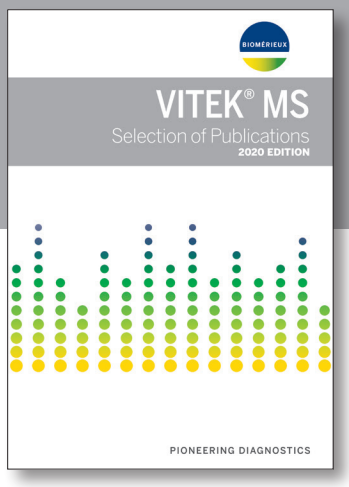

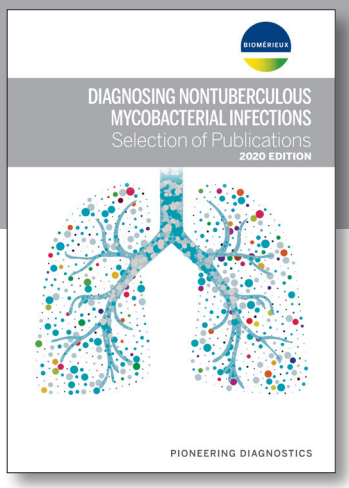

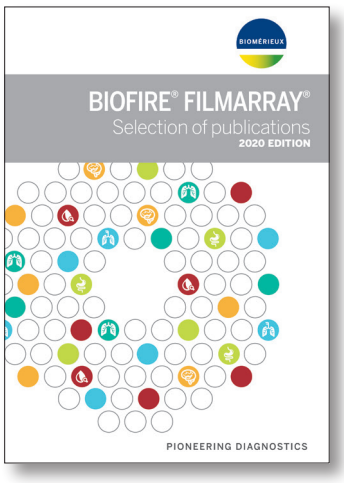

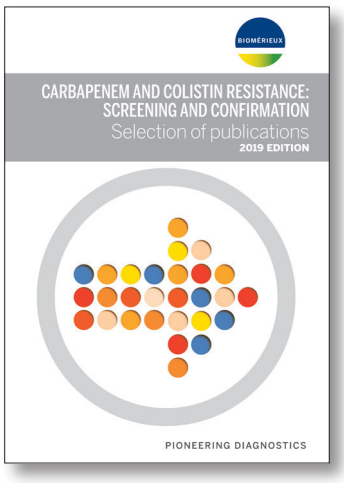

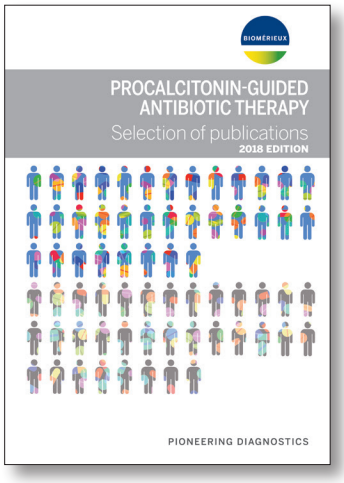

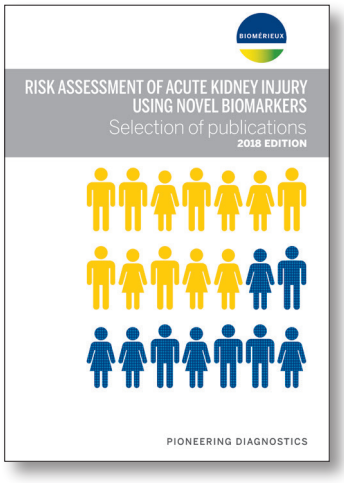

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