

**510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY**

A. 510(k) Number:

K081928

B. Purpose for Submission:

New device

C. Measurand:

Respiratory Syncytial Virus (RSV), respiratory viral antigens (Influenza A, Influenza B, Adenovirus, Parainfluenza virus types 1, 2 and 3)

D. Type of Test:

Direct detection or cell culture method, by immunofluorescence using fluoresceinated monoclonal antibodies (MAbs)

E. Applicant:

Diagnostic Hybrids, Inc.

F. Proprietary and Established Names:

D³ *Duet* DFA RSV/Respiratory Virus Screening Kit
Common Name: DFA (Direct Fluorescent Antibody) test kit for the identification of Respiratory Syncytial Virus (RSV), while screening for 6 common respiratory viruses (Influenza A, Influenza B, Adenovirus, Parainfluenza types 1, 2 and 3 virus)

G. Regulatory Information:

1. Regulation section:
866. 3480 Respiratory syncytial virus serological reagents
2. Classification:
Class I
3. Product code:
LKT
4. Panel:
Microbiology (83)

H. Intended Use:

1. Intended use(s):

The Diagnostic Hybrids, Inc. device, D³ *Duet* DFA RSV/Respiratory Virus Screening Kit, is intended for the qualitative detection and identification of respiratory syncytial virus, while screening for influenza A virus, influenza B virus, adenovirus, and parainfluenza virus types 1, 2 and 3 viral antigens, in nasal and nasopharyngeal swabs and aspirates or in cell culture. The assay detects viral antigens by immunofluorescence using monoclonal antibodies (MAbs), from patients with signs and symptoms of respiratory infection

It is recommended that specimens found to be negative after examination of the direct specimen result be confirmed by cell culture. Negative results do not preclude influenza virus infection and should not be used as the sole basis for diagnosis, treatment or other management decisions.

Performance characteristics for influenza A virus detection and identification were established when influenza A (H3N2) and influenza A (H1N1) were the predominant influenza A strains circulating in the United States. When other influenza A viruses are emerging, performance characteristics may vary. If infection with a novel influenza A virus is suspected based on current clinical and epidemiological screening criteria recommended by public health authorities, specimens should be collected with appropriate infection control precautions for novel virulent influenza viruses and sent to a state or local health department for testing. Viral culture should not be attempted in these cases unless a BSL 3+ facility is available to receive and culture specimens.

2. Indication(s) for use:

Same as intended use

3. Special conditions for use statement(s):

For prescription use only

4. Special instrument requirements:

Fluorescence microscope with the correct filter combination for FITC (excitation peak = 490 nm, emission peak = 520nm) and R-phycoerythrin (R-PE), magnification 200 to 400X

I. Device Description:

The Diagnostic Hybrids, Inc. device, D³ *Duet* DFA RSV/Respiratory Virus Screening Kit, uses a blend of viral antigen-specific murine MAbs. MAbs for RSV are directly labeled with R-phycoerythrin (R-PE) for the rapid detection and identification of RSV. MAbs for influenza A virus, influenza B virus, adenovirus, and parainfluenza virus types 1, 2, and 3 are directly labeled with fluorescein isothiocyanate (FITC), for rapid detection of these agents.

Kit components:

- D3 Duet DFA RSV/Respiratory Virus Screening Reagent - R-phycoerythrin-labeled murine MAbs directed against influenza A virus and a mixture of fluorescein-labeled murine MAbs directed against influenza A, influenza B, adenovirus, and parainfluenza virus types 1, 2, and 3. The buffered, stabilized, aqueous solution also contains Evans Blue as a counter-stain and 0.1% sodium azide as preservative.
- Normal Mouse Gamma Globulin DFA Reagent - a mixture of fluorescein labeled murine gamma globulin that has been shown to be non-reactive with any of the listed respiratory viruses. The buffered, stabilized, aqueous solution contains Evans Blue as a counter-stain and 0.1% sodium azide as preservative.
- Respiratory Virus Antigen Control Slides – five individually packaged control slides containing wells with cell culture-derived positive and negative control cells. Each positive well is identified with the virus infected cells present, i.e., influenza A virus, influenza B virus, respiratory syncytial virus, adenovirus, and parainfluenza virus types 1, 2 and 3. The negative well contains uninfected cultured cells. Each slide is intended to be stained only one time.
- Wash Solution Concentrate - a 40X concentrate consisting of Tween 20 and 4% sodium azide (0.1% sodium azide after dilution in de-mineralized water) in a 40X phosphate buffered saline solution.
- Mounting Fluid - an aqueous, buffered, stabilized solution of glycerol and 0.1% sodium azide.

J. Substantial Equivalence Information:

1. Predicate device name(s):

D3 Ultra DFA Respiratory Virus Screening & ID Kit

2. Predicate 510(k) number(s):

k081746

3. Comparison with predicate:

The similarities to predicate device are in the intended use/detected viruses, operating principle, basic design, materials and formulation. Difference is that device, unlike predicate, identifies only Respiratory Syncytial Virus (RSV), and does not identify Influenza A, Influenza B, Adenovirus, Parainfluenza 1, Parainfluenza 2 and Parainfluenza 3 virus.

