Bordetella pertussis
IgA/IgM ELISA Kit

Catalog Number KA2091
96 assay
Version: 01

Intend for research use only
Introduction and Background

A. Intended Use

*Bordetella pertussis* IgA/IgM ELISA Kit is a qualitative Enzyme Linked Immunosorbent assay (ELISA) for the detection of specific IgA and/or IgM antibodies to *Bordetella pertussis*. This kit can be used as two separate assays that enable the detection of either IgA or IgM antibodies or both.

B. Introduction

Whooping Cough (Pertussis) is a highly contagious bacterial respiratory tract infection, caused by *Bordetella pertussis*-gram-negative bacilli. It is typically manifested in children with paroxysmal spasms of severe coughing; whooping and posttussive vomiting that resides for many weeks. The disease results in high morbidity and mortality, especially of children. Pertussis is an endemic disease, but epidemics occur every 3-5 years. In the USA, 5000-7000 cases are reported each year. The incidence of Pertussis has been greatly reduced by mass vaccination; however, even in countries with high vaccination coverage, the disease is re-merging (1). Worldwide, nearly 50 million cases of pertussis are diagnosed annually and about 350,000 people die of the disease (2). The incidence of pertussis has increased steadily since 1980 (3). The vaccine induced immunity wanes after 5 to 10 years, making the vaccinated host vulnerable to infection. Infection in vaccinated persons causes a milder non-specific disease, without the classical clinical stages. Whooping cough is seen in only 6% of such cases; instead the illness is characterized by a non-specific, prolonged cough, lasting several weeks to months. Because of these atypical symptoms, Pertussis is under-diagnosed in adults and adolescents, who may be the reservoirs for infection of unvaccinated infants (4). Children who are too young to be fully vaccinated and those who have not yet completed the primary vaccination series are at highest risk for severe illness. The disease is highly contagious, with up to 90% of susceptible household contacts developing clinical disease following exposure. Early anti-microbial treatment will reduce the severity of the symptoms and limit the period of communicability. Prompt identification of the cases may help to prevent unvaccinated or under-vaccinated persons from being infected by vaccination or by anti-microbial prophylaxis. Laboratory diagnosis of Pertussis can be either direct by culture, DFA or PCR or by indirect serological tests. Since the bacteria reside in the upper respiratory tract during the first two weeks of the infection it can be detected by direct methods during this period only. The preferred specimen for direct detection is naso-pharyngeal sample (aspirates or swabs). Serology tests are helpful in diagnosis of atypical infections with prolonged cough and for epidemiological purposes. Elevated levels of antibodies against Pertussis Toxin (PT) and Filamentous Hemagglutinin (FHA) are regarded as sensitive serological markers for the diagnosis of Pertussis in adults and non-vaccinated children (5). In unvaccinated children increases in the levels of either immunoglobulin G (IgG) or immunoglobulin A (IgA) antibodies to a single or various antigens are required to meet the World Health Organization (WHO) definition of Pertussis. In vaccinated children, a single serum specimen may be diagnostic for Pertussis (6). *Bordetella pertussis* IgG ELISA Kit and *Bordetella pertussis* IgA/IgM ELISA Kit utilize enriched fraction of PT and FHA as antigens, allowing sensitive detection of IgA and/or IgM antibodies and the semi-quantitative determination of IgG antibodies to *Bordetella pertussis* allowing immuno-status follow-up and antibodies kinetics.
C. **Principle of the Test**

- Plates are coated with enriched fraction of *Bordetella pertussis* toxin and filamentous heamaglutinin.
- The serum to be tested is diluted 1/100 and incubated in the plate. In this step *B. pertussis* specific antibodies are bound to the immobilized antigens.
- Non-specific antibodies are removed by washing.
- Anti-human IgA and/or IgM conjugated to horseradish peroxidase (HRP) is added. In this step the HRP conjugate is bound to the prebound antigen-antibody complex.
- Unbound conjugate is removed by washing.
- TMB-substrate is added and is hydrolyzed by the peroxidase, yielding a blue solution of the reduced substrate.
- Upon the addition of the stop solution, the blue color turns yellow and the absorbance should be read by an ELISA reader at a wavelength of 450/620 nm.
- The absorbance is proportional to the levels of the specific antibodies that are bound to the coated antigens.

D. **Warning and Precautions**

1. This kit contains human sera, and found to be negative for HBsAg, and for antibodies to HCV and to HIV 1 & 2. Since no known method can offer complete assurance that products derived from human blood do not transmit infection, all human blood components supplied in this kit must be handled as potentially infectious serum or blood according to the recommendations published in the CDC/NIH manual "Biosafety in Micro Biological and Biomedical Laboratories, 1988".

