

**510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION  
DECISION SUMMARY  
ASSAY ONLY TEMPLATE**

**A. 510(k) Number:**  
**K060218**

**B. Purpose for Submission:**  
To add additional organism groups to the antibiotic erythromycin, quinupristin/dalfopristin, and chloramphenicol on the Gram Positive ID/AST and AST only Phoenix™ panels.

**C. Measurand:**  
Erythromycin at 0.0625-8 µg/mL  
Quinupristin/dalfopristin at 0.25-4 µg/mL  
Chloramphenicol at 1-32 µg/mL

**D. Type of Test:**  
Antimicrobial Susceptibility Test (Quantitative and Qualitative) colorimetric oxidation-reduction, growth-based

**E. Applicant:**  
Becton, Dickinson & Company

**F. Proprietary and Established Names:**  
BD Phoenix™ Automated Microbiology System – Erythromycin (GP) 0.0625-8 µg/mL, Quinupristin/dalfopristin (GP) 0.25-4 µg/mL, Chloramphenicol (GP) 1-32 µg/mL

**G. Regulatory Information:**

1. Regulation section:  
21 CFR 866.1645 Fully Automated Short-Term Incubation Cycle  
Antimicrobial
2. Classification:  
Class II
3. Product Code:  
LON
4. Panel:  
83 Microbiology

**H. Intended Use:**

1. Intended use(s):

Erythromycin at 0.0625-8 µg/mL, Quinupristin/dalfopristin at 0.25-4 µg/mL, and Chloramphenicol at 1-32 µg/mL on the Phoenix™ Gram Positive ID/AST or AST only panel is intended for use with the BD Phoenix™ Automated Microbiology System for the quantitative determination of antimicrobial susceptibility by minimal inhibitory concentration (MIC) of most gram-positive bacteria isolates from pure culture belonging to the genera *Staphylococcus* and *Enterococcus*.

2. Indication(s) for use:  
This submission is for the addition of the antibiotics Erythromycin at 0.0625-8 µg/mL, Quinupristin/dalfopristin at 0.25-4 µg/mL, and Chloramphenicol at 1-32 µg/mL on the Phoenix™ Gram Positive ID/AST or AST only panel.
3. Special condition for use statement(s):  
Prescription Use Only
4. Special instrument Requirements:  
Not Applicable

#### **I. Device Description:**

The BD Phoenix™ Automated Microbiology System includes instrumentation and software, sealed and self-inoculating molded polystyrene trays with 136 micro-wells containing dried reagents, and specific inoculum broth formulations for ID and AST Indicator. The organism to be tested must be a pure culture and be preliminarily identified as gram positive or gram negative. Colonies are then suspended in broth, and equated to a 0.5 McFarland with the recommendation to use the BD CrystalSpec™ Nephelometer. A further dilution is made into an AST broth, which contains an AST indicator, prior to inoculating the panel. The AST broth is a cation-adjusted broth containing Tween 80. After adding the indicator solution to the AST inoculum, the color is blue, and after inoculation, incubation and organism growth, it changes to pink then colorless as reduction in the panel well proceeds. Inoculated panels are barcode scanned and loaded into the BD Phoenix™ Automated Microbiology System instrument where the panels are continuously incubated at 35°C. The resulting AST has a final inoculum of  $5 \times 10^5$  CFU/ml. The instrument incubates, reads and records the results of the biochemical substrates and antimicrobial agents and interprets the reactions to give an ID of the isolate and MIC value and category interpretation of the antimicrobial agents. Organisms growing in the presence of a given antimicrobial agent reduce the indicator, signaling organism growth and resistance to the antimicrobial agent. Organisms killed or inhibited by a given antimicrobial do not cause reduction of the indicator and therefore do not produce a color change. Additional interpretation is done using software driven "EXPERT" System using rules derived from the Clinical and Laboratory Standards Institute (CLSI). Readings are taken every 20 minutes with an ID result available between 2-12 hours and an AST result available between 4-16 hours. This is only an autoread result; there are no manual readings possible.

#### **J. Substantial Equivalence Information:**

1. Predicate device name(s):  
VITEK® System
2. Predicate K number(s):  
N50510
3. Comparison with predicate:

Similarities		
Item	Device	Predicate
Intended use	Intended for the <i>in vitro</i> quantitative determination of antimicrobial susceptibility by minimal inhibitory concentration (MIC) of most bacteria.	same
Isolates	Isolated colonies from culture used	Isolated colonies from culture used
Results	Report results as minimum inhibitory concentration (MIC) and categorical interpretation (SIR)	Report results as minimum inhibitory concentration (MIC) and categorical interpretation (SIR)
Incubation conditions	<16 hours	<16 hours
Type of Test	Automated	Automated

Differences		
Item	Device	Predicate
Reading algorithm	Results are determined from serial twofold dilutions of antimicrobial agents	Results are determined from extrapolation of doubling dilutions
Technology	Automated growth based enhanced by use of a redox indicator (colorimetric oxidation-reduction) to detect organism growth.	Automated growth based with detection using an attenuation of light measured by an optical scanner.

**K. Standard/Guidance Document Referenced (if applicable):**

“Class II Special Controls Guidance Document: Antimicrobial Susceptibility Test (AST) Systems; Guidance for Industry and FDA”; CLSI M7 (M100-S16) “Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically; Approved Standard.”

