



血液培養新知研討

A World of Difference in Blood Culturing

BDDS
Product Specialist

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March 26, 2011



Helping all people
live healthy lives

Outline

- Blood Culture Overview
- BD Blood Culture System History
- BD BACTEC™ 9000 Series
Technology & Detection Algorithms
- BD BACTEC™ 9000 Series Media
Development
- BD BACTEC™ Safety

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BD BACTEC™

A World of Difference in Blood Culturing

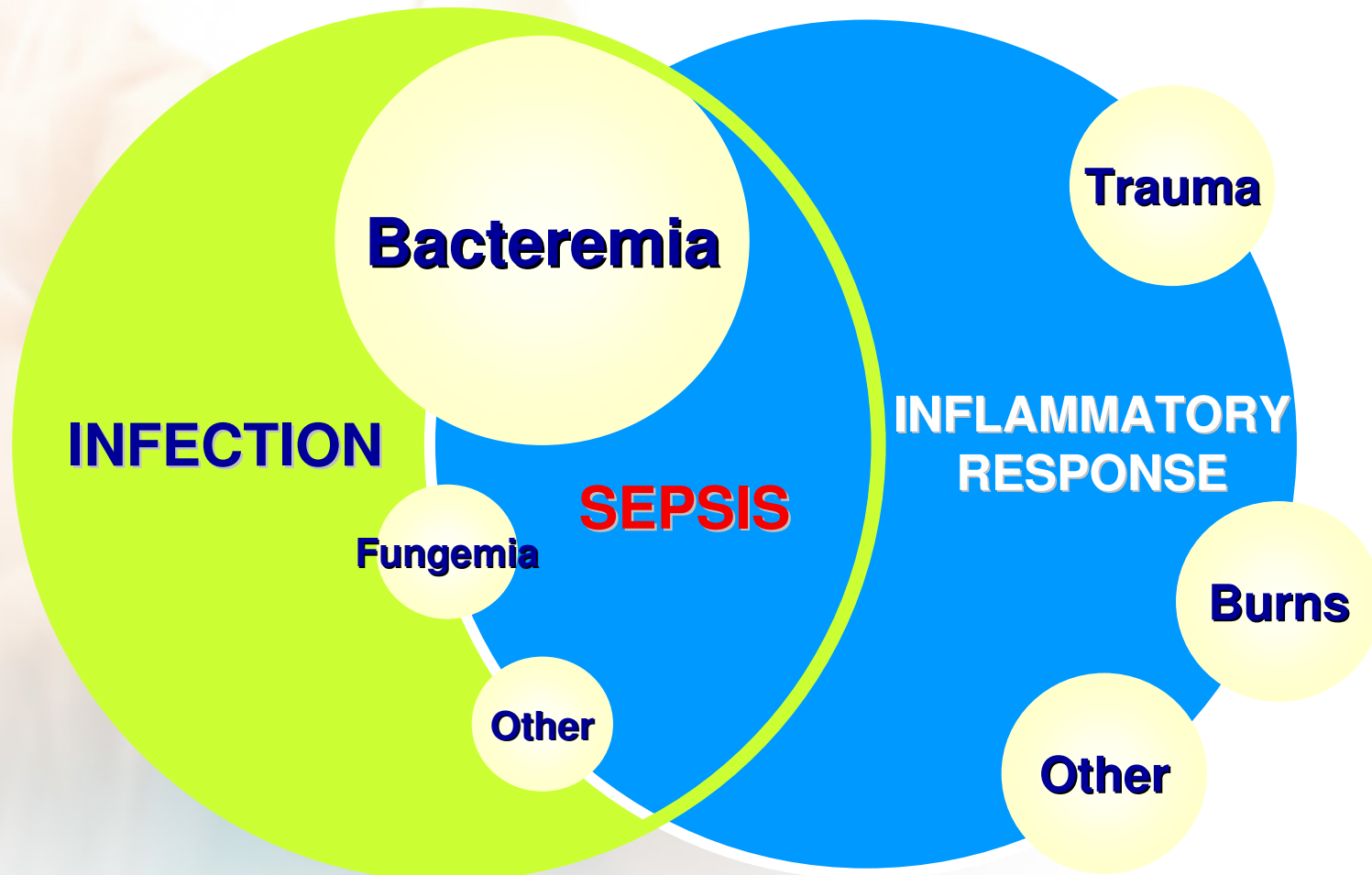
Blood Culture Overview



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Interrelationship Between Inflammatory Response, Sepsis and Infection

Adapted from Bone *et al.*, 1992



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The Clinical Importance of Blood Cultures

- “Reports show that the frequency of bloodstream infections is rising worldwide (CDC 2000). Nosocomial infections play an important role in this trend. *Pittet et al, Clin.Microbiol.Infect.Dis., June 1997*”
- “Bloodstream infection (BSI) is an important cause of serious morbidity and mortality. Approx. 200,000 patients are diagnosed with BSI annually in the United States with an estimated mortality from BSI of 22 to 29%.”: *Munson et al, JCM Jan 2003*
- “Overall 23% of our patients did not live long enough to receive adequate treatment or were treated with inadequate antimicrobial agents...It is the responsibility of clinical microbiologists to delineate better procedures for conveying rapidly to the bedside information regarding etiology and antimicrobial susceptibility patterns of isolates from bloodstream infections.”: *Bouza et al, Clin.Microbiol.Infect.Dis. May 1999*
- “However due to its clinical importance, every hour of earlier detection is crucial.”: *Vigano et al, Diagn. Micro. Inf. Disease 44, 2002*

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“Do Positive Blood Cultures affect Therapy and Mortality?”

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Outcome According to Therapy

EMPIRIC	AFTER Cx +	AFTER AST	ASSOC. MORT (%)	RELATIVE RISK
A	A	A	10.5	1.0
I	A	A	13.3	1.27
I	I	A	25.8	2.46
I	I	I	33.3	3.18

A = Appropriate Therapy

I = Inappropriate Therapy

Clin Infec Dis 24:584-602, 1997

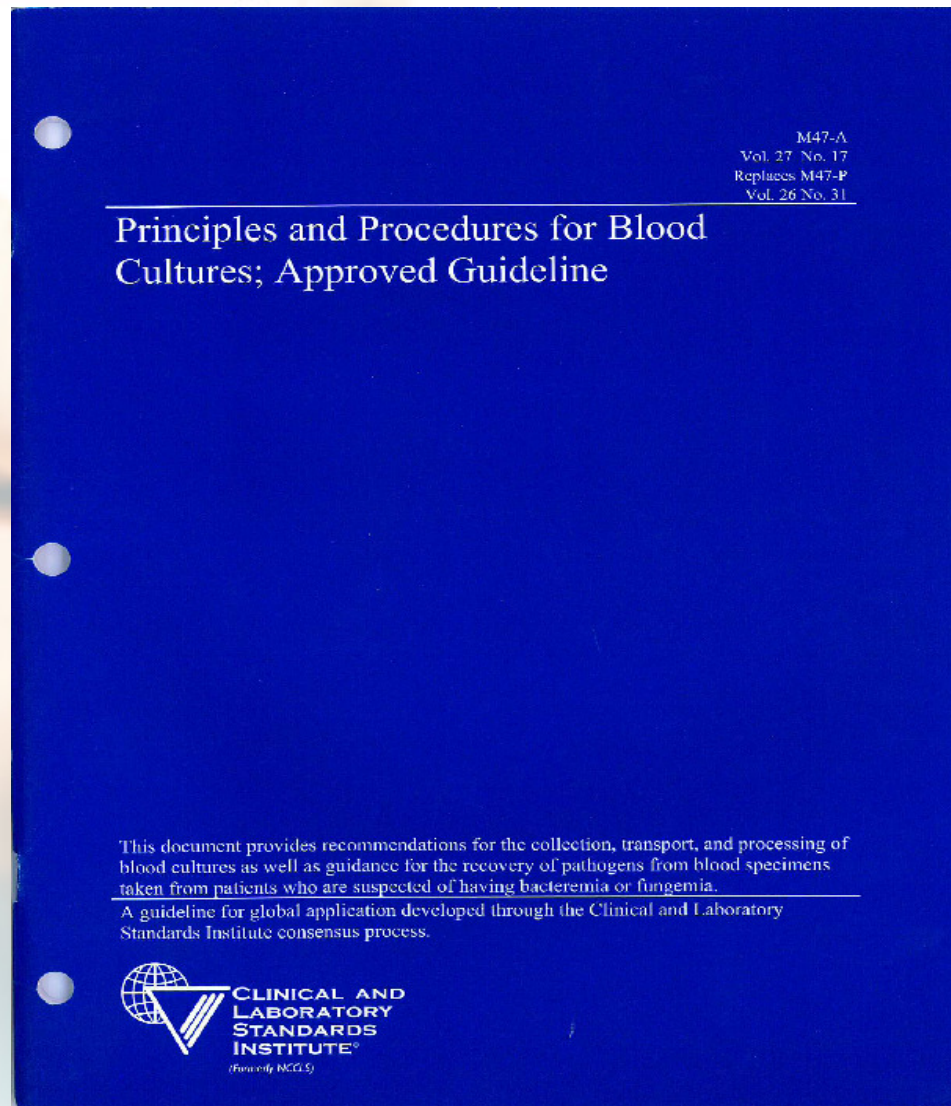
Reasons for Negative BC in Sepsis Patients

- ☹ **Infection is contained locally**
 - ☹ Cellular products (endotoxin, peptidoglycan, lipoteichoic acid, bacterial DNA) and/or cytokines
- ☹ **Poor Timing of collection**
- ☹ **Too low blood volume collected**
- ☹ **Patient on antibiotics**



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Optimal Recovery of Organisms in Blood Culture



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Key Points from CLSI M47-A

- Timing of drawing blood cultures
- Number of blood culture sets
- Volume of blood for culture
- Distribution of blood between aerobic and anaerobic blood culture bottles
- Blood Culture Collection

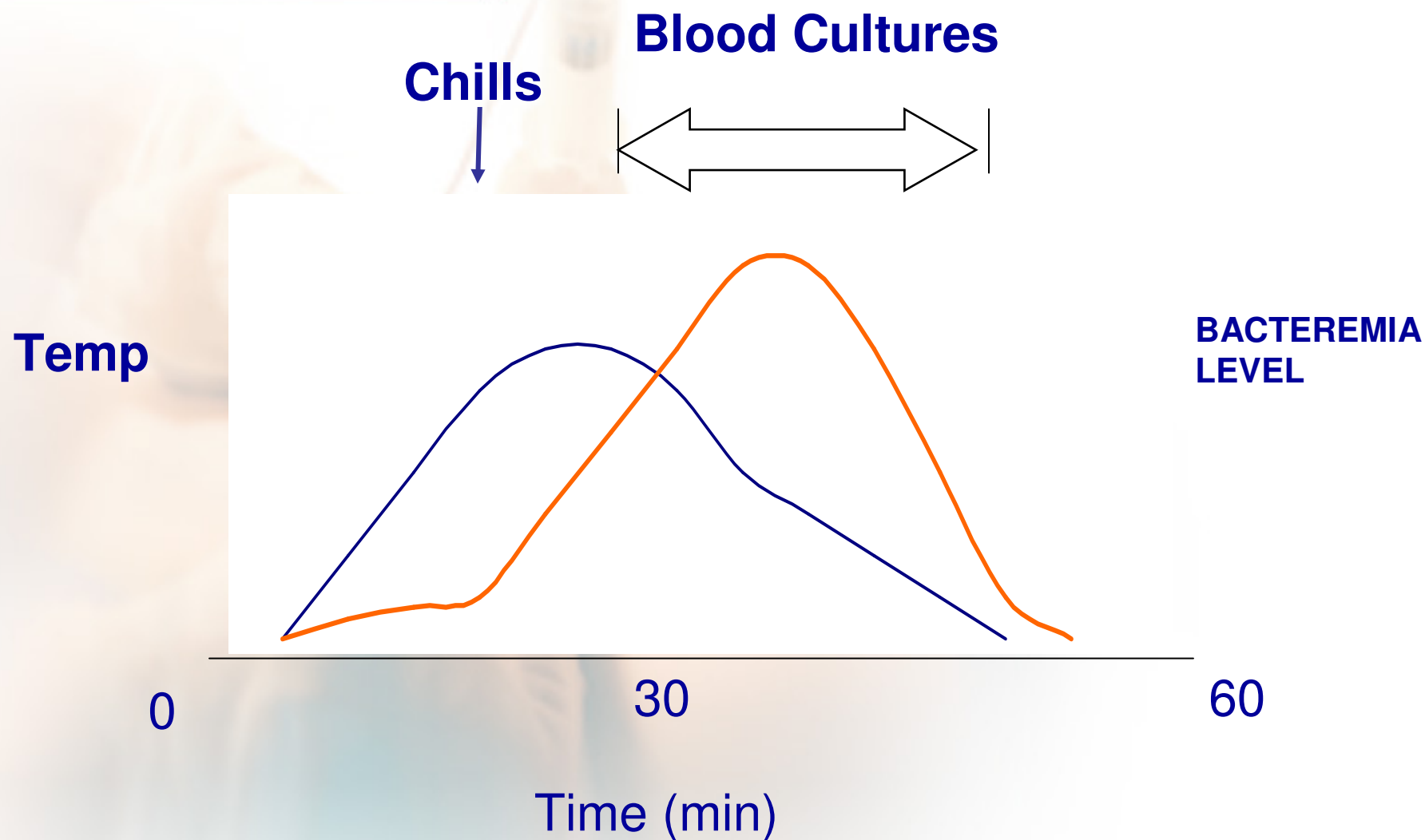


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Timing of Drawing Blood Cultures