Similarities		
Item	Device	Predicate
Intended Use / Detected viruses	For the qualitative detection and identification of respiratory syncytial virus (RSV), while screening for influenza A, influenza B virus, adenovirus, and parainfluenza virus types 1, 2 and 3 viral antigens, in	For the qualitative detection and identification of the respiratory viruses, Influenza A, Influenza B, Respiratory Syncytial Virus (RSV), Adenovirus, Parainfluenza 1, Parainfluenza 2 and

Similarities		
Item	Device	Predicate
	nasal and nasopharyngeal swabs and aspirates or in cell culture	Parainfluenza 3 virus by either direct detection or cell culture method
Basic principle	DFA (Direct Fluorescent Antibody) test - Immunofluorescence using R-phycoerythrin-labeled or fluorescein-labeled monoclonal antibodies (MAbs)	DFA (Direct Fluorescent Antibody) test - Immunofluorescence using fluoresceinated monoclonal antibodies (MAbs)
Antibody	Blend of murine monoclonal antibodies (MAbs) directed against seven respiratory viruses	Blend of murine monoclonal antibodies (MAbs) directed against seven respiratory viruses
Instrumentation (required but not provided)	Fluorescence microscope with the correct filter combination for FITC (excitation peak = 490 nm, emission peak = 520nm) and R-phycoerythrin (R-PE), magnification 200 to 400X	Fluorescence microscope with the correct filter combination for FITC (excitation peak = 490 nm, emission peak = 520nm).
Sample type	Nasal and nasopharyngeal swab and nasal aspirate respiratory specimens	Respiratory specimens

Differences		
Item	Device	Predicate
Virus identification	Identifies RSV; detects but does not identify six respiratory viruses	Identifies seven respiratory viruses
Antibody labeling	R-phycoerythrin-labeled murine MAbs and a blend of fluorescein-labeled murine MAbs	Blend of fluorescein-labeled murine MAbs
Assay flow	One-step assay: RSV is both detected and identified in a single step. In the same step assay screens for additional six viruses	Two-step assay: first step only screens for seven viruses, while second step identifies each of the seven viruses

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

N/A

L. Test Principle:

The test kit uses viral antigen-specific murine monoclonal antibodies that are directly labeled with either fluorescein or R-phycoerythrin for rapid detection of respiratory viruses and identification of Influenza A. The cells to be tested, derived from a clinical specimen or cell culture, are placed onto a glass slide, allowed to air dry, and fixed in acetone. After addition of the D³ Duet DFA RSV/Respiratory Virus Screening Reagent and incubation at 35° to 37°C the stained cells are washed with the diluted wash solution, a drop of the supplied Mounting Fluid is added and a coverslip is placed on the prepared cells. The cells are examined using a fluorescence microscope. The RSV virus infected cells will fluoresce golden-yellow, while cells infected with any of the other six viruses will fluoresce apple-green. Uninfected cells will contain no fluorescence but will be stained red by the Evans Blue counter-stain. If only golden-yellow fluorescent cells are present the specimen can be reported as positive for RSV antigen. If only apple-green fluorescent cells are present, the particular virus may be identified using an FDA approved assay such as the individual reagents from the D³ Ultra™ DFA Respiratory Virus Screening & ID Kit (D³ Ultra) on new, separate cell preparations. If both golden-yellow and apple-green are present, the additional virus may be identified using an FDA approved assay such as the individual reagents from the D³ Ultra on new, separate cell preparations. It is recommended that results for specimens found to contain no fluorescent cells after examination of the direct specimen result be confirmed by cell culture.

Interpretation of results:

It is recommended that controls be examined first to ensure proper test performance before examination of the specimens. The entire cell spot or monolayer of cells should be examined before reporting final results. Patient sample results should not be reported unless controls perform as expected.

Uninfected cells will fluoresce dull red due to the Evans Blue counter-stain included in the DFA Reagent.

Fluorescent staining pattern of respiratory virus infected cells:

- RSV: A positive reaction is one in which golden-yellow fluorescence is observed in the cytoplasm, nucleus or in both. Cytoplasmic staining is often punctuated with small inclusions in the syncytia.
- Other respiratory viruses: Green fluorescence observed in the cytoplasm and/or nucleus is suggestive of infection with a respiratory virus other than respiratory syncytial virus. (Further identification may be achieved with the D³ Ultra Kit). The staining patterns described below are for reference only; identification of the viral antigens present in the apple-green fluorescent cells must be performed using another FDA cleared device:
 - a) Influenza A virus: The fluorescence is cytoplasmic, nuclear or both. Cytoplasmic staining is often punctate with large inclusions while nuclear staining is uniformly bright.
 - b) Influenza B virus: The fluorescence is cytoplasmic, nuclear or both. Cytoplasmic staining is often punctate with large inclusions while nuclear

staining is uniformly bright.

- c) Adenovirus: The fluorescence is cytoplasmic and punctate or bright nuclear or both.
- d) Parainfluenza virus types 1, 2, and 3: The fluorescence is cytoplasmic and punctate with irregular inclusions. Types 2 and 3 cause the formation of syncytia.
- Co-infection with respiratory syncytial virus and other viruses has been reported in a number of studies. The presence of multiple viruses is indicated when a stained slide well exhibits both golden-yellow and apple-green fluorescent cells.