**L. Test Principle:**

The AST portion of the BD Phoenix™ Automated Microbiology System is a broth based microdilution method that utilizes a redox indicator (colorimetric oxidation-reduction) to enhance detection of organism growth. The MIC is determined by

comparing growth in wells containing serial two-fold dilutions of an antibiotic to the growth in “growth control wells” which contain no antibiotic.

### M. Performance Characteristics (if/when applicable):

#### 1. Analytical performance:

##### a. *Precision/Reproducibility*

Intersite and Intrasite testing demonstrated >95% reproducibility. The ten isolate study described in the guidance document was used (10 organisms tested 3 times on 3 days at 3 sites).

##### b. *Linearity/assay reportable range:*

Not applicable

##### c. *Traceability, Stability, Expected values (controls, calibrators, or method):*

Quality Control was performed during the testing of all isolates on each day of testing with the following results. The table below includes the concentrations tested around the expected range with the frequency of the reference and the Phoenix™ results at each concentration.

#### Erythromycin

Organism	Concentration µg/mL	Reference results	Phoenix™ results	Organism	Concentration µg/mL	Reference results	Phoenix™ results
	0.125						
<i>S. aureus</i> ATCC 29213 Expected range 0.25-1 µg/mL	0.25	9	131	<i>E. faecalis</i> ATCC 29212 Expected Range 1-4 µg/mL	0.25		
	0.5	104	7		0.5		
	1	27			1	2	
	2				2	105	121
	4				4	33	14
	8				8		

#### Quinupristin/dalfopristin

Organism	Concentration µg/mL	Reference results	Phoenix™ results	Organism	Concentration µg/mL	Reference results	Phoenix™ results
<i>S. aureus</i> ATCC 29213 Expected range 0.25- 1µg/mL	0.25	9	131	<i>E. faecalis</i> ATCC 29212 Expected Range 2-8 µg/mL	0.25		
	0.5	104	7		0.5		
	1	27			1	2	
	2				2	105	121
	4				4	33	14
	8				8		

## Chloramphenicol

Organism	Concentration µg/mL	Reference results	Phoenix™ results	Organism	Concentration µg/mL	Reference results	Phoenix™ results
<i>S. aureus</i> ATCC 29213 Expected range 2-8 µg/mL	1			<i>E. faecalis</i> ATCC 29212 Expected Range 4-16 µg/mL	1		
	2	3			2		
	4	58	3		4	88	
	8	76	134		8	52	136
	16	3	1		16		
	32				32		

Phoenix™ produced acceptable QC results >95% of the time.

Inoculum density control: The organism suspension density of the ID broth was equivalent to a 0.5 McFarland standard using the BBL™ CrystalSpec™ Nephelometer which was verified each day of testing. Internal data was used to demonstrate that the use of the BBL™ CrystalSpec™ Nephelometer would produce reproducible results. Five different instruments were used.

- d. Detection limit:*  
Not applicable
- e. Analytical specificity:*  
Not applicable
- f. Assay cut-off:*  
Not applicable

### 2. Comparison studies:

#### *a. Method comparison with predicate device:*

The broth dilution reference panel was prepared according to the CLSI recommendation and used to compare with the Phoenix™ results. Clinical testing was performed at several sites. The testing included both fresh clinical isolates and stock isolates along with a challenge set with known results. Performance charts below include all data; original and the additional organisms for fresh and challenge organisms. The test device had a growth rate of >95%.

### Gram positive organisms for erythromycin

Erythromycin	EA Tot	EA N	EA %	Eval EA Tot	Eval EA N	Eval EA %	CA N	CA %	#R	min	maj	vmj
	1395	1325	95	441	393	89.1	1320	94.6	952	59	5	11

### Gram positive organisms for quinupristin/dalfopristin

Quinupristin/ dalfopristin	EA Tot	EA N	EA %	Eval EA Tot	Eval EA N	Eval EA %	CA* N	CA %	#R	min	maj	vmj
	2019	1908	94.5	681	654	96	1433*	95.5	30	53	12	2

\* Total tested =1500

**Gram positive organism for Chloramphenicol**

Chloramphenicol	EA Tot	EA N	EA %	Eval EA Tot	Eval EA N	Eval EA %	CA N	CA %	#R	min	maj	vmj
	1447	1352	93.4	1403	1312	93.5	1351	93.4	46	79	16	1

EA-Essential Agreement

**maj**-major discrepancies

CA-Category Agreement

**vmj**-very major discrepancies**R**-resistant isolates**min**- minor discrepancies

Essential agreement (EA) is when the BD Phoenix™ panels agree with the reference test panel results exactly or within one doubling dilution of the reference method. Category agreement (CA) is when the BD Phoenix™ panel result interpretation agrees exactly with the reference panel result interpretation. Evaluable (Eval) are results that are within the test range and on scale.

**b. Matrix comparison:**

Not applicable

3. Clinical studies:**a. Clinical sensitivity:**

Not applicable

**b. Clinical specificity:**

Not applicable

**c. Other clinical supportive data (when a and b are not applicable):**

Not applicable

4. Clinical cut-off:

Not applicable

5. Expected values/Reference range:

Antibiotic	Interpretive Criteria (SIR)
Erythromycin	$\leq 0.5, 1-4, \geq 8$
Quinupristin/dalfopristin	$\leq 1, 2, \geq 4$
Chloramphenicol	$\leq 8, 16, \geq 32$

**N. Labeling:**

The expected value range, interpretive criteria and QC for each antibiotic are included in the package insert. The labeling is sufficient and it satisfies the requirements of 21 CFR Part 809.10.

**O. Conclusion:**

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.