“When is the best time to draw blood cultures on a patient with suspected sepsis?”

Timing of Drawing Blood Cultures



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Timing of Drawing Blood Cultures



- Acute Infective Endocarditis

Obtain blood culture sets **within a 30-minute** period before administration of empiric antimicrobial agents

- Subacute Infective Endocarditis:

Obtain blood culture sets with the sets **spaced 30 minutes to one hour apart.**

If those sets are negative at 24 hours, obtain two more sets of cultures, for a total of five sets overall.

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Number of Blood Culture Sets



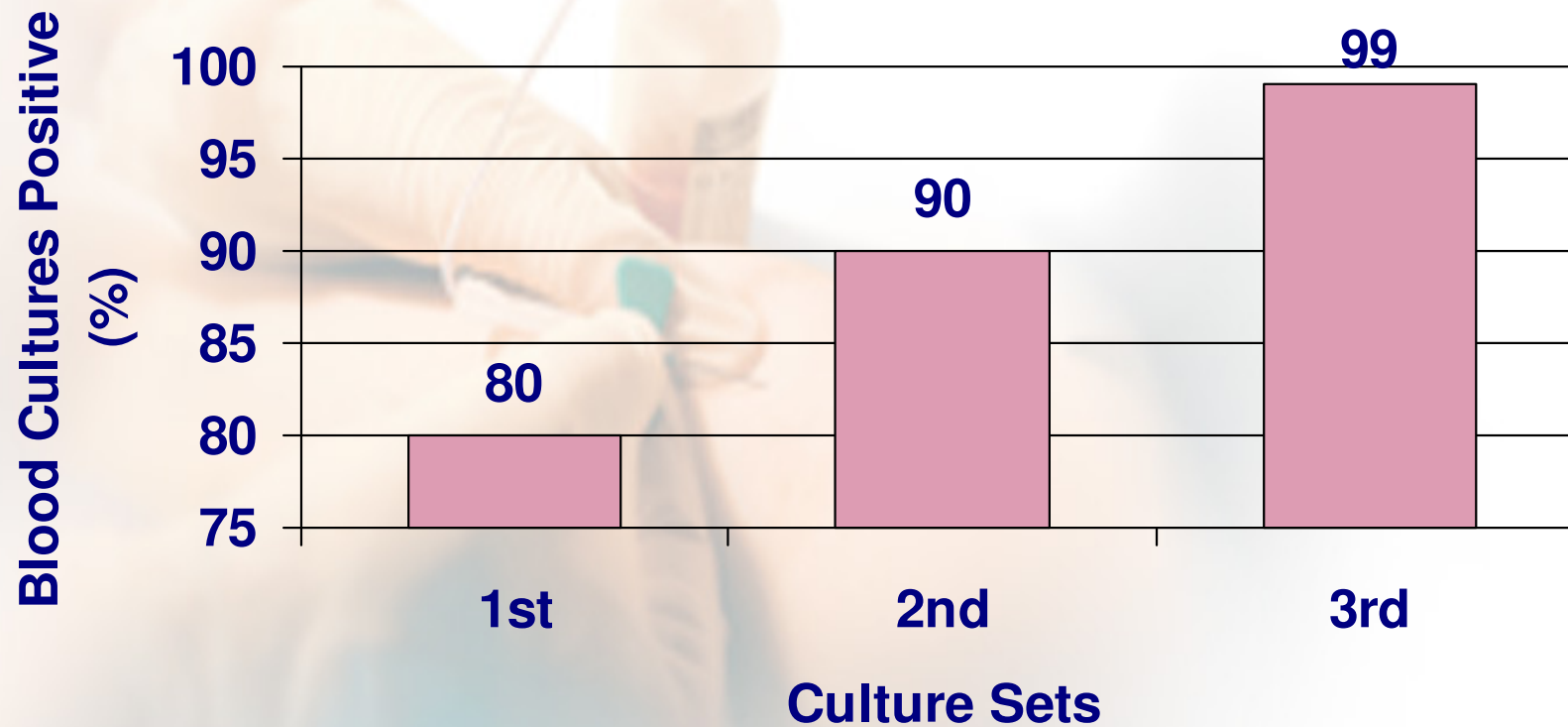
“How many blood culture sets do I need to draw?”

Single blood culture should never be drawn from adult patients; this practice results in an inadequate volume of blood cultured, and the results of single blood cultures are more difficult to interpret.

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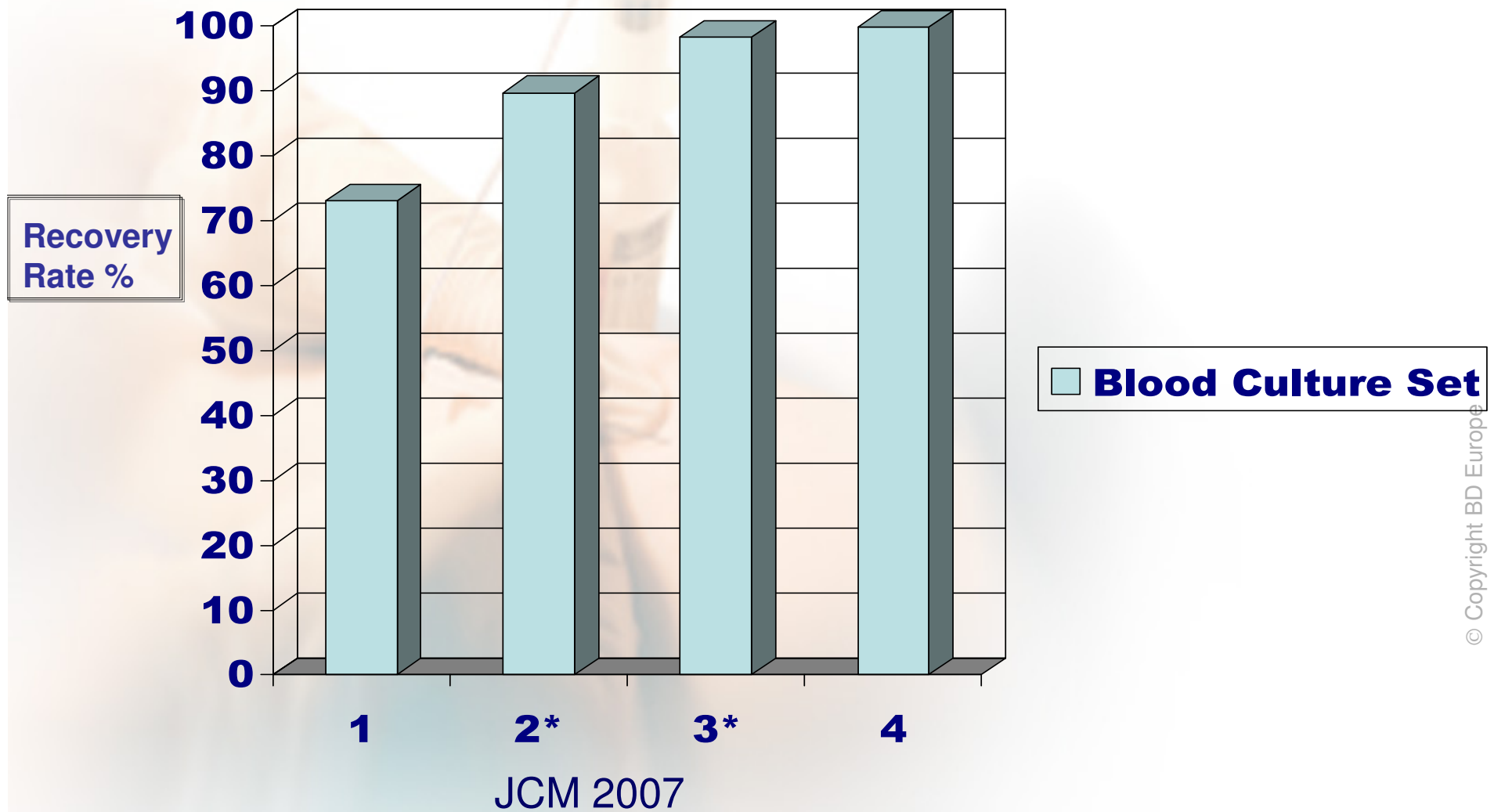
Blood Culture Positivity Rates

Mayo Clinic, 1975



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Number of Blood Culture Sets



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Organisms as contaminants vs. true positives

Organism	False Positives	True positives
Bacillus spp.	> 90%	<10%
CNS	>90%	<10%
Propionibacterium spp.	80%	<10%
Corynebacterium spp.	80%	20%
Viridans streptococci	50%	50%
Clostridium spp.	40%	60%
Staphylococcus aureus spp.	25%	75%
Enterococcus spp.	15%	85%
Source: From a presentation by Dr. Patrick Murray, University of Maryland School of Medicine, Microbiology for the Millennium Conference, Feb. 17-19, 1999, Baltimore, MD.		

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Volume of Blood for Culture

“How much blood should I draw from the patient?”