Results of direct specimen testing: The quality of the specimen with respect to the number of epithelial cells in the sample can be assessed by examining the different fields at a magnification of 200X. A satisfactory specimen should have at least 2 columnar epithelial cells per field. A negative result is indicated by the absence of fluorescence in a minimal sampling of 20 columnar epithelial cells. An inadequate sample is indicated by fewer than 20 columnar epithelial cells present in the sample, in which case the test is considered invalid. A new specimen should be obtained and tested or cell culture of the remaining specimen should be initiated.

A satisfactory specimen with no fluorescent cells observed should be reported as “No respiratory syncytial virus, influenza A, influenza B, adenovirus, parainfluenza type 1, parainfluenza type 2, or parainfluenza type 3 viral antigens detected by direct specimen testing”.

If golden-yellow fluorescent cells are found, it should be reported as “Respiratory syncytial virus antigens detected by direct specimen testing.”

If only apple-green fluorescent cells are found, the identification of the virus(es), other than respiratory syncytial virus may be based on the follow-up assay (e.g. D³ *Ultra* DFA Kit). In such cases, identification and reporting of the apple-green fluorescing viral antigen(s) should be performed according the respective device’s instructions.

If co-infection of respiratory syncytial virus and one of the other respiratory viruses is detected (exhibited by both golden-yellow and apple-green fluorescent cells present) the identification of the virus(es), other than respiratory syncytial virus, may be based on the follow-up assay, such as D³ *Ultra* DFA Kit (not provided). In such cases, it should be reported as “respiratory syncytial virus *and* identification and reporting of the apple-green fluorescing viral antigen(s) should be performed according the respective device’s instructions.

Results from Culture Isolation / Confirmation: The entire cell spot or monolayer of cells must be examined for virus-infected, fluorescent cells. If no fluorescent cells are found, the results of testing of the specimen should be reported as, “No Respiratory Syncytial Virus, Influenza A, Influenza B, Adenovirus, Parainfluenza 1, Parainfluenza 2, or Parainfluenza 3 isolated by cell culture.”

If golden-yellow fluorescent cells are found, it should be reported as “Respiratory syncytial virus isolated in cell culture”.

If only apple-green fluorescing cells are found, the identification of the virus(es), other than respiratory syncytial virus may be based on the follow-up assay (such as

D3 *Ultra* DFA Kit). In such cases, identification and reporting of the apple-green fluorescing viral antigen(s) should be performed according the respective device's instructions.

If co-infection of respiratory syncytial virus and one of the other respiratory viruses is detected (exhibited by both golden-yellow and apple-green fluorescent cells present) the identification of the virus(es), other than respiratory syncytial virus, may be based on the follow-up assay, such as D3 *Ultra* DFA Kit (not provided). In such cases, it should be reported as "Respiratory syncytial virus and identification and reporting of the apple-green fluorescing viral antigen(s) should be performed according the respective device's instructions."

M. Performance Characteristics (if/when applicable):

1. Analytical performance:

a. *Precision/Reproducibility:*

Assay precision, intra-assay variability and inter assay variability were assessed with a panel of proficiency-level antigen control slides. The panel consisted of slides spotted with cell preparations of the following:

1. Low level RSV (Washington strain)
2. Mid level RSV (Washington strain)
3. Low level influenza A (Victoria strain) mixed with Mid level RSV (Washington strain)
4. Mid level influenza A (Victoria strain) mixed with Low level RSV (Washington strain)
5. Low level respiratory virus (either influenza virus B {Taiwan strain}, adenovirus type 1, Parainfluenza virus types 1, 2, or 3 (strains C35, Greer, C243 respectively). This panel member was rotated during the 5-days of testing so that each virus is tested twice.
6. Negative – no infected cells present

The low level is estimated to contain between 4 to 10% infected cells per cell spot. The mid level is estimated to contain between 20 to 25% infected cells per cell spot. Both levels were below the level used in quality control slides. Each panel member was re-coded daily to prevent its identification. Each panel was stained twice per day for 5-days by three different laboratories.

The following results were recorded for both the control slide and the panel slide:

1. Presence or absence of Yellow-gold fluorescence.
2. Percent of cells exhibiting Yellow-gold fluorescence
3. Presence or absence of Green fluorescence
4. Percent of cells exhibiting Green fluorescence

The combined data for negative specimens – no infected cells present - from the three sites demonstrates that the R-PE labeled and FITC labeled MAbs reproducibly do not stain uninfected cells. No fluorescent cells were seen in 100% (60/60) of the wells lacking infected cells.