2. TMB-Substrate solution is an irritant material to skin and mucous membranes. Avoid direct contact.

3. All the components of this kit have been calibrated and tested by lot. It is not recommended to mix components from different lots since it might affect the results.

4. Diluted sulfuric acid (1 M H₂SO₄) is an irritant agent for the eyes and skin. In case of contact with eyes, immediately flush area with water and consult a physician.
E. **Summary of Procedure**

Add 50 μl of Cut Off Control, Negative Control, Positive Control, and 1/100 of diluted specimens to the microtiter plate wells coated with specific immunodominant *B.pertussis* proteins

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Cover plate and incubate 1h at 37°C at 100% humidity

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Wash 3 times with Wash Buffer

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Add 50 μl of 1/300 diluted HRP Conjugate

↓

Cover plate and incubate 1h at 37°C at 100% humidity

↓

Wash 3 times with Wash buffer

↓

Add 100 μl of TMB-Substrate

↓

Cover plate and incubate 15min at room temperature

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Add 100 μl of Stop Solution

↓

Read absorbance at 450/620 nm

↓

Calculate and interpret results
Material and Method

F. Kit contents:
1. **B. pertussis Antigen Coated Microtiter Plate**: 96 break apart wells (8x12) coated with *Bordetella pertussis* antigens, packed in an aluminum pouch containing a desiccant card. 1 Plate
2. **Concentrated Wash Buffer (20X)**: A PBS-Tween buffer. Contains less than 0.05% proclin as a preservative. 1 bottle, 100 ml
3. **Serum Diluent**: A ready-to-use buffer solution. Contains less than 0.05% proclin as a preservative. 1 Bottle, 60 ml
4. **Conjugate Diluent**: A ready-to-use buffer solution. Contains less than 0.05% proclin as a preservative. 1 Bottle, 40 ml
5. **Negative Control IgA and IgM**: A ready-to-use *B. pertussis* IgA and IgM negative human serum. Contains less than 0.05% proclin and less than 0.1% Sodium Azide as preservatives. 1 Vial, 0.75 ml
6. **Positive Control IgA and IgM**: A ready-to-use *B. pertussis* IgA and IgM positive human serum. Contains less than 0.05% proclin and less than 0.1% Sodium Azide as preservatives. 1 Vial, 0.75 ml
7. **Cut-Off Control IgA**: A ready-to-use calibrator containing human IgA antibodies specific to *B. pertussis*, used for cut off determination. Contains less than 0.05% proclin and less than 0.1% Sodium Azide as preservatives. 1 Vial, 0.75 ml
8. **Cut-Off Control IgM**: A ready-to-use calibrator containing human IgM antibodies specific to *B. pertussis*, used for cut off determination. Contains less than 0.05% proclin and less than 0.1% Sodium Azide as preservatives. 1 Vial, 0.75 ml
9. **HRP-Conjugate IgA (300X)**: Horseradish peroxidase (HRP) conjugated anti-human IgA (α chain specific). Contains less than 0.05% proclin as a preservative. 1 Vial, 0.2 ml
10. **HRP-Conjugate IgM (300X)**: Horseradish peroxidase (HRP) conjugated anti-human IgM (μ chain specific). Contains less than 0.05% proclin as a preservative. 1 Vial, 0.2 ml
11. **TMB-Substrate**: A ready-to-use solution. Contains 3, 3', 5, 5'-Tetramethylbenzidine as a chromogen and peroxide as a substrate. 1 Bottle, 14 ml
12. **Stop Solution**: A ready-to-use solution. Contains 1 M H₂SO₄. 1 Bottle, 15 ml
13. **Plate Cover**: 1 unit
G. Materials Required But Not Supplied

✓ Clean test tubes for dilution of patients sera.
✓ Disposable plastic vial for dilution of the concentrated HRP-conjugate.
✓ Adjustable micropipettes and multichannel pipettes (5-50, 50-200 and 200-1000 μl ranges) and disposable tips.
✓ One liter volumetric flask.
✓ One 50 ml volumetric cylinder.
✓ Wash bottle.
✓ Absorbent paper.
✓ Vortex mixer
✓ A 37°C water bath with a lid, or a moisture chamber placed in a 37°C incubator.
✓ ELISA-reader with a 450 and 620 nm filters.
✓ Distilled or double deionized water