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Volume of Blood for Culture

- Adults: 20 to 30 mL / culture
- (i.e., per venipuncture)
- Infants and younger children:
- <1% patient's total blood volume



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- Distribution of blood between
- aerobic and anaerobic blood
- culture bottles



use of paired aerobic/anaerobic blood culture bottles yielded more staphylococci, members of the family *Enterobacteriaceae*, and anaerobes when compared to paired aerobic blood culture bottles

Reference #50 JCM 2003



BD BACTEC™

A World of Difference in Blood Culturing

BD BACTEC™ Blood Culture System History



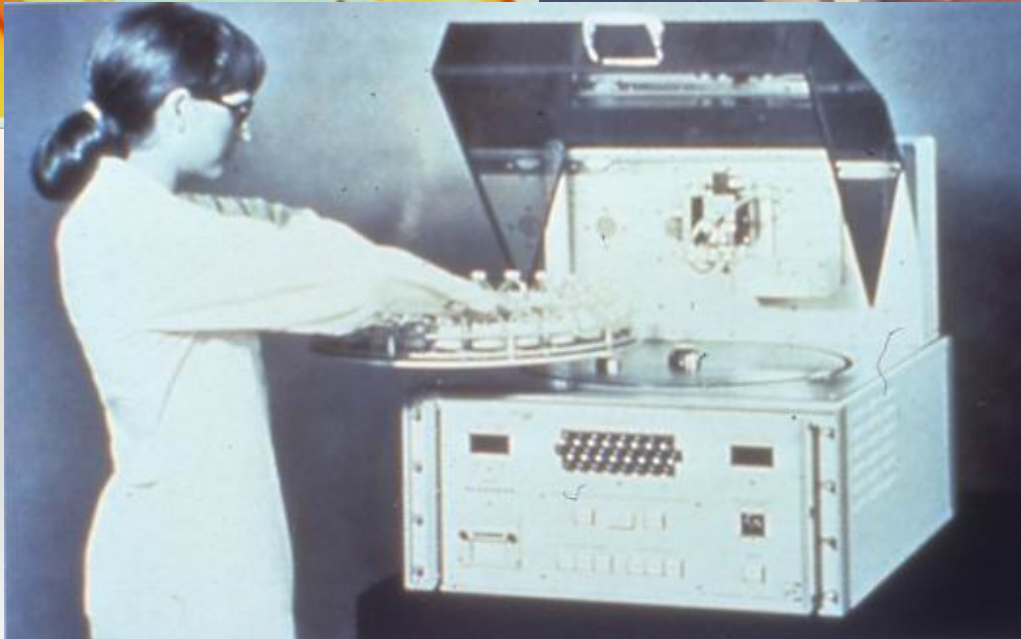
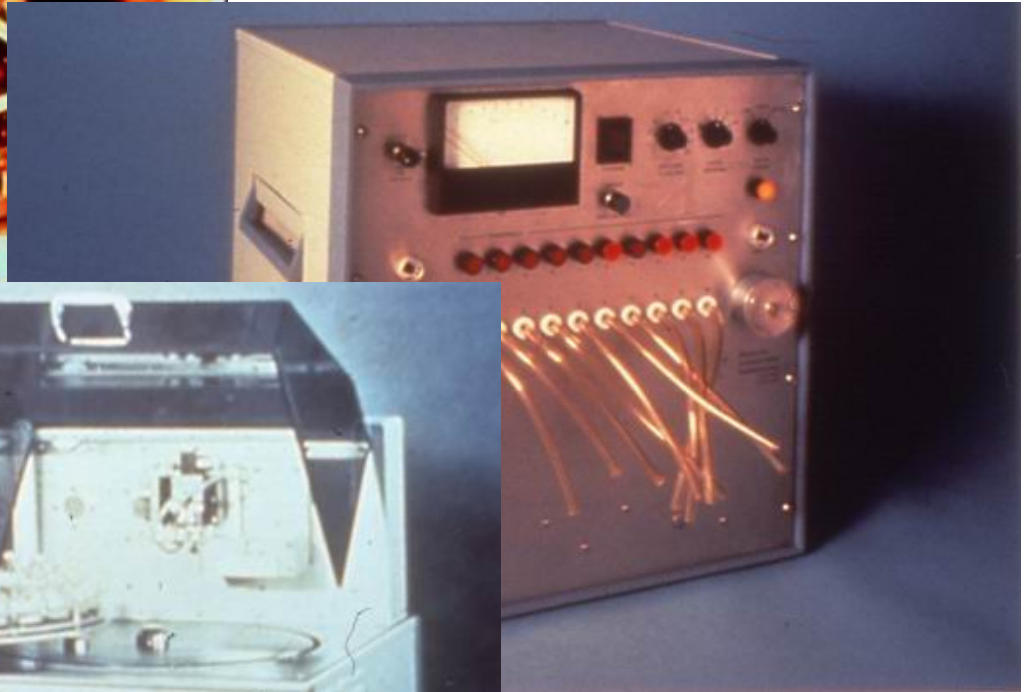
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Primary Blood Culture



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The BACTEC™ History goes back to 1968: BACTEC™ Radiometric



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The BACTEC™ History goes back to 1968: BACTEC™ Radiometric



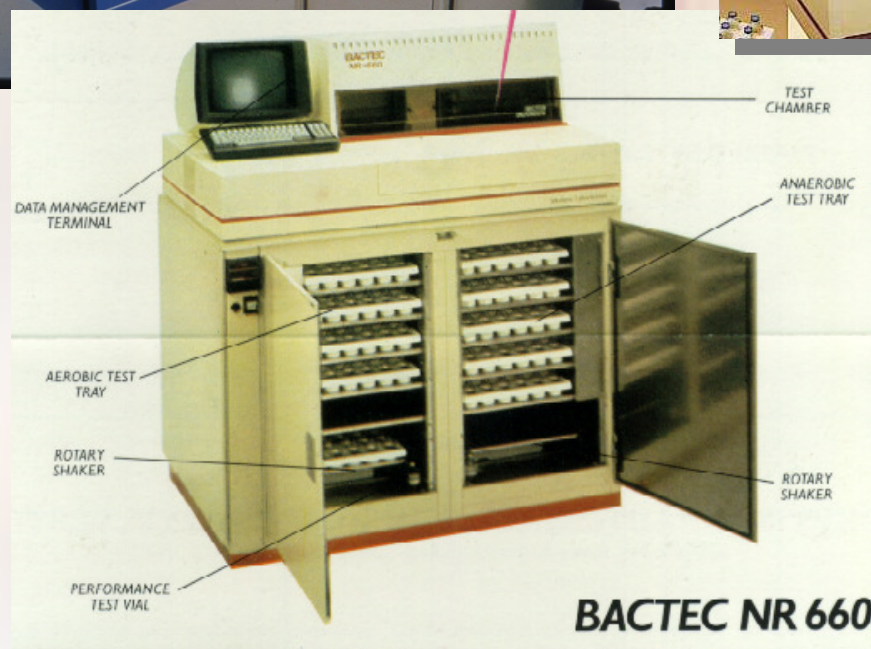
- $^{14}\text{CO}_2$
- Blood culture/TB culture
- Growth Index(GI)
- Primary Isolation/NAP
/AST for TB test

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The BACTEC™ History goes back to 1968: BACTEC™ NR



BACTEC 730

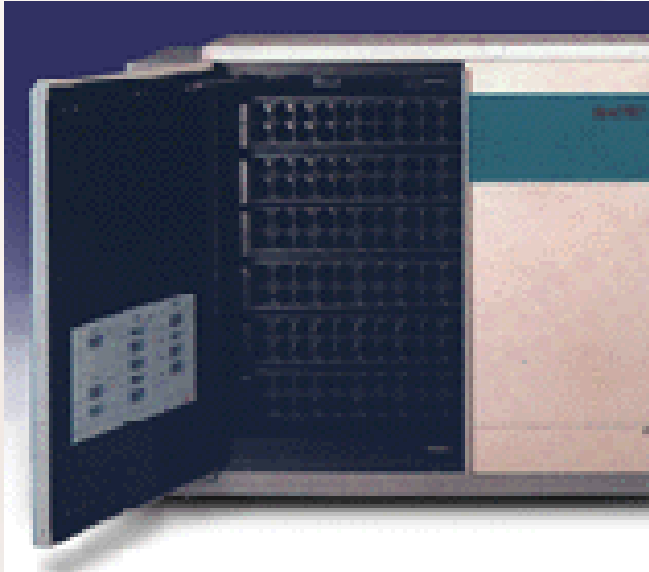


BACTEC NR 660



BACTEC 9000

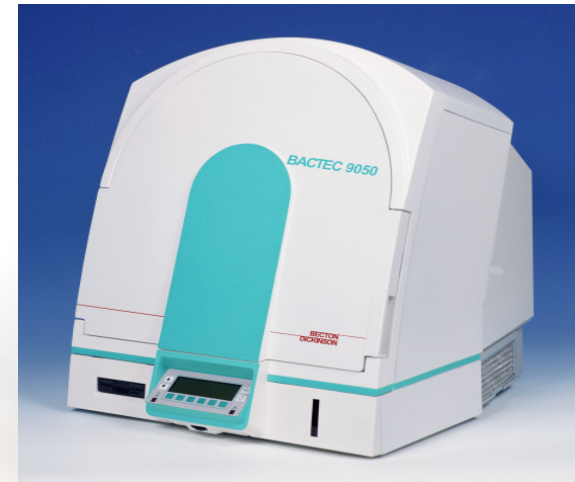
The BACTEC™ History goes back to 1968: BACTEC™ 9000 & FX



BACTEC 9240



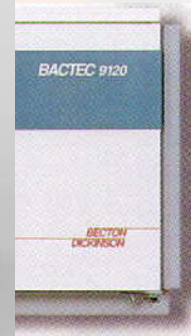
BACTEC FX



BACTEC 9050



BACTEC 9120



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BD BACTEC™

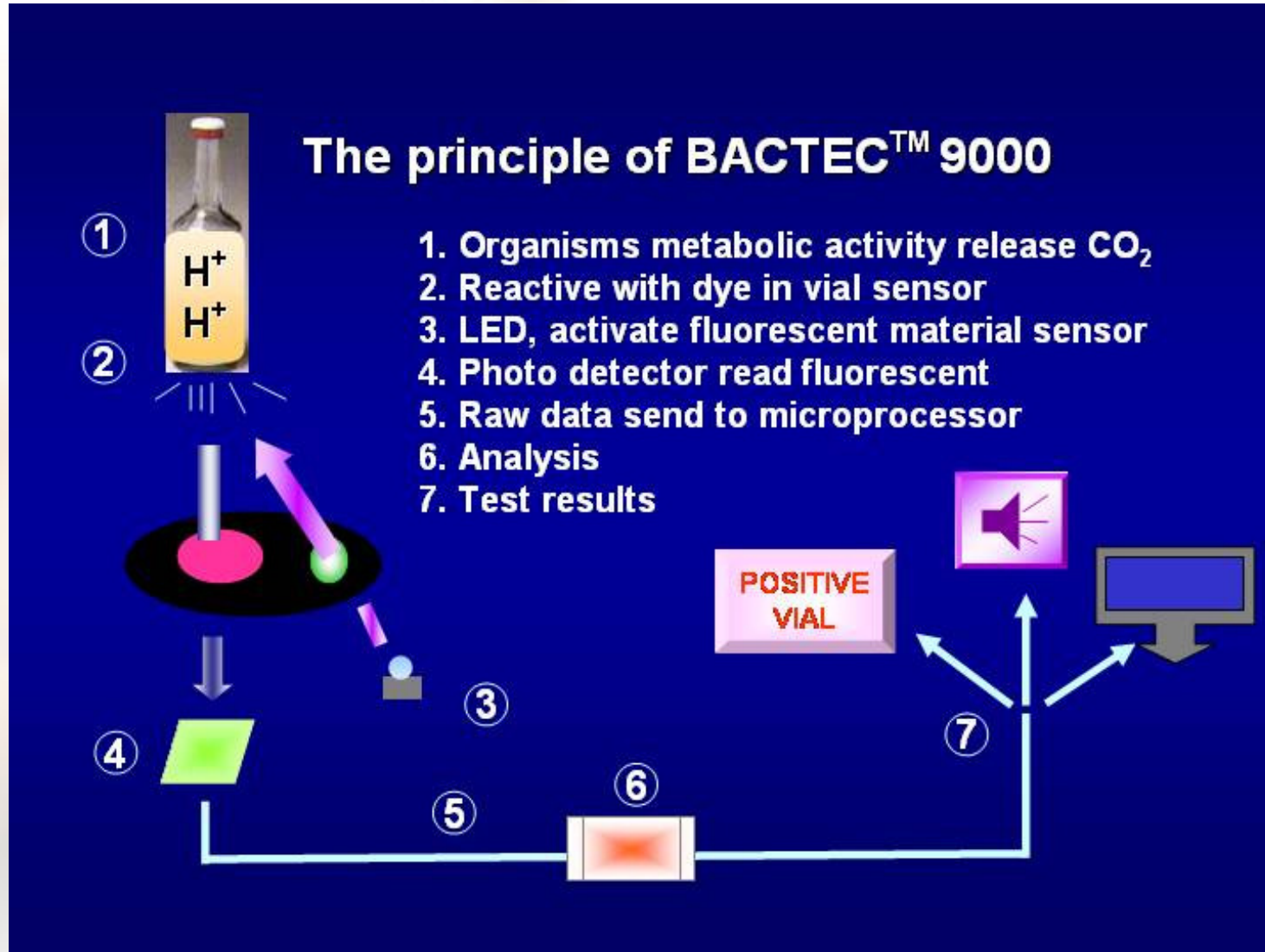
A World of Difference in Blood Culturing