The combined data from the three sites demonstrates reproducible detection of respiratory syncytial virus by the R-PE labeled MAb. The presence of respiratory syncytial virus infected cells was reported in 98% (147/150) of the wells in which the infected cells were expected:

Respiratory syncytial virus detection Summary				
Positive Control Slide	Low Level Slide	Mid-Level Slide	Low Level with Mid-Level Influenza A	Mid-Level with Low Level Influenza A
100% (30/30)	100% (30/30)	100% (30/30)	90% (27/30)	100% (30/30)

The combined data demonstrates the reproducibility of the detection of Influenza A virus by the FITC labeled MAb. The presence of Influenza A virus infected cells was reported in 96.7% (87/90) of the wells in which the infected cells were expected:

Influenza A virus detection Summary		
Positive Control Slide	Low Level Influenza A with Mid-Level RSV	Mid-Level Influenza A with Low Level RSV
100% (30/30)	90% (27/30)	100% (30/30)

The combined data demonstrates that the presence of R-PE fluorescent cells does not interfere with the detection of influenza A virus by the FITC labeled MAb in a reproducible manner. The presence of influenza A virus infected cells was reported in 94.7% (54/57) of the wells in which the R-PE stained infected cells were present:

Influenza A virus detection in the presence of R-PE positive cells summary	
Low Level R-PE stained cells with Mid-Level influenza A virus	Mid-Level R-PE stained cells with Low Level influenza A virus
100% (27/27)	90% (27/30)

The combined data from all three sites demonstrates that the presence of R-PE in the stain reproducibly does not interfere with the FITC staining of other viruses. The presence of influenza B virus infected cells was reported in 100% (36/36) of the wells in which the infected cells were expected. The presence of adenovirus infected cells was reported in 100% (36/36) of the wells in which the infected cells were expected. The presence of parainfluenza virus type 1 virus infected cells was reported in 100% (36/36) of the wells in which the infected cells were expected. The presence of parainfluenza virus type 2 virus infected cells was reported in 100% (36/36) of the wells in which the infected cells were expected. The presence of parainfluenza virus type 3 virus infected cells was reported in 100% (36/36) of the wells in which the infected cells were expected.

Respiratory virus detection in the presence of R-PE Summary					
Adenovirus Control Slide	Low Level Adenovirus	Influenza B Virus Control Slide	Low Level Influenza B Virus	Parainfluenza type 1 Control Slide	Low Level Parainfluenza type 1
100% (30/30)	100% (6/6)	100% (30/30)	100% (6/6)	100% (30/30)	100% (6/6)
Parainfluenza type 2 Control Slide	Low Level Parainfluenza type 2	Parainfluenza type 3 Control Slide	Low Level Parainfluenza type 3		
100% (30/30)	100% (6/6)	100% (30/30)	100% (6/6)		

The reproducibility study data demonstrates that the presence of R-PE in the stain reproducibly does not interfere with the detection of the 5 respiratory viruses by their respective FITC labeled MABs.

b. Linearity/assay reportable range:

Not applicable

c. Traceability, Stability, Expected values (controls, calibrators, or methods):

Not applicable

d. Detection limit:

Results for analytical detection limit for the seven viruses detected by the D³ Duet were reported in numbers of fluorescent cells per cell monolayer. Each master stock virus preparation was diluted in a ten-fold manner. Four wells of a 96-well cell culture plate were inoculated with each dilution. The plates were centrifuged at 700 xg for 60 minutes, and then incubated at 35° to 37°C for 24-hours. Four wells from each dilution were stained with the D³ Duet. Each well was then examined at 200x magnification and the number of fluorescent cells counted. The table below lists the virus identity and strain along with the fluorescent cell count.

Analytical Sensitivity of D³ Duet compared with that of D³ Ultra MAbs (values are numbers of fluorescent cells per cell monolayer)			
Virus strain	Virus Dilutions from master stock	Fluorescent staining cells/well	
		D ³ Duet	D ³ Ultra
Influenza A virus (PR, VR-95 H1N1)	1x10 ⁻⁵	4, 1, 5, 4	1, 3, 0, 5
	1x10 ⁻⁶	1, 2, 0, 3	0, 0, 1, 0
	1x10 ⁻⁷	0, 0, 0, 0	0, 0, 0, 0
Influenza B virus (Hong Kong, VR-823)	1x10 ⁻⁴	3, 3, 4, 2	0, 4, 3, 5
	1x10 ⁻⁵	1, 0, 1, 1	0, 0, 2, 2
	1x10 ⁻⁶	0, 0, 0, 0	0, 0, 0, 0
Adenovirus (Type 8, VR-8)	1x10 ⁻⁶	1, 1, 3, 3	1, 3, 2, 4
	1x10 ⁻⁷	0, 0, 0, 0	0, 0, 0, 0
RSV (Washington, VR-1401)	1x10 ⁻²	1, 1, 3, 3	2, 3, 2, 0
	1x10 ⁻³	2, 0, 0, 1	2, 1, 0, 0
	1x10 ⁻⁴	0, 0, 0, 0	0, 0, 0, 0
Parainfluenza 1 (C-35, VR-94)	1x10 ⁻⁴	6, 5, 8, 6	9, 8, 4, 6
	1x10 ⁻⁵	0, 2, 4, 2	1, 0, 2, 1
	1x10 ⁻⁶	0, 0, 0, 0	0, 0, 0, 0
Parainfluenza 2 (Greer, VR-92)	1x10 ⁻⁶	5, 4, 2, 1	4, 3, 1, 2
	1x10 ⁻⁷	0, 0, 1, 0	0, 1, 1, 1
	1x10 ⁻⁸	0, 0, 0, 0	0, 0, 0, 0
Parainfluenza 3 (C 243, VR-93)	1x10 ⁻⁶	1, 2, 0, 3	1, 1, 3, 5
	1x10 ⁻⁷	1, 0, 1, 0	1, 1, 1, 0
	1x10 ⁻⁸	0, 0, 0, 0	0, 0, 0, 0

