Impact of the Verigene Rapid Diagnostic Blood Test as an Antibiotic Stewardship Tool Amongst Hospitalized Patients in a Community Healthcare System

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Background

- Rapid diagnostic testing of blood specimens is suggested by the IDSA/SHEA/PIDS to optimize antibiotic therapy and improve clinical outcomes.
- The Verigene (Nanosphere) Gram negative (BC-GN) and Gram positive (BC-GP) blood culture nucleic acid tests allow for the identification of select blood pathogens, common contaminants, and resistance genes within 2 to 2.5 h.
- The impact of combined BC-GN and BC-GP rapid testing on antibiotic use within a large community healthcare system has yet to be assessed.

Objectives

Primary Objective:

- To compare the time to appropriate antibiotic therapy following implementation of a Pharmacy-driven Verigene-guided antibiotic stewardship protocol to that of a pre-implementation control group

Secondary Objectives:

- To determine potential differences between Verigene-guided antibiotic stewardship group and the historical control for the following:
  - Time to discontinuation of antibiotics for blood contaminants
  - Length of stay
  - Total admission costs
  - Pharmacy charges
  - *Clostridium difficile* infection
  - Mortality
  - 30-day readmission

Methods

Study Design:

- IRB-approved, pre-post interventional study

Setting:

- 10 community hospitals in Tampa Bay, FL
- 2825 beds total

Study Duration:

- Control Group: May 2015
- Verigene Group: August 2015

Inclusion Criteria:

- Hospitalized adult, pediatric, and neonatal patients
- First blood Gram stain during study time frame per patient

Methods (contd.) and Results

Exclusion Criteria

- Discharge or expiration prior to clinician assessment of results
- Verigene results that were misreported in Cerner
- Polymicrobial initial Gram stains
- Non-Listeria Gram positive rods upon final culture
- Gram variable blood isolates
- Cultures results with *Pseudomonas aeruginosa, Citrobacter spp., Enterobacter spp.*, or *Proteus spp.*
  - The Pharmacy Verigene Theradoc alert was not functioning appropriately during study time frame.

Intervention

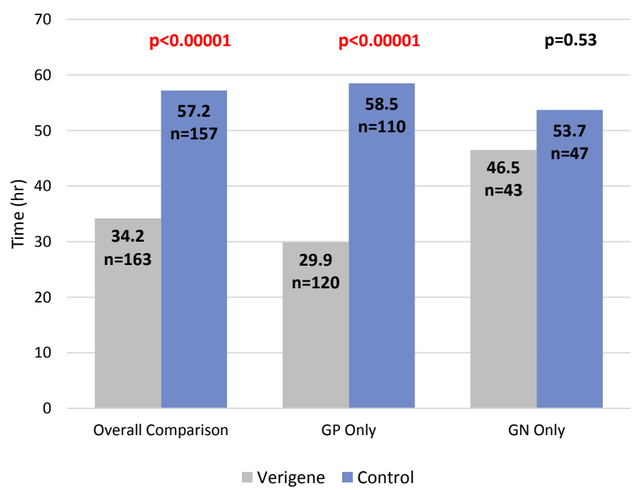
- Verigene testing was performed for all blood isolates with unique morphology upon Gram stain within 72 hours.
- Pharmacists were alerted to Verigene results via the Theradoc electronic data capture system.
- Physicians were called with antibiotic stewardship interventions based on Verigene results.