Technology and Detection Algorithms



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BD BACTECTM 9000: Most Sensitive Fluorescence Technology



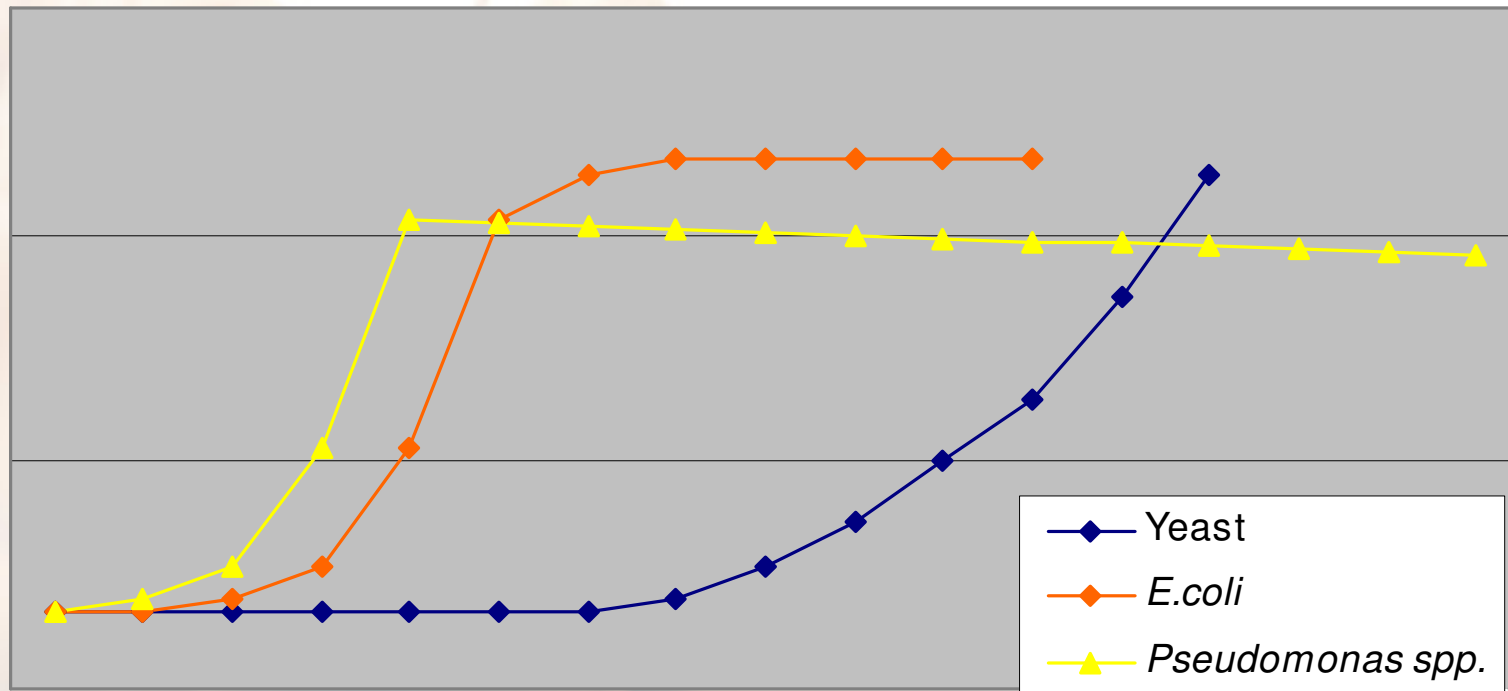
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BD BACTEC™ Algorithm Development

- A wide variety of
- Different Algorithms
- used in Different Combinations for
- Optimal Recovery and Time to Detection in Every Situation

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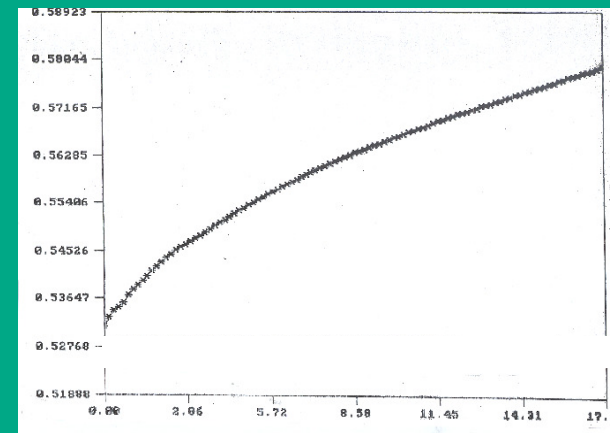
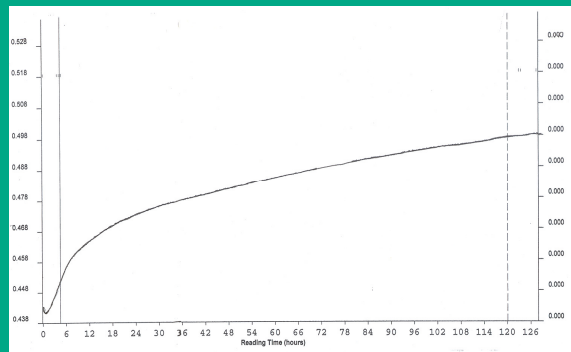
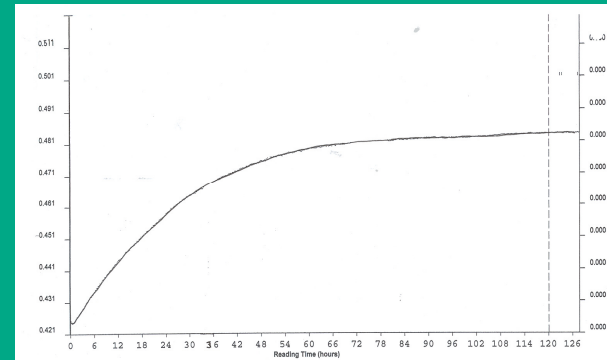
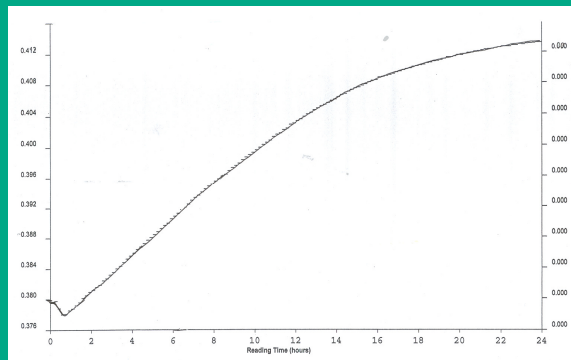
BD BACTEC™ Algorithm Development



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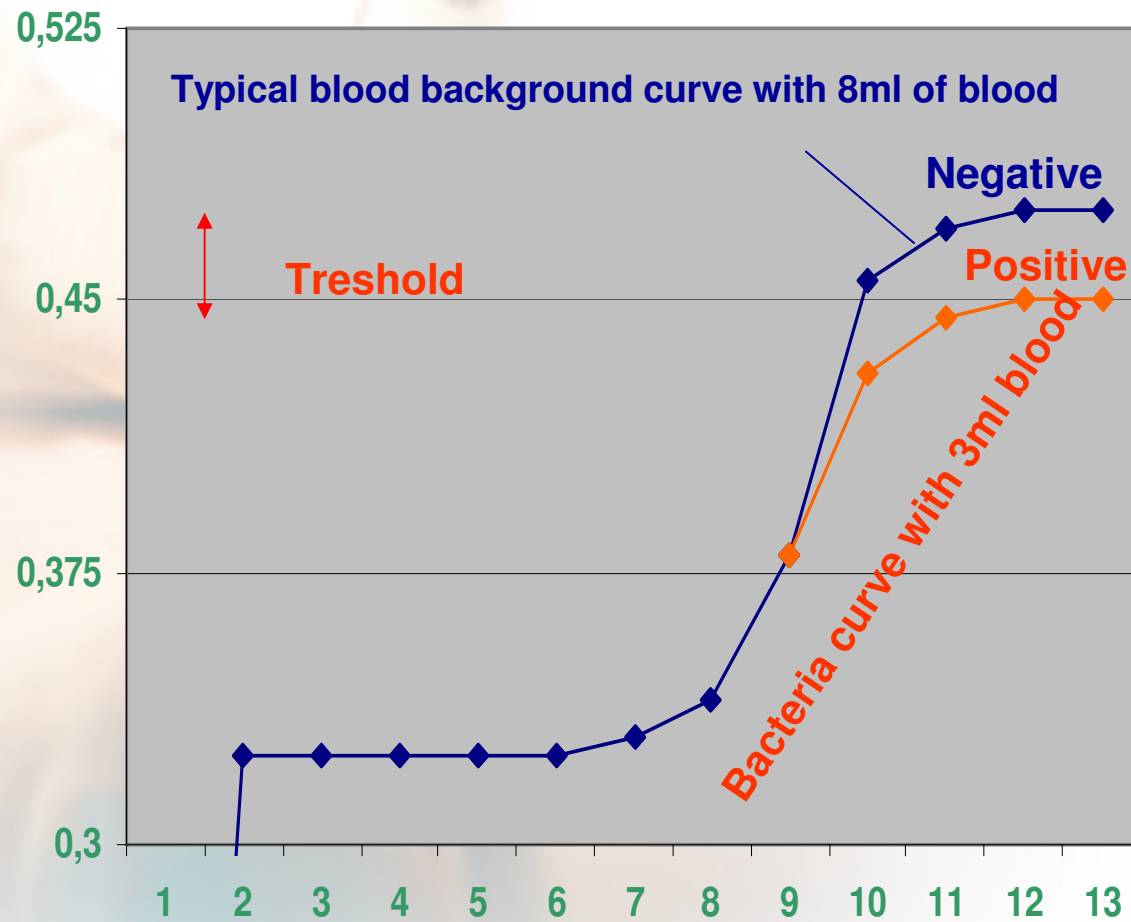
BD BACTEC™ Algorithm Development

Examples of some growth curves and blood background curve



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BD BACTEC™ Algorithm Development

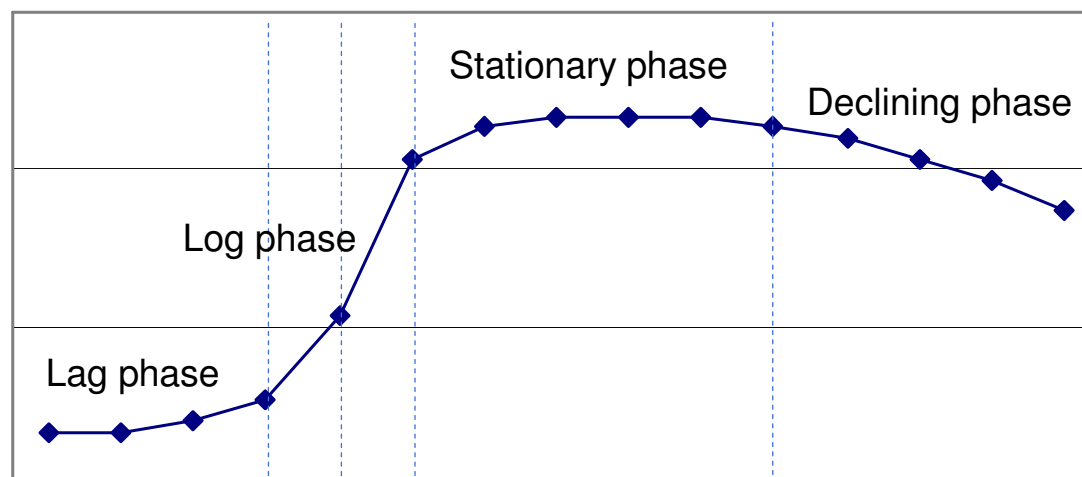


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BD BACTEC™ Algorithm Development