Analytical reactivity (inclusivity) of the D³ Duet was evaluated using 10 influenza A virus and 4 influenza B virus strains. Four wells of a 96-well cell culture plate were inoculated with each viral strain (diluted to less than 20-TCID₅₀ per 0.2-mL inoculum). The plates were centrifuged at 700xg for 60 minutes, and then incubated at 35° to 37°C for 24-hours. Four wells from each strain were stained with the D³ Duet, and each well was then examined at 200x magnification and the number of fluorescent cells counted. The table below lists the virus identity and strain along with the fluorescent cell count.

Analytical Reactivity (inclusivity) of D³ Duet on various influenza A virus and influenza B virus strains (values are numbers of fluorescent cells per cell monolayer)	
Influenza strain	Fluorescent staining cells/cell monolayer
Influenza A WS, VR-1520 (H1N1)	10, 8, 7, 7
Influenza A Hong Kong, VR-544 (H3N2)	12, 11, 11, 12
Influenza A New Jersey, VR-897 (H1N1)	8, 11, 10, 14
Influenza A Victoria, VR-822 (H3N2)	7, 9, 10, 11
Influenza A PR, VR-95 (H1N1)	6, 9, 8, 11
Influenza A Port Chalmers, VR-810 (H3N2)	8, 11, 15, 9
Influenza A Aichi, VR-547 (H3N2)	16, 15, 14, 13
Influenza A Denver, VR-546 (H1N1)	6, 9, 9, 8
Influenza A Mal, VR-98 (H1N1)	16, 13, 11, 15
Influenza A A/NWS/33, VR-219 (H1N1)	12, 17, 15, 10
Influenza B Russia/69, VR-790	13, 14, 12, 15
Influenza B Mass/3/66, VR-523	12, 19, 14, 13
Influenza B Hong Kong/5/72, VR-791	8, 8, 9, 11
Influenza B Maryland/1/59, VR-296	16, 12, 13, 12

Based on the data presented above, the assay can reliably detect influenza A virus and influenza B virus strains exhibiting both temporal and geographical diversity at viral levels near the limit of detection in cell culture.

e. *Analytical specificity:*

Cross-Reactivity Testing

The D³ Duet RSV/Respiratory Virus Screening Kit was tested for cross-reactivity against a variety of cells and microorganisms. Stringent conditions for cross-reactivity testing were achieved by using a high concentration of the D³ Duet DFA Influenza RSV/Respiratory Virus Screening Reagent and relatively high titers of microorganisms. The D³ Duet DFA RSV/Respiratory Virus Screening Reagent was prepared at 1.5X the concentration that is provided in the kit. No cross-reactivity was observed for 32 virus strains or for 17 host culture cell types. Twenty-five bacterial strains, one yeast, three *Chlamydia sp.* and one protozoan were evaluated for cross-reactivity,

including *Staphylococcus aureus*, a protein-A-producing bacterium. Staining of *S. aureus* appeared as small points of fluorescence.

Thirty-two virus strains were tested for cross reactivity. Depending on the particular virus, 71 to 1,400 TCID₅₀ were inoculated into shell vial culture and incubated for 24 to 48 hours, to yield a 1+ to 3+ infection, processed and stained with the 1.5X DFA Reagent according to the procedure as detailed in this product insert. No cross reactivity was observed for the viruses listed below:

Virus Strains Tested for Cross Reactivity with D ³ Duet DFA RSV/Respiratory Virus Screening Reagent					
Organism	Strain or Type	Inoculum (TCID ₅₀)	Organism	Strain or Type	Inoculum (TCID ₅₀)
Parainfluenza 4a	M-25, VR-1378	1,400	CMV	Towne, VR-977	430
Parainfluenza 4b	CH19503, VR-377	1,400	CMV	Davis, VR-807	430
Metapneumovirus	Subgroup A1	1,400	CMV	AD169, VR-538	430
Metapneumovirus	Subgroup A2	1,400	Varicella-zoster	Webster, VR-916	430
Metapneumovirus	Subgroup B1	1,400	Varicella-zoster	Ellen, VR-1367	430
Metapneumovirus	Subgroup B2	1,400	Rhinovirus 39	209 Picornavirus, VR-340	1,400
Coronavirus	OC43, VR-1558	1,400	Rubeola		Commercially available slides stained.*
Coronavirus	229E, VR-740	1,400	Mumps		Commercially available slides stained.*
HSV-1	1F, VR-733	71	Echovirus	Types 4, 6, 9, 11, 30, 34	Commercially available slides stained.*
HSV-1	MacIntyre, VR-539	71	Coxsackievirus	Types B1, B2, B3, B4, B5, B6	Commercially available slides stained.*
HSV-2	MS, VR-540	71			
HSV-2	Strain G, VR-734	71			

