EE95

Value Comparison of BACT/ALERT® VIRTUO® System Versus BD BACTEC™ FX Blood Culture System from a Provider Perspective

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Introduction

- Bloodstream infections are associated with high rates of morbidity and mortality[1]
- Based on a real-world study, BACT/ALERT® VIRTUO® system reported faster time to detection (TTD) and turnaround time (TAT) for bacterial organisms. The clinical consequences of improved TTD and TAT translates to reduction in mortality and length of stay (LOS) when patients receive appropriate treatment[1]
- To capture the clinical and economic impact of automated blood culture systems on the management of bloodstream infections, the model mapped the clinical consequences of receiving faster results and increased positivity for BACT/ALERT® VIRTUO® system versus BD BACTEC™ FX

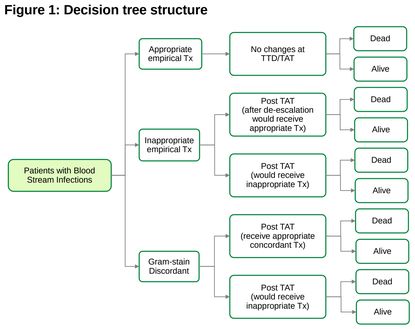
Objective

- To estimate the economic and clinical outcomes of time to detection and positivity rates of bloodstream infections (BSI) when implementing BACT/ALERT® VIRTUO® (VIRTUO) system compared to BD BACTEC™ FX (FX)

Methods

- A decision tree was developed to estimate LOS, mortality and cost differences between VIRTUO and FX blood culture detection systems

Figure 1: Decision tree structure



- TTD and TAT were derived from the literature and used to estimate time to start of antibiotic treatment (for patients not on empirical treatment) as shown in **(Table 1)** and transition to effective therapy for patient with Gram stain discordant therapy **(Table 2)**
- Mortality and LOS were estimated based on time to appropriate treatment. A logistic regression model related to mortality for appropriate treatment was used in the decision tree to adjust mortality rates based on TTD/TAT [*y=100/(1+exp(-0.01*(x - 349.92))); where x is TTD/TAT*]. The economic model assumes that patients at time "x" will receive appropriate treatment
- The model follows patients with appropriate, inappropriate or no empirical treatment and assigns proportion of patients with concordant treatment vs. discordant treatment based on data from the literature **(Table 2)**

Table 1: Proportion of patients on empirical treatment and its related concordance

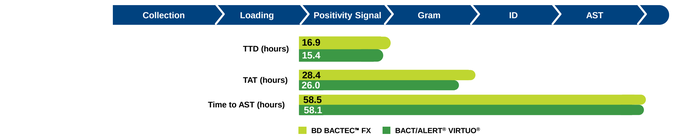
	Value	Source
Blood Culture Organism Type (%)		
% Bacterial	93.9%	Calculated
% Fungal	6.1%	(2)
Empirical Antibiotic Treatment (%)		
Bacterial empirical treatment	83.0%	(3)
No empirical treatment	17.0%	
Fungal empirical treatment	3.0%	
Antibiotic Treatment Concordance (%)		
Discordant empirical treatment	19.3%	(3)
Concordant empirical treatment	80.7%	Calculated

- The model accounts for change in treatment patterns at TTD and TAT. Patients who did not receive empirical treatment at the start of the decision tree will begin empirical treatment at TTD **(Figure 2)**. Similarly, for those who received Gram stain discordant treatment, antibiotic therapy will be replaced with concordant treatment at TAT when Gram staining results are reported

Table 2: Proportion of patients experiencing de-escalation

	Value	Source
De-escalate after Gram stain results (TAT)	6.9%	(4)
Gram stain discordant therapy	3.7%	(3)

Figure 2: Schematic representation of time measurements (1)



Note: TTD, time to detection; TAT, turnaround time; ID, identification; AST, antimicrobial susceptibility testing

- Additionally, differences in positivity rates **(Table 3)** between both systems were used to estimate the proportion of patients with missed bloodstream infection diagnoses who were assumed to be at risk of developing septic shock (34% of patients)[3]

Table 3: Positivity rates reported for BACT/ALERT® VIRTUO® system versus BD BACTEC™ FX

	BACT/ALERT® VIRTUO®(1)	BD BACTEC™ FX(1)
Total Positivity Rate	18.2%	15.5%
Positivity Rate	17.8%	15.2%
False Positive Rate	0.4%	0.3%
Negative	81.8%	84.5%

- The model captures LOS using a direct approach. Patients are assigned LOS based on whether they receive appropriate (7 days) vs. inappropriate (10 days) empirical treatment. Hospitalization costs are based on LOS **(Table 4)**.
- Laboratory resource utilization was derived from the literature and labor costs were applied to assess efficiencies between the systems. Blood cultures were collected and evaluated from an initial cohort of 28 patients per day[1]**(Table 5 & 6).** The model estimates total LOS and reports economic costs incurred per day, per month and per year