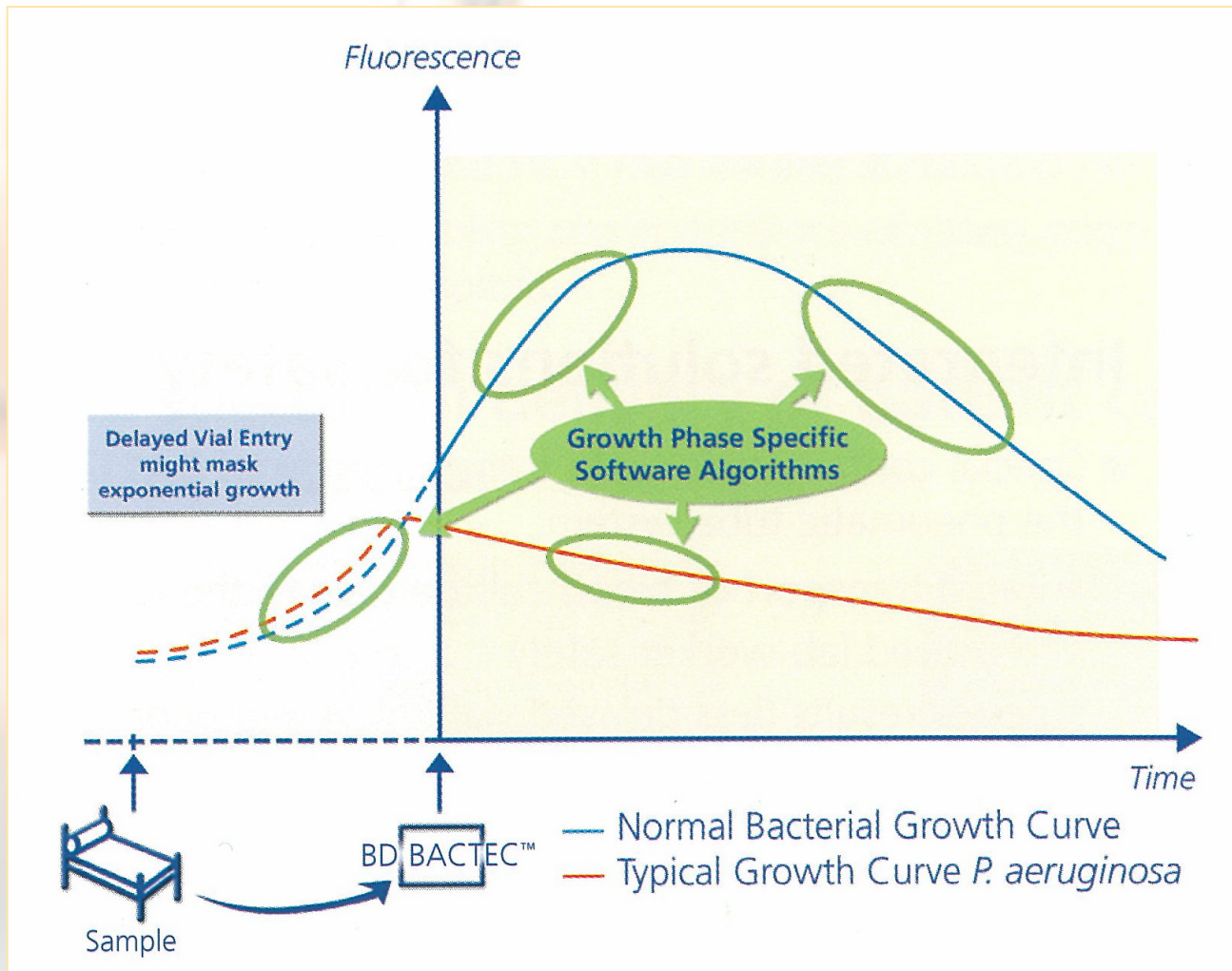
- BD BACTEC™'s secondary detection algorithms allow to detect even strains which produce hardly any CO₂ (e.g. *Pseudomonas* spp.), or strains from vials which have been entered in the system with delay. These positives are often missed by systems using a threshold algorithm.

■ Example of Number of Algorithms used



PHASE	I	II	III	IV
Other Systems:	1	1	1	
BD BACTEC™:	7	2	1	3

BD BACTEC™ Algorithm Development

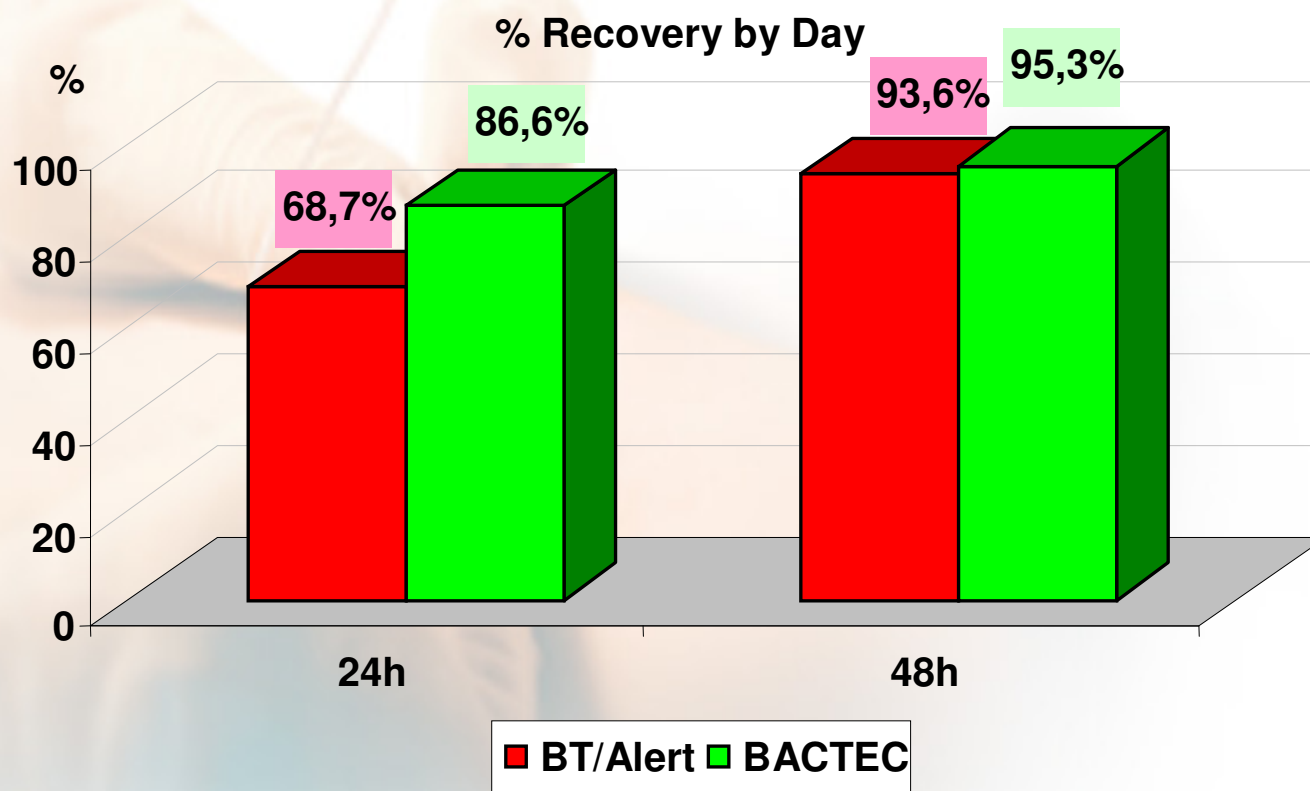


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BD BACTEC™: Proven fastest Time to Detection



Endimiani et al, Microbiologica
25, 2002

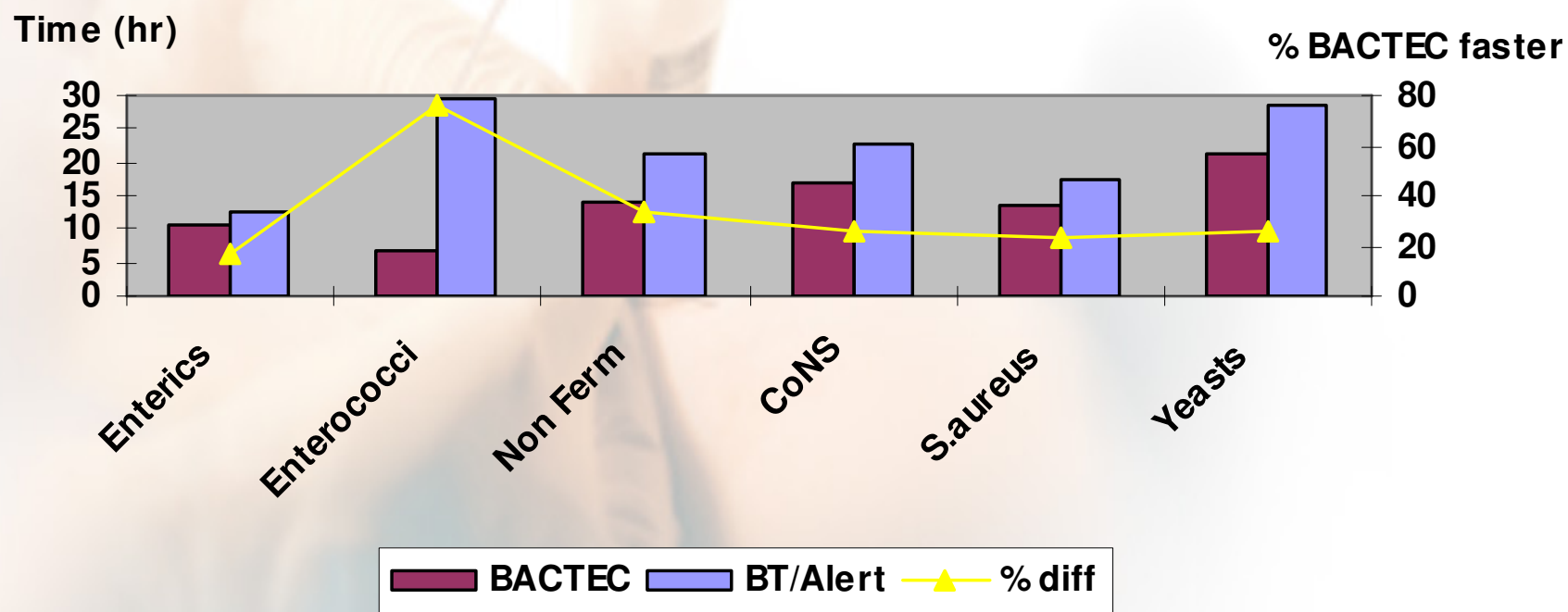


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BD BACTEC™: Proven fastest Time to Detection



Endimiani et al, Microbiologica
25, 2002



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BD BACTEC™ Algorithm Development



Rate of false negatives in BACTEC 9000" :Shah/Fahr ECCMID 2003

Delayed Vial Entry

BACTEC™ Plus : 20 h. T= 36 °C



48 h. T= 25 °C

BacT/ALERT™ FAN: < 4 h. T= 36 °C



?