H. Storage and Shelf-Life of Reagents

1. All the reagents supplied should be stored at 2-8°C. The unopened reagents vials are stable until the expiration date indicated on the kit pack. Exposure of originally stoppered or sealed components to ambient temperature for a few hours will not cause damage to the reagents. DO NOT FREEZE!
2. Once the kit is opened, its shelf life is 90 days.
3. Unused strips must be resealed in the aluminum pouch with the desiccant card, by rolling the open end and sealing tightly with tape over the entire length of the opening.
4. Crystals may form in the 20x concentrated Wash Buffer during cold storage, this is perfectly normal. Redissolve the crystals by warming the buffer to 37°C before diluting. Once diluted, the solution may be stored at 2-8°C up to twenty one days.

I. Serum Collection

Prepare sera from aseptically collected samples using standard techniques. Heat inactivated sera should not be used. The use of lipemic, turbid or contaminated sera is not recommended. Particulate material and precipitates in sera may cause erroneous results. Such specimens should be clarified by centrifugation or filtration prior to the test.

J. Specimens storage

Specimens should be stored at 2-8°C and tested within 7 days (adding of 0.1% Sodium Azide is highly recommended). If longer storage period is anticipated, aliquot and store the specimens below -20°C. Avoid repeated thawing and freezing.

K. Test Procedure

The same procedure is used for IgA and IgM.

● Preparation of Reagents
1. Bring all components and the clinical specimens to be tested to room temperature. Mix gently the Cut Off Serum, Negative Control, Positive Control and the clinical specimens before use.

2. Determine the total number of specimens to be tested. In addition to the specimens, the following must be included in each test: One well of Negative Control, Positive Control and two wells of Cut Off Controls.

3. Withdraw the microtiter plate from its aluminum pouch by cutting one end near the seal. Leave the required number of strips (according to the number of specimens to be tested) in the 96 well frame. Unused strips must be resealed in the aluminum pouch with the desiccant card, by rolling the open end and sealing tightly with tape over the entire length of the opening.

4. Dilute the Concentrated Wash Buffer 1/20 with doubledeionized or distilled water. For example, in order to prepare one liter of wash buffer, add 50ml of the Concentrated Wash Buffer to 950ml of doubledeionized or distilled water.

   **Incubation of sera samples and controls**

5. Dilute each patient serum 1/100 with the supplied Serum Diluent as follows: Add 10 µl of patient serum to 190 µl of Serum Diluent (1/20), and then dilute further by adding 25 µl of 1/20 dilution to 100 µl of Serum Diluent.

6. Dispense 50 µl of each of the following: Cut Off Control IgA and/or IgM, Negative Control, Positive Control as well as 50 µl of the diluted serum samples 1/100 into separate wells of the test strip.

7. Cover the strips with a plate cover and incubate for 1h at 37°C in a moisture chamber.

8. Discard the liquid content of the wells.

9. **Washing step:**
   - **Manual Wash:**
     Fill each well with wash buffer up to the end of the well and discard the liquid, repeat this step twice for a total of three washing steps.
   - **Automated Wash:**
     Fill each well with 350ul of wash buffer and discard the liquid, repeat this step twice, for a total of three washing steps.

10. Dry the strips and frame by gently tapping them over clean absorbent paper.

   **Incubation with Conjugate**

11. Concentrated HRP-Conjugated anti-human IgA and/or IgM should be diluted to working solution shortly before use. Dilute 1/300 the respective concentrated HRPconjugated anti-human IgA or IgM with Conjugate Diluent. For example: for two strips prepare a minimum of 3 ml conjugate as follows: 10 µl of Concentrated HRP-conjugated anti-human IgA or IgM is mixed with 3 ml of Conjugate Diluent.

12. Dispense 50 µl of diluted HRP- Conjugate into each well.

13. Cover the strips with a plate cover and incubate for 1h at 37°C in a moisture chamber.

14. Discard the liquid content and wash as described 9-10.

   **Incubation with TMB - Substrate**

15. Dispense 100 µl TMB-Substrate into each well, cover the strips with a plate cover and incubate at room temperature for 15 minutes.

16. Stop the reaction by adding 100 µl of stop solution (1 M H₂SO₄) to each well.
Determination of Results

17. Determine the absorbance at 450/620 nm and record the results. Determination should not exceed 30 minutes following stopping of chromogenic reaction.

Note: Any air bubbles should be removed before reading. The bottom of the ELISA plate should be carefully wiped.

Performance Characteristics

L. Test Validation
The following criteria must be met for the test to be valid. If these criteria are not met, the test should be considered invalid and should be repeated.