Table 4: Hospitalization costs

Category (Room and board charges)	Provider Costs	Source
ICU per day	$2,893.32	Cleveland Clinic price list (6)
Hospitalization bed day	$1,137.40	Cleveland Clinic price list
Severe Sepsis (Hospital costs)	$69,412.0	HCUP:DRG 870 (For an average of 17.8 days of hospital stay) (7)

Table 5: Laboratory costs

	VIRTUO®	BACTEC™ FX
Hourly Wage(8)	$27.8	$27.8

Table 6: Laboratory resource consumption

	VIRTUO®(1)	BACTEC™ FX(1)
Total minutes per day for 110 bottles	2.4	13.3
Positive unloaded bottles/day	3.1	1.8
Negative unloaded bottles/day	0.0	2.9
Daily maintenance	0.0	3.0
Waste bin change (every 72 bottles)	0.2	0.0
Weekly maintenance	0.2	0.0
Total	**5.9**	**21.0**

Results

Base case analysis using appropriate vs. inappropriate LOS

- Estimated mortality among patients with BSI was 18.03% for VIRTUO and 19.67% for FX (difference of 1.65%)
- Per day laboratory savings from workflow improvements were $7 with VIRTUO
- Total costs and LOS for patients with BSI was $39,873 and 35.05 days respectively for VIRTUO compared to $40,502 and 35.24 days respectively for FX, resulting in a 0.19 day LOS reduction and savings of $629 **(Table 10)**
- The total cost savings when extrapolated for a month and year were $17,610 for 770 patients tested and $229,723 for 10,044 patients tested, respectively, for VIRTUO

Table 9: Base Case Mortality Results: Overall

	BACT/ALERT® VIRTUO®		BD BACTEC™ FX		Difference
	%	# of patient	%	# of patient	
Overall	16.93%	0.85	14.49%	0.73	2.44%
Not identified as positive by BACTEC™ FX	0.00%	0.00	4.03%	0.20	-4.03%
Fungal BSI	1.10%	0.05	1.16%	0.06	-0.06%
Total for 28 patients	**18.03%**	**0.90**	**19.67%**	**0.99**	**-1.65%**

Table 10: Base Case: Costs and LOS

	BACT/ALERT® VIRTUO®		BD BACTEC™ FX		Difference	
	Costs	LOS	Costs	LOS	Costs	LOS
Received empirical Tx/appropriate Tx	$39,870	35.1	$39,552	34.8	$319	0.3
Not identified as positive by BACTEC™ FX						
% that do not develop septic shock	$0	0.00	$361	0.3	-$361	-0.3
% that develop septic shock	$0	0.00	$580	0.1	-$580	-0.1
Laboratory	$3	-	$10	-	-$7	-
Total for 28 patients	**$39,873**	**35.05**	**$40,502**	**35.24**	**-$629**	**-0.19**

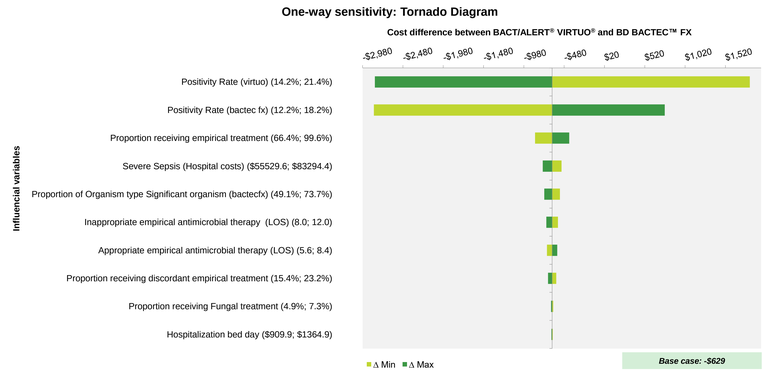
Scenario Results

- We ran a scenario for 10,000 blood culture per year (or 2,500 patients per year) to assess the outcomes specifically for smaller hospitals
- In this scenario the total costs and LOS for patients with BSI was $9,931 and 8.73 days respectively for VIRTUO compared to $10,089 and 8.78 days respectively for FX, resulting in a 0.05 day LOS reduction and savings of $158
- The total cost savings when extrapolated for a month and year were $4,414 for 192 patients tested and $57,574 for 2,502 patients tested, respectively, for VIRTUO

Sensitivity analysis

- We ran a sensitivity analysis to identify the most influential variables and results can be seen in **Figure 3** where it shows that positivity rate is the most influential variable followed by proportion of patients receiving empirical treatment and severe sepsis

Figure 3: OWSA-Provider perspective



Conclusions

- This study shows that use of VIRTUO may reduce mortality, hospitalization costs, and LOS, for patients with bloodstream infections attributable to faster TTD/TAT and increased positivity, while decreasing laboratory costs due to the reduced hands-on time required to operate VIRTUO

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