T= 25 °C

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A World of Difference in Blood Culturing

Media Development



Helping all people
live healthy lives

The BD BACTEC™ Media Development : BACTEC™ Fluorescent Series

Media Compatibility:

- Standard/10 Aerobic/F
- Standard Anaerobic/F
- Lytic/10 Anaerobic/F
- PLUS Aerobic/F
- PLUS Anaerobic/F
- PEDS PLUS/F
- MycoF/ Lytic



BD BACTEC™ Lytic/10 Anaerobic Medium

Diagn Microbiol Infect Dis 1996 ;24(4):191-6

BACTEC™ Lytic/10 Anaerobic/F

- High blood volume anaerobic bottle
- Saponin containing
- 8 - 10 mL optimum volume (3 - 10 mL range)

- Faster detection of facultative organisms

	<u>Lytic/F</u>	<u>Std. Ana/F</u>
TTD (hr)	13.2	18.2

- Higher recovery of significant organisms

<u>Both</u>	<u>Lytic/F only</u>	<u>Std. Ana/F only</u>
79	36	7



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BD BACTEC™ Media Development: Lytic Anaerobic Medium

Comparison of Standard Anaerobic and Lytic Anaerobic Media

N° of organisms isolated:

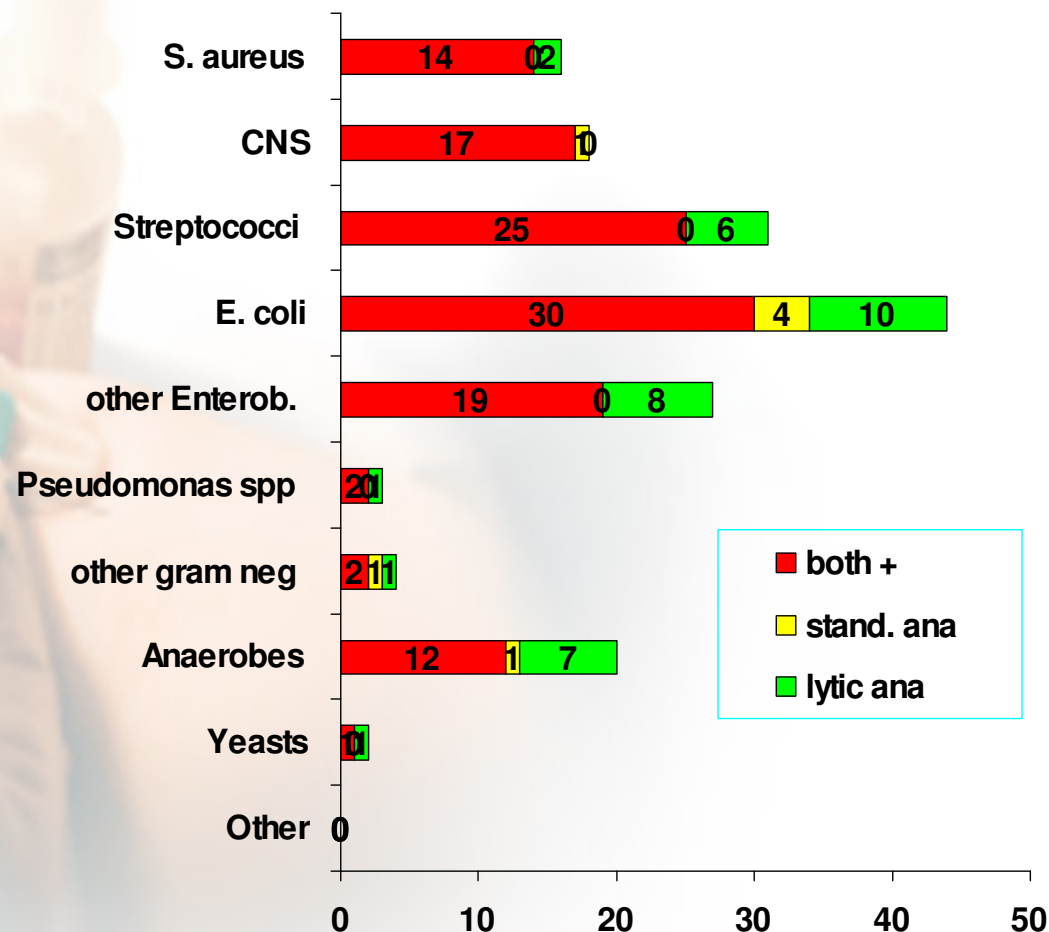
lytic anaerobic	158
non lytic anaerobic	129

Difference 18.4%

P value <0.05



[Hollick et al.
Diagn.Microbiol.Infect.Dis.
1996;24:191-196](#)



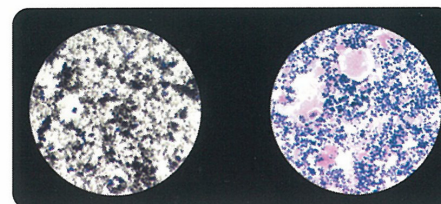
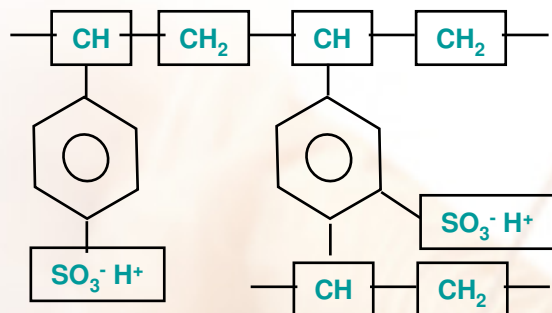
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BD BACTEC™ Media Development: PLUS Medium

- **PLUS Aerobic/F**
- **PLUS Anaerobic/F**
- **Contains neutralizing resins**
 - PLUS Aerobic/F**
 - **8 - 10 mL optimum sample**
(3 - 10 mL range)
 - PLUS Anaerobic/F**
 - **8 - 10 mL optimum sample**
(3 - 7 mL range)

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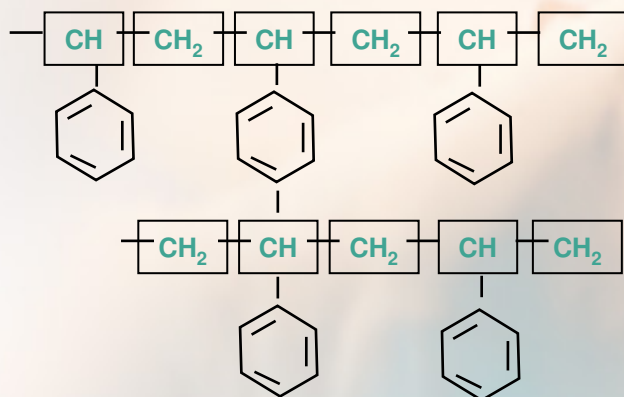
BD BACTECTM Media Development: PLUS Medium



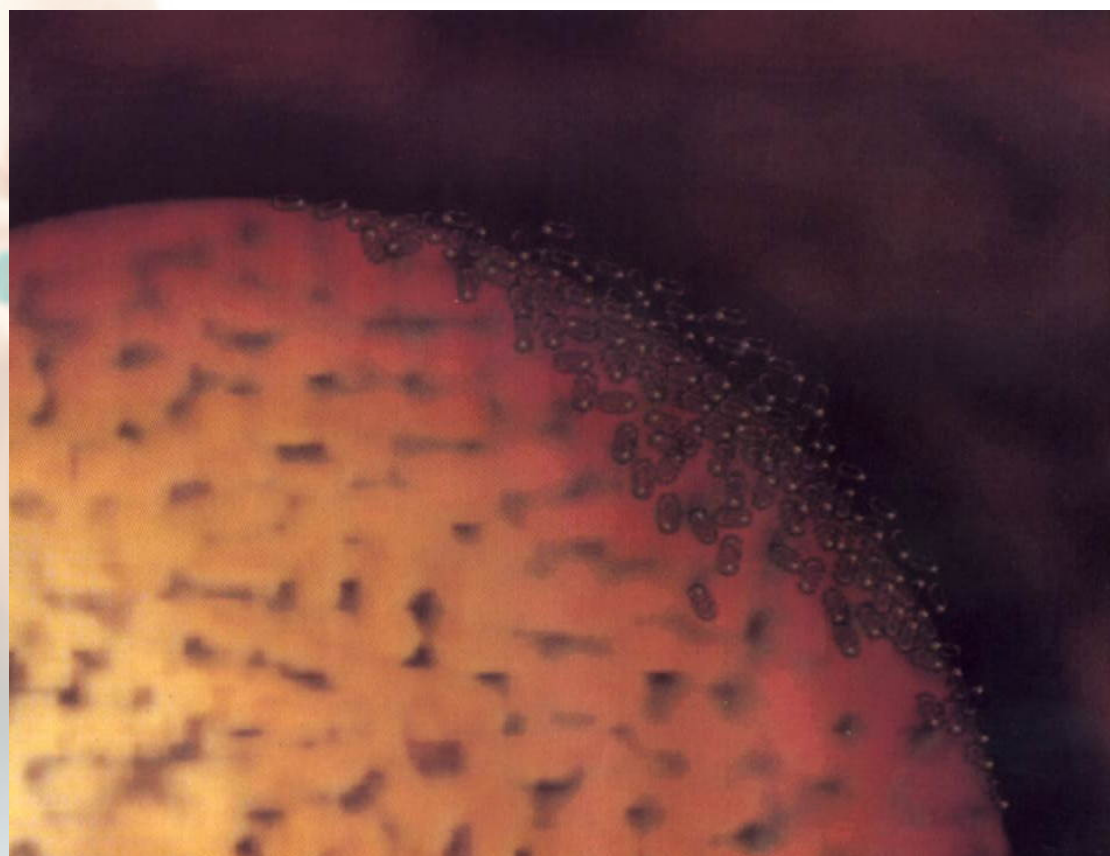
Charcoal based

BACTEC PLUS

Cationic Exchange Resin



Polymeric Adsorbent Resin

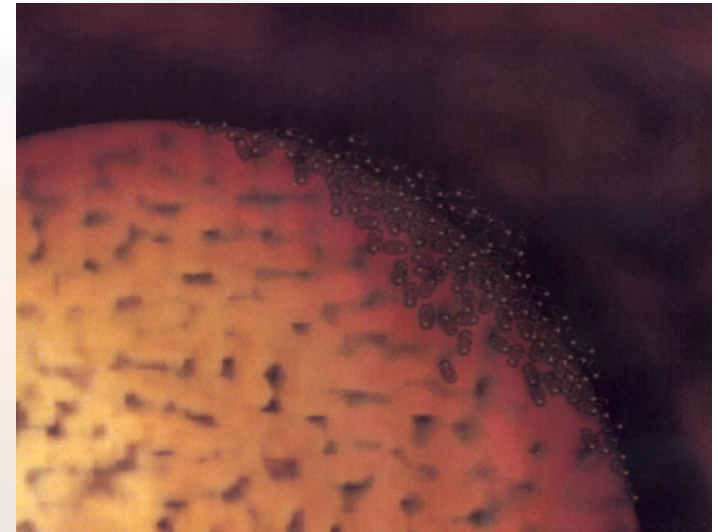


Features of Resin Medium

- Strong cationic exchange resin
 - bind ionically to positively charged antimicrobials such as aminoglycosides.
- Polymeric adsorbent resin
 - bind to the hydrophobic regions of virtually any antimicrobial agent.