Seventeen host culture cell types were tested for cross-reactivity. Cell cultures were prepared in shell vial format. Confluent monolayers were stained with the 1.5X preparation of the D³ Duet DFA RSV/Respiratory Virus Screening Reagent according to the procedure as detailed in the product insert, and then examined for cross-reactivity. No cross-reactivity was observed for the following:

Cell lines Tested for Cross Reactivity with D ³ Duet DFA Influenza A/Respiratory Virus Screening Reagent			
A549	monolayer	pCMK	cell spot
BGMK	monolayer	pRhMK	cell spot
HEp-2	monolayer	RD	monolayer
LLC-MK2	monolayer	RhMK II	cell spot
MDCK	monolayer	pRK	monolayer
MRC-5	monolayer	R-Mix	monolayer
MRHF	monolayer	Vero	cell spot
Mv1Lu	monolayer	WI-38	cell spot
NCI-H292	monolayer		

Thirty microorganisms, including 25 bacterial and one yeast cultures, three *Chlamydia sp.* and one protozoan commercially available slides, were stained with the 1.5X DFA Reagent according to the procedure as detailed in the product insert, then examined for cross reactivity. Except for *Staphylococcus aureus*, which was cross reactive with the D³ Duet DFA Influenza A/Respiratory Virus Screening Reagent, all other microorganisms tested negative. Reactivity with *Staphylococcus aureus* is more than likely due to binding the protein A produced by *Staphylococcus aureus*. Concentrations for each bacterial organism cultured by DHI for cross reactivity testing were determined from suspensions of the bacteria in PBS by spectrophotometer according to McFarland standards of levels 1.0 and 2.0 (equaling approximately 3.0×10^6 and 6.0×10^6 CFU per mL). Slides were prepared with spots of 0.01-mL of the suspensions to give either 3.0×10^4 or 6.0×10^4 per spot. At the same time, 1-mL of each suspension was plated on an appropriate agar dish for colony confirmation. According to the confirmation agar cultures, initial concentrations of the bacterial organisms in the study ranged from 6.4×10^4 to 2.9×10^7 CFU. Microorganisms tested are listed below.

Microorganisms Tested for Cross Reactivity with D ³ Duet DFA Influenza A/Respiratory Virus Screening Reagent	
BACTERIA	CFU TESTED
<i>Acholeplasma laidlawii</i>	$\sim 6 \times 10^7$
<i>Acinetobacter calcoaceticus</i>	9.7×10^5
<i>Bordetella bronchiseptica</i>	1.7×10^5
<i>Bordetella pertussis</i>	4.6×10^6
<i>Corynebacterium diphtheriae</i>	2.5×10^6
<i>Escherichia coli</i>	2.6×10^5
<i>Gardnerella vaginalis</i>	5.0×10^5
<i>Haemophilis influenzae type A</i>	9.3×10^5
<i>Klebsiella pneumoniae</i>	6.4×10^6
<i>Legionella pneumophila</i>	6.5×10^4
<i>Moraxella cartarrhalis</i>	6.4×10^4
<i>Mycoplasma hominis</i>	$\sim 6 \times 10^4$
<i>Mycoplasma orale</i>	$\sim 6 \times 10^4$
<i>Mycoplasma pneumoniae</i>	$\sim 6 \times 10^4$
<i>Mycoplasma salivarium</i>	$\sim 6 \times 10^7$
<i>Neisseria gonorrhoeae</i>	1.3×10^6
<i>Proteus mirabilis</i>	2.1×10^6
<i>Pseudomonas aeruginosa</i>	1.0×10^7
<i>Salmonella enteritidis</i>	2.5×10^6
<i>Salmonella typhimurium</i>	1.8×10^6
<i>Staphylococcus aureus*</i>	1.0×10^7
<i>Streptococcus agalactiae</i>	9.6×10^6
<i>Streptococcus pneumoniae</i>	8.0×10^5
<i>Streptococcus pyogenes</i>	2.9×10^7
<i>Ureaplasma urealyticum</i>	$\sim 6 \times 10^4$
<i>Chlamydophila pneumoniae</i>	Commercially available slides stained.
<i>Chlamydophila psittaci</i>	Commercially available slides stained.
<i>Chlamydia trachomatis</i>	Commercially available slides stained.
YEAST	
<i>Candida glabrata</i>	8.7×10^6
PROTOZOAN	
<i>Trichomonas vaginalis</i>	Commercially available slides stained.

*Reactivity with *Staphylococcus aureus* is more than likely due to binding the protein A produced by *Staphylococcus aureus*.

- f. *Assay cut-off:*
Not applicable

2. Comparison studies:

a. *Method comparison with predicate device:*

Direct fresh specimens:

A study was performed prospectively at three sites with 1203 fresh specimens that were received for respiratory virus testing. Each specimen was evaluated by the D³ *Duet* DFA Influenza A/Respiratory Virus Screening Kit and a cleared DSFA device for the presence of respiratory syncytial virus, influenza A, influenza B, adenovirus, parainfluenza 1, parainfluenza 2 and parainfluenza 3 in cells derived from clinical specimens. Seventeen specimens were excluded from analysis due to a variety of reasons (site deviations, duplicate specimen, insufficient cell numbers, or high background). These exclusions left 1187 specimen results for analysis.