PATIENT DEMOGRAPHICS	Verigene (n=241)	Control (n=213)	*p*-value
Age, (IQR)	67 (51-80)	68 (56-81)	0.21
Female sex	117 (48.5%)	103 (48.4%)	1
Antibiotic allergy	68 (28.2%)	51 (23.9%)	0.33
ICU during admission	46 (19.1%)	64 (30.0%)	***0.008***
ID Consult	161 (66.8%)	153 (71.8%)	0.85
CHF	24 (10.0%)	44 (20.7%)	***0.002***
Type II DM	83 (34.4%)	74 (34.7%)	1.00
Chronic kidney disease	44 (18.3%)	30 (14.1%)	0.25
Chronic liver disease	8 (3.3%)	16 (7.5%)	0.06
SOURCE			
Urinary	43 (17.8%)	40 (18.8%)	0.81
SSTI/Wound	27 (11.2%)	28 (12.7%)	0.66
Respiratory	18 (7.5%)	27 (12.7%)	0.08
Vascular/Catheter	9 (3.7%)	6 (2.8%)	0.79
Endocarditis	8 (3.3%)	8 (3.3%)	1.00
Unknown/Other	39 (16.2%)	28 (13.1%)	0.42
Contaminant	97 (40.2%)	78 (36.6%)	0.44

TIMING OF VERIGENE RESULTS	
Mean time from Gram Stain to Verigene (h), ± SD	6 (±6.2)
Mean difference in Verigene ID and traditional culture ID (h), (95% CI)	23.6 (21.5 to 25.6)
Mean difference in Verigene and traditional final susceptibility (h), (95% CI)	35.6 (33.3 to 37.8)

ORGANISM (FINAL CULTURE)	Verigene (n=241)	Control (n=213)	*p*-value
GRAM POSITIVE	182 (75.2%)	158 (74.2%)	0.75
Coagulase-negative *Staphylococcus*	99 (41.1%)	70 (32.9%)	0.08
Streptococcus spp.	35 (14.5%)	29 (13.6%)	0.79
Staphylococcus aureus (MRSA)	24 (10.0%)	22 (10.3%)	1
Staphylococcus aureus (MSSA)	19 (7.9%)	21 (9.9%)	0.51
Enterococcus spp.	6 (2.5%)	4 (1.9%)	0.76
Other Gram positive	9 (3.7%)	5 (2.3%)	0.43
GRAM NEGATIVE	60 (24.8%)	55 (25.8%)	0.83
E. coli (No resistance genes)	28 (11.6%)	36 (16.9%)	0.14
Klebsiella spp. (No resistance genes)	8 (3.3%)	8 (3.8%)	0.8
E. coli (CTX-M)	6 (2.5%)	2 (0.9%)	0.29
Acinetobacter spp.	2 (0.8%)	3 (1.4%)	0.67
Klebsiella spp. (CTX-M/ESBL/CRE)	2 (0.8%)	1 (0.5%)	1.0
Other Gram negative	14 (5.8%)	6 (2.8%)	0.17

Figure 1: Time from Blood Gram Stain to Appropriate Antibiotics



Results (contd.)

SECONDARY OUTCOMES	Verigene	Control	*p*-value
Time on antibiotics for contaminant (h)	14.3 (N=72)	39.7 (N=51)	**<0.00001**
Contaminant, antibiotics never initiated	52.8%	31.4%	***0.03***
Length of stay (d), mean	9.7	10.7	0.9
Total admission costs, mean	$14,534	$17,745	***0.04***
Pharmacy charges, mean	$3,804	$4,197	0.34
Clostridium difficile infection	2.5%	6.1%	0.06
30-day mortality	2.5%	4.2%	0.70
Readmission within 30 days	7.6%	19.7%	***0.02***

Study Limitations

- A delay in posting of Verigene results at some hospitals due to need to transport to the central lab may have prolonged time to appropriate therapy.
- The primary outcome was not evaluable in patients with concurrent non-bloodstream infections or whom were already on appropriate antibiotics at time of Verigene or culture result.
- The Verigene cohort study period was only 6 weeks after implementation of the test, and some physicians did not fully trust test results yet.
- Data on four Gram negative pathogens are missing from results due to malfunctioning alert during study period.
- Negative CTX-M results in Gram negative organisms do not rule out an ESBL producer, which limited the ability to streamline based on Verigene results.

Conclusions

- By decreasing the time to appropriate antibiotic therapy, Verigene can assist with antibiotic stewardship efforts in an inpatient community hospital system.

References

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3. Suzuki H, et al. *J Infect Chemother*. 2015; 21(12): 849-56