Features of Resin Medium

- The usefull surface of the resins in 1 BACTEC vial equals the surface of 5 football fields...
- Provide the organisms with growth-centres to enhance speed and recovery rate (up to 40% more)
- No interference with Gram stain readings



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BD BACTEC™ Resin Technology

- 19% Increase in recovery of clinically significant positives in the “overall” patient group ($p < 0.001$)
- 33% Increase in recovery of clinically significant positives in patients receiving antimicrobial therapy ($p < 0.001$)
- All types of resin media showed improved recovery over the non-resin media

Meta-Analysis

■ Summary Data -- 40 Studies

# Studies (Years)	# Sets	Overall +		Overall % Increase	Therapy +		Therapy % Increase
		Resin	Non-Resin		Resin	Non-Resin	
12 (1982-1984)	14,016	865	688	25.6%	116	79	46.8%
15 (1985-1992)	60,938	4,344	3,695	17.6%	972	738	31.7%
13 (1993-1995)	41,564	3,092	2,572	20.2%	662	497	33.2%
OVERALL TOTALS	116,518	8,301	6,955	19.35 %	1,750	1,314	33.18 %

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BD BACTECTM Media Development: PLUS Medium

ANTIMICROBIALS NEUTRALIZED BY BACTEC RESINS

Amikacin
Amphotericin B
Ampicillin
Ampicillin/Sulbactam
Amoxicillin/Clavulanic Acid
Azlocillin
Axtreonam
Carbenicillin
Cefaclor
Cefalexin
Cefamandole
Cefazolin
Cefoperazone
Cefotaxime
Cefotetan
Cefoxitin
Cefsulodine
Ceftazidime
Ceftriaxone

Cefuroxime
Cephalexin
Cephaloridine
Cephalothin
Cephapirin
Chloramphenicol
Ciprofloxacin
Clavulanic Acid
Clindamycin
Colistin
Erythromycin
Gentamicin
Imipenem
Kanamycin
Lincomycin
Lincomycin
Methicillin
Metronidazole
Mezlocillin

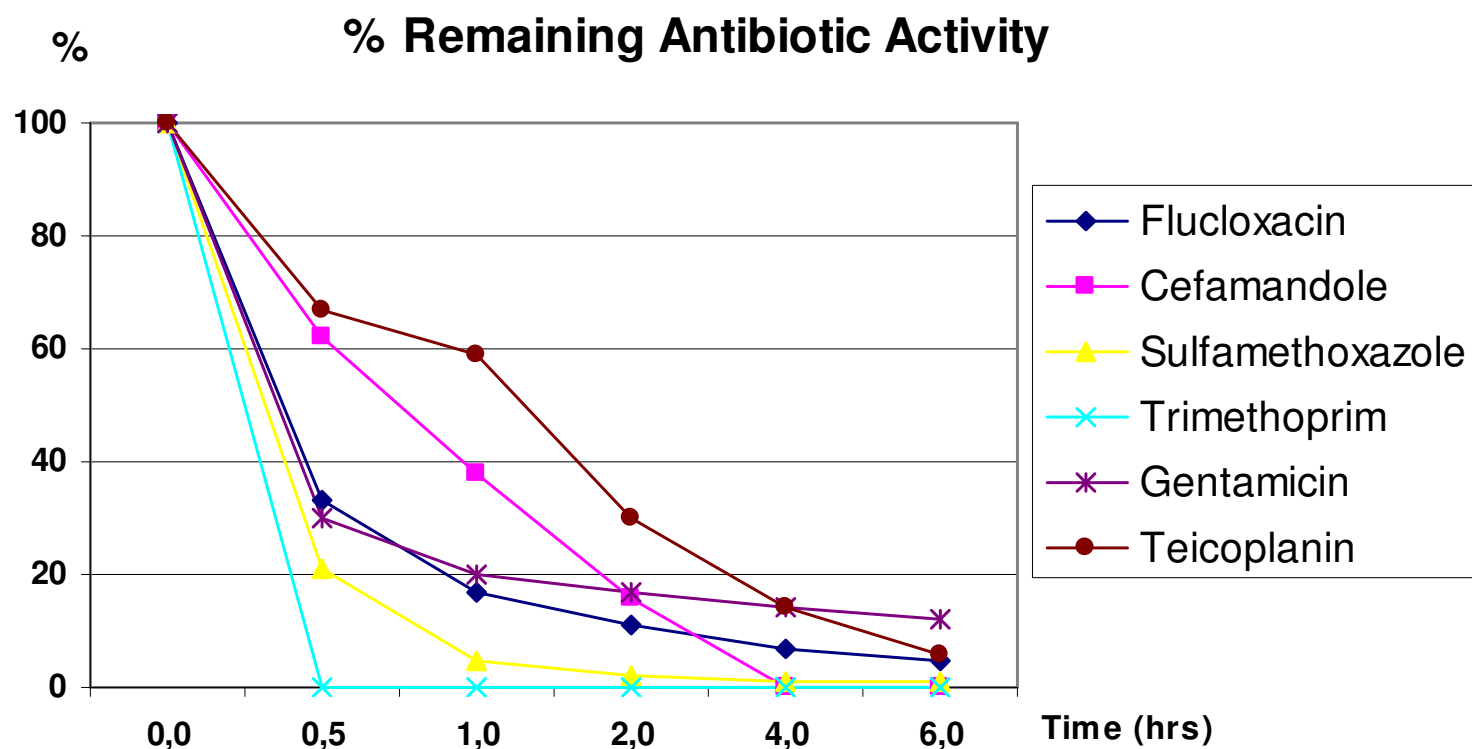
Moxalactam
Naladixic Acid
Neomycin
Netilmicin
Nitrofuranton
Norfloxacin
Oxacillin
Penicillin G
Piperacillin
Polymyxin B
Rifampicin
Streptomycin
Sulfamethoxazole/Trimethoprim
Tetracycline
Ticarcillin
Ticarcillin/Clavulanic Acid
Tobramycin
Vancomycin

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BD BACTEC™ Media Development: PLUS Medium



Spaargaren et al.
JCM Dec 1998

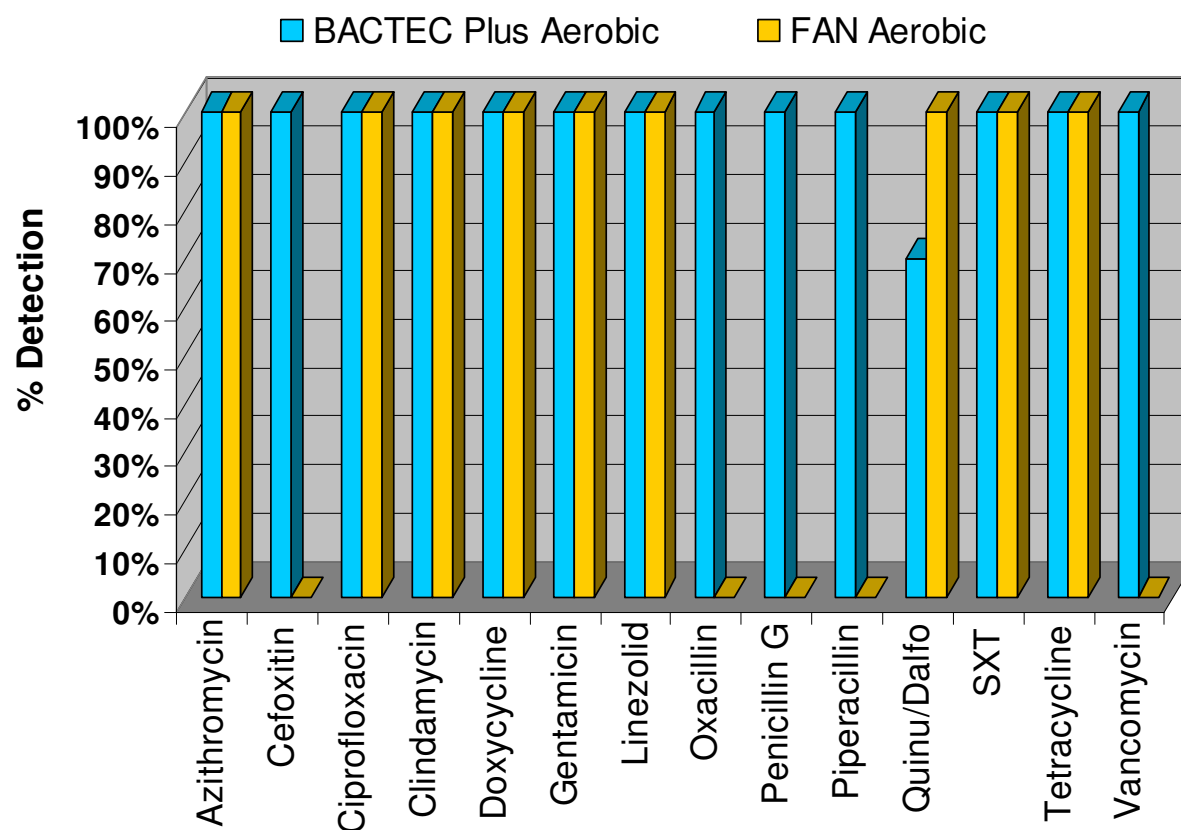


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BD BACTEC™ Media Development: PLUS Medium



*R.F.Pfeltz et al, ASM 2003
poster C-004*

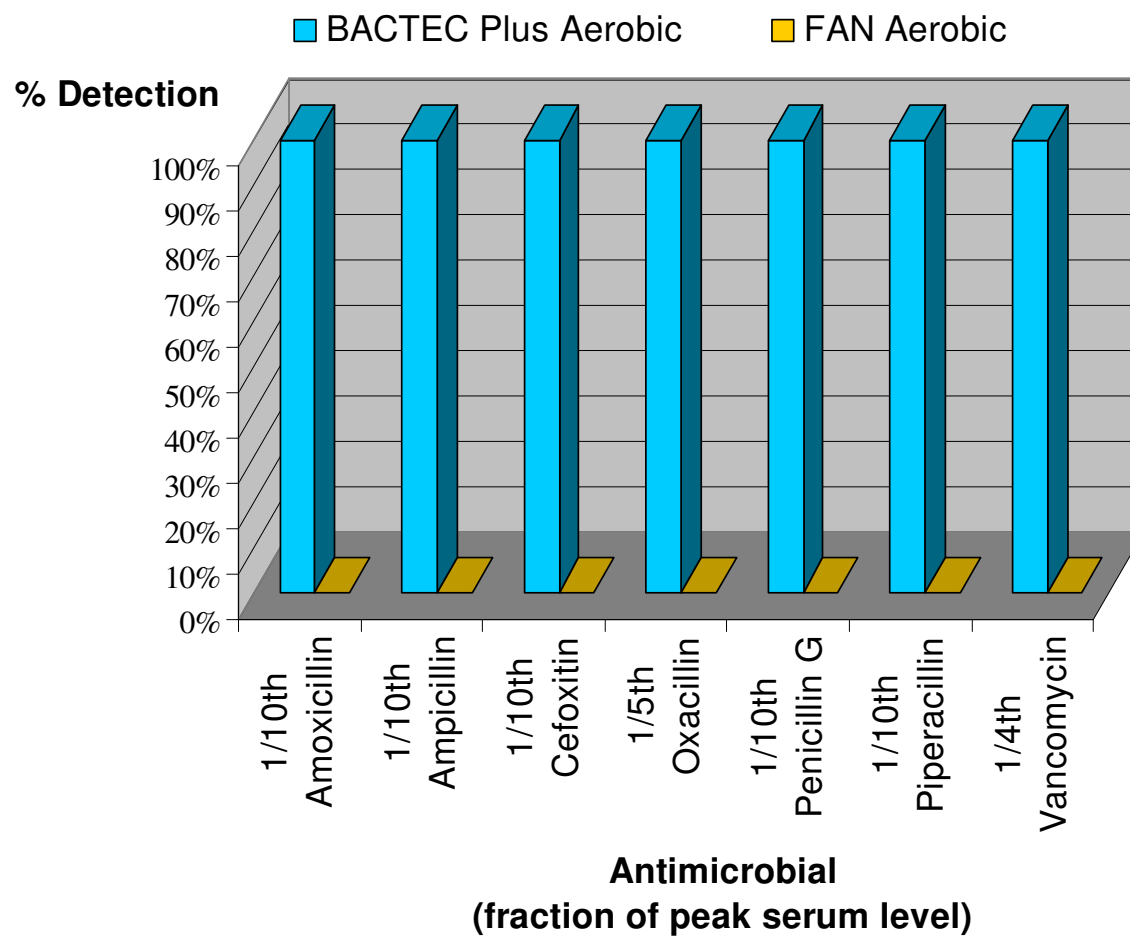


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BD BACTEC™ Media Development: PLUS Medium