The following tables detail the summary of the comparison of the D³ *Duet* and the cleared DSFA comparator assay, combined for study sites 1, 2, and 3:

D ³ <i>Duet</i> R-PE identification of respiratory syncytial virus positive specimens			
Direct Specimen (1187 Specimens)		D ³ <i>Ultra</i> Final Identification (respiratory syncytial virus)	
		Pos	Neg
D ³ <i>Duet</i> R-PE (respiratory syncytial virus)	Pos	300	0
	Neg	0	887
Positive Percent Agreement (PPA)		100% (300/300)	
95% CI- PPA		97.8, 100%	
Negative Percent Agreement (NPA)			100% (887/887)
95% CI- NPA			99.6, 100%

D ³ <i>Duet</i> FITC detection of influenza A virus, influenza B virus, adenovirus, and parainfluenza virus types 1, 2, and 3			
Direct Specimen (1187 Specimens)		D ³ <i>Ultra</i> Final Identification	
		Pos	Neg
D ³ <i>Duet</i> FITC Screen	Pos	187	0
	Neg	0	1000*
Positive Percent Agreement (PPA)		100% (186/186)	
95% CI- PPA		98.0, 100%	
Negative Percent Agreement (NPA)			100% (1001/1001)
95% CI- NPA			99.6, 100%

* One specimen was screen positive by both devices, but was unable to be identified with the identification reagents.

Virus Follow-up Identification of 187 D ³ <i>Duet</i> FITC Positive Specimens for influenza A virus, influenza B virus, adenovirus, and parainfluenza virus types 1, 2, and 3 viruses, using D ³ <i>Ultra</i> Identification Reagents						
Virus	Sensitivity		95%CI for Sensitivity	Specificity		95% CI for Specificity
	TP / (TP+FN)	percent		TN/ (TN+FP)	percent	
Influenza A virus	100/100	100%	96.3, 100	1087/1087	100%	99.7, 100
Influenza B virus	11/11	100%	74.1, 100	1176/1176	100%	99.7, 100
Adenovirus	52/52	100%	93.1, 100	1135/1135	100%	99.7, 100
Parainfluenza type 1	4/4	100%	51.0, 100	1183/1183	100%	99.7, 100
Parainfluenza type 2	1/1	100%	20.7, 100	1186/1186	100%	99.7, 100
Parainfluenza type 3	19/19	100%	83.2, 100	1168/1168	100%	99.7, 100

The D³ *Duet*'s ability to identify respiratory syncytial virus using phycoerythrin in direct specimens was compared to the D³ *Ultra*'s ability using fluorescein. The positive percent agreement was 100% (95% CI range of 98.7% to 100%). The negative percent agreement was 100% (95% CI range of 99.6% to 100%). When the ability of the D³ *Duet* to detect the six other respiratory viruses using fluorescein in direct specimens was compared to the D³ *Ultra*'s ability using fluorescein, the positive percent agreement was 100% (95% CI range of 97.8% to 100%). The negative percent agreement was 100% (95% CI range of 99.6% to 100%).

Specimen type distribution:

Tables below show the study results by the claimed specimen type. Results from sites 1, 2, and 3 have been combined.

Respiratory syncytial virus by specimen type Study Sites 1, 2, and 3 Combined						
Specimen type	PPA		95%CI for PPA	NPA		95% CI for NPA
	TP / (TP+FN)	percent		TN/ (TN+FP)	percent	
NPA	155/155	100%	97.6, 100	435/435	100%	99.1, 100
NPS	132/132	100%	97.2, 100	410/410	100%	99.1, 100

D³ Duet FITC detection of influenza A virus, influenza B virus, adenovirus, and parainfluenza virus types 1, 2, and 3 viruses by specimen type Study Sites 1, 2, and 3 Combined						
Specimen type	PPA		95%CI for PPA	NPA		95% CI for NPA
	TP / (TP+FN)	percent		TN/ (TN+FP)	percent	
NPA	103/103	100%	96.4, 100	484/484	100%	99.2, 100
NPS	79/79	100%	95.4, 100	460/460	100%	99.2, 100

Cultured specimens:

To evaluate the performance of this device using cultured clinical specimens, a fourth study was performed with 298 frozen specimens to compare performance of the D³ Duet DFA RSV/Respiratory Virus Screening Kit with that of the predicate for the presence of respiratory syncytial virus, influenza A virus, influenza B virus, adenovirus, parainfluenza virus types 1, 2 and 3 from cultured clinical specimens. At Study Site 4, 298 frozen specimens were processed for cell culture testing in accordance with the procedure in the Comparator product insert (same procedure for both Subject and Comparator devices) using R-Mix Too™ FreshCells™ in 48/24-fill multi-well plates. All specimens at study site 4 were derived from nasopharyngeal specimens. The results of this study are presented below. The table below shows the age distribution for individuals studied at site 4:

Site 4 (culture) – Age Distribution	
0 - 1 month	5
>1 month - 2 years	130
>2 - 12 years	44
>12 - 21 years	28
22 - 30 years	19
31 - 40 years	20
41 - 50 years	10
51 - 60 years	9
61 - 70 years	8
71 - 80 years	6
81 - 90 years	8
>90 years	5
Unknown age	6
Total	298

The following tables detail the results of the cell culture study's comparison of D³ Duet's phycoerythrin-labeled MAbs identification of respiratory syncytial virus specimens positive specimens, and D³ Duet's fluorescein-labeled MAbs detection of influenza A virus, influenza B virus, adenovirus, and parainfluenza virus types 1, 2, and 3 positive specimens.