1. \( \text{OD}_{\text{Positive Control}} \geq 1.0 \)
2. \( \text{Ratio OD}_{\text{Positive Control}} / \text{OD}_{\text{Cut Off}} > 2.0 \)
3. \( \text{OD}_{\text{Negative Control}} \leq 0.25 \)

M. Calculation of Test Results

1. The average absorbance value of the Cut off serum run in duplicate should be calculated.
2. In order to normalize the results obtained in different tests, the cut off index (COI) is calculated according to the following formula:
3. \( \text{COI} = \frac{\text{Absorbance of the serum sample}}{\text{OD average value of the Cut off serum}} \)

N. Interpretation is for both IgA and IgM

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Absorbance at 450nm</th>
<th>COI</th>
<th>Results</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>O.D &lt; COV</td>
<td>&lt;1.0</td>
<td>Negative No detectable IgA or IgM antibodies</td>
<td>No indication of B.pertussis infection (see test limitations)</td>
<td></td>
</tr>
<tr>
<td>COV ≤ O.D ≤ 1.1xCOV</td>
<td>1-1.1</td>
<td>Borderline A second serum sample should be obtained after 2-4 weeks and tested (When second sample is borderline the result should be considered negative).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O.D &gt;1.1 x COV</td>
<td>&gt;1.1</td>
<td>Positive Significant level of IgA and/or IgM antibodies</td>
<td>May indicate current B.pertussis infection.</td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Interpretation of results based on the detection of IgA, IgM and IgG antibodies detection.

<table>
<thead>
<tr>
<th></th>
<th>IgG</th>
<th>IgM</th>
<th>IgA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bordetella Pertussis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>No indication of <em>B. pertussis</em> infection (see test limitations)</td>
</tr>
<tr>
<td>Negative or Positive</td>
<td>Positive</td>
<td>Negative or Positive</td>
<td></td>
<td>May indicate current infection</td>
</tr>
<tr>
<td>Positive or Negative</td>
<td>Negative</td>
<td>Positive</td>
<td></td>
<td>May indicate recent infection</td>
</tr>
<tr>
<td>Positive</td>
<td>Negative</td>
<td>Negative or Positive</td>
<td></td>
<td>May indicate recent or past infection or past immunization</td>
</tr>
</tbody>
</table>

O. Precision

Table 3: IgA Intra-assay (within-run) precision:

<table>
<thead>
<tr>
<th>Sample</th>
<th>No of Replicates</th>
<th>Mean OD Value</th>
<th>CV%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>10</td>
<td>0.857</td>
<td>5.4</td>
</tr>
<tr>
<td>Negative</td>
<td>10</td>
<td>0.225</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Table 4: IgA Inter-assay (between-run) precision:

<table>
<thead>
<tr>
<th>Sample</th>
<th>No of Replicates</th>
<th>Mean OD Value</th>
<th>CV%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>10</td>
<td>0.911</td>
<td>5.6</td>
</tr>
<tr>
<td>Negative</td>
<td>10</td>
<td>0.147</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Table 5: IgM Intra-assay (within-run) precision:

<table>
<thead>
<tr>
<th>Sample</th>
<th>No of Replicates</th>
<th>Mean OD Value</th>
<th>CV%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>10</td>
<td>0.862</td>
<td>3.1</td>
</tr>
<tr>
<td>Negative</td>
<td>10</td>
<td>0.28</td>
<td>2.4</td>
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</tbody>
</table>

Table 6: IgM Inter-assay (between-run) precision:

<table>
<thead>
<tr>
<th>Sample</th>
<th>No of Replicates</th>
<th>Mean OD Value</th>
<th>CV%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>10</td>
<td>0.906</td>
<td>5.7</td>
</tr>
<tr>
<td>Negative</td>
<td>10</td>
<td>0.238</td>
<td>6.9</td>
</tr>
</tbody>
</table>

P. Test Limitations

1. Samples obtained too early during primary infection may not contain detectable antibodies. If *B. pertussis* is suspected, a second sample should be obtained 2-4 weeks later and tested in parallel with the original sample.

2. When infection is suspected in infants under the age of 6 months, antigen detection method should be applied (culture, PCR) since children younger than 6 months rarely develop antibodies.
Q. Reference
1. Melker H.E. et al., Emerging Infectious Diseases 6(4), 2000. Centers of Disease Control
3. CDC report, February 1998
5. Trollfors B. et al., Clinical Infectious Diseases 1999; 28; 552-9