*R.F.Pfeltz et al, ASM 2003
poster C-004*



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BD BACTECTM Media Development: PLUS Medium

JOURNAL OF CLINICAL MICROBIOLOGY, Mar. 2007, p. 816–821

Comparison of BACTEC PLUS Blood Culture Media to BacT/Alert FA Blood Culture Media for Detection of Bacterial Pathogens in Samples Containing Therapeutic Levels of Antibiotics[▽]

Diane Flayhart,^{2†} Anita P. Borek,² Teresa Wakefield,² James Dick,^{1,2} and Karen C. Carroll^{1,2*}

*The Division of Microbiology, Department of Pathology, The Johns Hopkins University School of Medicine,¹ and
The Johns Hopkins Hospital, Microbiology Laboratory,² Baltimore, Maryland 21287*

Received 6 October 2006/Returned for modification 14 November 2006/Accepted 5 December 2006

Blood culture bottles with antimicrobial removal systems are recommended for patients who develop fever while on antibiotics. This study compared the ability of Becton Dickinson (Sparks, MD) BACTEC PLUS bottles and bioMerieux (Durham, NC) BacT/Alert FA bottles to effectively remove vancomycin, cefoxitin, ceftriaxone, cefepime, piperacillin-tazobactam, ampicillin, oxacillin, gentamicin, and a combination of gentamicin/penicillin, thus allowing bacterial pathogens to grow. Each bottle was spiked with 10 ml of human blood, antibiotic, and strains of organisms susceptible to the antibiotic evaluated. The organisms used were type strains and clinical isolates of *Staphylococcus aureus* (methicillin susceptible and resistant), *Streptococcus pneumoniae*, a viridans streptococcus, *Enterococcus faecalis*, *Enterococcus faecium*, *Streptococcus agalactiae*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. Testing was completed in triplicate, using 10 to 100 CFU/ml of organisms with various concentrations of each antibiotic. Two rounds of testing were completed per antibiotic/organism combination. Bottles were mixed and loaded onto their respective instruments as per the manufacturer's instructions. Antimicrobial removal was evaluated on the basis of time to detection of organism growth, for up to 5 days of incubation. Overall, the BacT/Alert FA system recovered 25.1% of strains from test bottles and 96.9% of strains from growth control bottles (no antibiotic added), and the BACTEC PLUS system recovered 95.1% of strains from test bottles and 100% of strains from growth control bottles. Both systems performed well in the detection of *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* in the presence of gentamicin. In the presence of ceftriaxone, neither system was able to recover *Streptococcus pneumoniae*. The ability to remove vancomycin and cefoxitin was also determined by measuring antibiotic levels remaining in bottles after 1 h of incubation. The results demonstrated remaining levels of 72 to 90% of vancomycin and 71 to 72% of cefoxitin in the BacT/Alert system. For the BACTEC system, remaining levels were 0 to 30% of vancomycin and 0% of cefoxitin. Under these simulated conditions, the BACTEC PLUS system was superior to the BacT/Alert FA system in recovering gram-positive and gram-negative bacterial pathogens in the presence of β -lactam antibiotics, gentamicin/penicillin, and vancomycin.

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BD BACTECTM Media Development: PLUS Medium

JOURNAL OF CLINICAL MICROBIOLOGY, Mar. 2007, p. 816–821

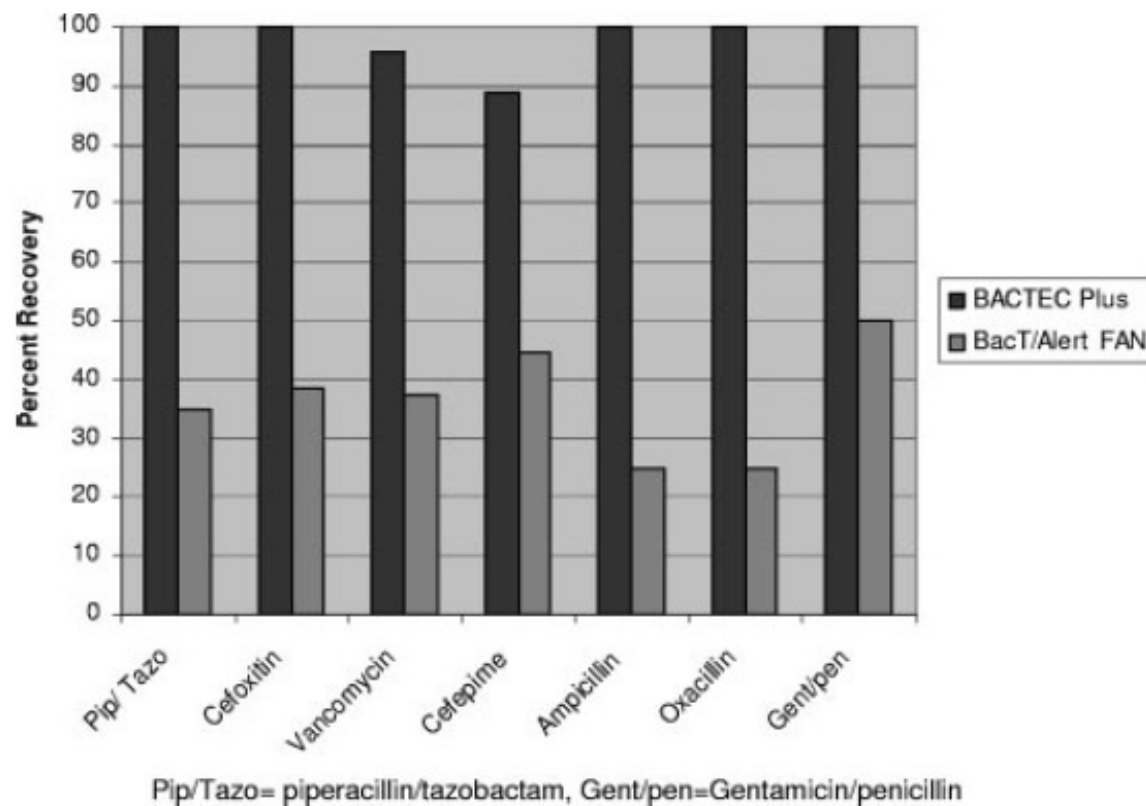


FIG. 1. Percent recovery of control and challenge organisms in BACTEC PLUS and BacT/Alert FA bottles containing antibiotics. Abbreviations: Pip/Tazo, piperacillin/tazobactam; Gent/pen, gentamicin/penicillin.

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BD BACTEC™ Media Development: Myco/F Lytic

Myco/F Lytic

- Newest addition to the BACTEC Family
- Formula
 - Middlebrook 7H9 broth based
 - Brain Heart Infusion Broth
 - Saponin
 - Ferric aminonium citrate
- For yeast, fungi & Mycobacteria



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BD BACTEC™

A World of Difference in Blood Culturing

Safety



Helping all people
live healthy lives

BD BACTEC SAFETY

Medical Actions with Needle Stick Injury Risk

LOW RISK ACTIONS

Capillary blood sampling

Injection

Blood gases

Venous blood sampling

Infusion (placement/removal)

BLOOD CULTURE

Implantable access

HIGH RISK ACTIONS



*"Accidental Blood Exposure:
Surveillance in France: an
update": GERES*

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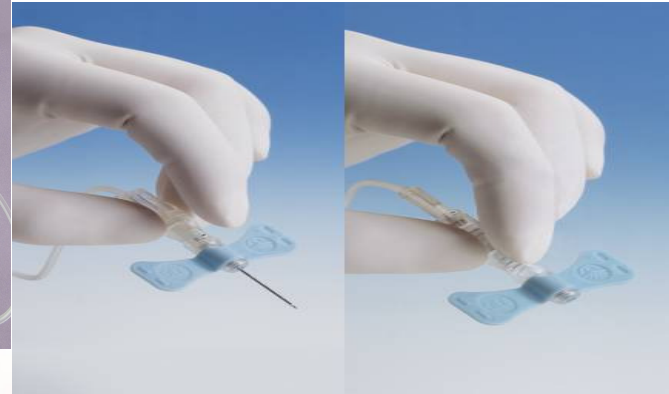
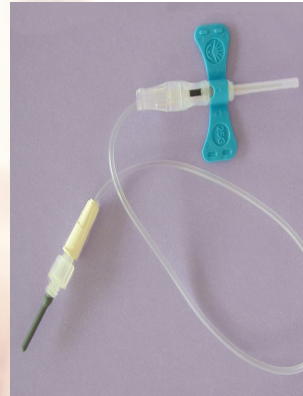
Tools for Blood collection

“How to collect blood safely and easily?”

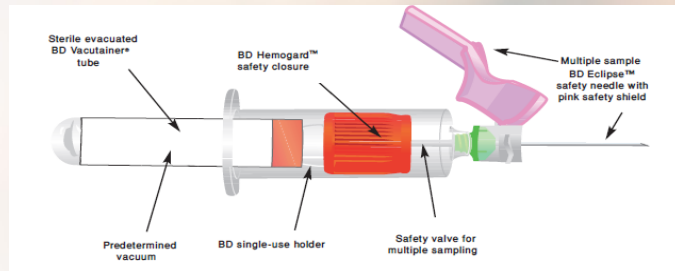
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真空採血系統組件

採血雙向針 Needle



採血持針器 Holder

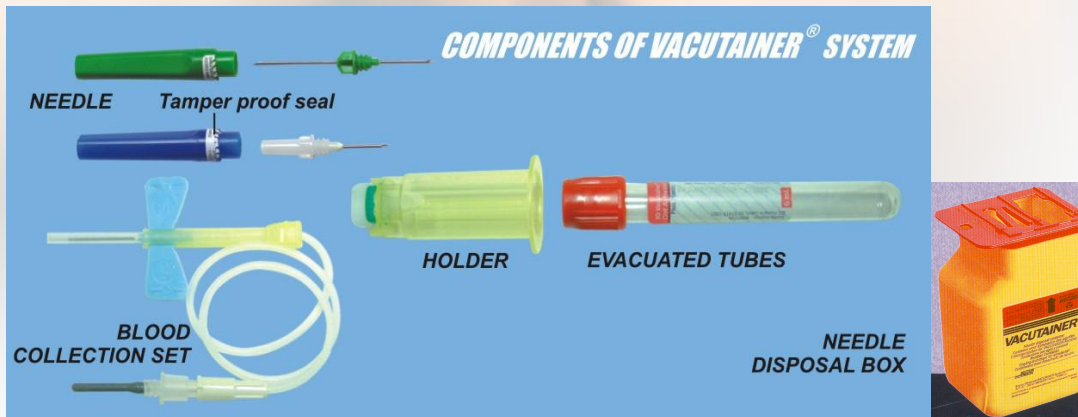


真空試管 Vacutainer



Safety from Venipuncture till Result

- BACTEC vials are compatible with Vacutainer® Safety Lock Blood Collection Set
- Use of only ONE adapter to inoculate vials and draw samples for other tests
- leading to :
 - Less needle sticks
 - Less false positives due to contamination



BD BACTEC™ Safety

Safety in the Laboratory

- Only BD is offering Safety Subculturing Units

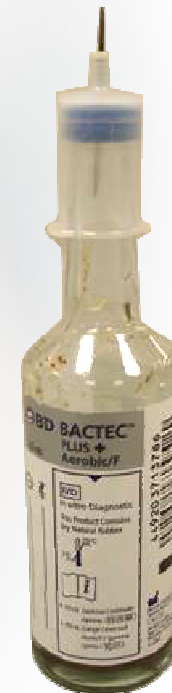
Only (non-safe) subculturing unit possible for BacT/Alert



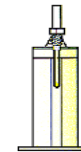
Dangerous subculturing with syringe and needle



Safety subculturing units exclusively offered by BD



BD BACTEC™
Venting/Subculturing Unit



Vacutainer™ Single Use
Holder with pre-attached
Luer adapter

Helping All People Live Healthy Lives



Thank You for Your Attention

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