D ³ Duet R-PE identification of respiratory syncytial virus positive specimens			
Cell Culture (298 Specimens)		D ³ Ultra Final Identification (respiratory syncytial virus)	
		Pos	Neg
D ³ Duet R-PE (respiratory syncytial virus)	Pos	33	0
	Neg	0	265
Positive Percent Agreement (PPA)		100% (33/33)	
95% CI- PPA		89.5, 100%	
Negative Percent Agreement (NPA)			100% (265/265)
95% CI- NPA			98.6, 100%

D ³ Duet FITC detection of influenza A virus, influenza B virus, adenovirus, and parainfluenza virus types 1, 2, and 3			
Cell Culture (298 Specimens)		D ³ Ultra Final Identification	
		Pos	Neg
D ³ Duet FITC Screen	Pos	104	0
	Neg	0	194
Positive Percent Agreement (PPA)		100% (104/104)	
95% CI- PPA		96.4, 100%	
Negative Percent Agreement (NPA)			100% (194/194)
95% CI- NPA			98.1, 100%

A variety of viral respiratory pathogens were isolated. Virus identification of D³ Duet FITC Positive Specimens using D³ Ultra Identification Reagents yielded the following isolates: respiratory syncytial virus [prevalence 11.1% (33/298)], influenza A virus [prevalence 22.5% (67/298)], influenza B virus [prevalence 6.7% (20/298)], adenovirus [prevalence 3.4% (10/298)], parainfluenza type 1 virus [prevalence 1.7% (5/298)], parainfluenza type 2 virus [prevalence 1.0% (3/298)], and parainfluenza type 3 virus [prevalence 3.0% (9/298)]. There were sixteen co-infections as follows: three influenza A virus + parainfluenza type 3 virus, one influenza A virus + parainfluenza type 1 virus, one influenza A virus + parainfluenza type 2 virus, two influenza A virus + respiratory syncytial virus, one influenza A virus + adenovirus, one influenza B virus + parainfluenza type 2 virus, one influenza B virus + parainfluenza type 3 virus, one influenza B virus + respiratory syncytial virus, one respiratory syncytial virus + parainfluenza type 1 virus, two respiratory syncytial virus + parainfluenza type 3 virus, one adenovirus + parainfluenza type 1 virus and one adenovirus + parainfluenza type 3 virus.

- 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:
A study was performed prospectively at three sites with 1187 fresh specimens that were received for respiratory virus testing. Each specimen was evaluated for the presence of respiratory syncytial virus, influenza A, influenza B, adenovirus, parainfluenza 1, parainfluenza 2 and parainfluenza 3 in cells derived from clinical specimens. Prevalence of the respiratory viruses within this population during the 2006/2007 season is noted in the table below:

Respiratory Virus Prevalence 2006/2007 Fresh Specimens (n = 1187)							
	Adenovirus	Influenza A	Influenza B	Parainfluenza 1	Parainfluenza 2	Parainfluenza 3	Respiratory Syncytial Virus
No. of positives	52	100	11	4	1	19	300
Prevalence	4.4%	8.4%	0.9%	0.3%	0.08%	1.6%	25.3%

*Six co-infections were detected (0.5%): 1-influenza A virus/adenovirus, 1-influenza A virus/parainfluenza virus type 3, 2-influenza A virus/ respiratory syncytial virus, 1-adenovirus/respiratory syncytial virus, 1-respiratory syncytial virus/ parainfluenza virus type 3.

The following table summarizes the participant age demographics according to test results for a population of 1187 fresh specimens, prospectively collected and evaluated for performance using the comparator assay:

Participant Age Demographics								
Virus: Age*:	Adenovirus	Influenza A	Influenza B	Parainfluenza 1	Parainfluenza 2	Parainfluenza 3	Respiratory Syncytial Virus	Negative
Totals[†]	52	100	11	4	1	19	300	704
<1m	0	1	0	0	0	1	26	68
1m to 2y	35	47	4	4	1	16	237	359
2y to 12y	16	36	6	0	0	0	31	147
12y to 21y	1	7	0	0	0	1	0	24
21y to 30y	0	1	0	0	0	0	0	20
31 to 40y	0	1	0	0	0	0	1	17
41 to 50y	0	4	1	0	0	0	0	19
51 to 60y	0	2	0	0	0	0	0	12
61 to 70y	0	0	0	0	0	0	0	10
71 to 80y	0	0	0	0	0	0	2	8
81 to 90y	0	1	0	0	0	1	1	17
91 to 100y	0	0	0	0	0	0	0	4
Not reported	0	0	0	0	0	0	2	0

* Age: m = months, and y = years

[†] Due to 6 co-infections the total adds up to 1193

N. Proposed Labeling:

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.