



West Nile Detect™ IgM Capture ELISA
For In Vitro Diagnostic Use

INTENDED USE

The West Nile *Detect*™ IgM Capture ELISA is designed for the qualitative detection of IgM antibodies to West Nile recombinant antigens (WNRA) in human serum. This test is intended for use for the presumptive clinical laboratory diagnosis of West Nile virus infection in patients with clinical symptoms consistent with meningoencephalitis. Positive results must be confirmed by Plaque Reduction Neutralization Test (PRNT), or by using the current CDC guidelines for diagnosis of this disease.

Assay performance characteristics have not been established for testing cord blood, neonate, prenatal screening, general population screening without symptoms of meningoencephalitis or automated instruments. This assay is not FDA cleared or approved for testing blood or plasma donors.

Caution: IgM assay cross-reactivity has been noted with some West Nile IgM assays testing specimens containing antibody to enteroviruses. Reactive results reported from children must contain a caution statement regarding possible cross-reactivity with enteroviruses.

SUMMARY AND EXPLANATION OF THE TEST

Exposure to West Nile Virus causes a disease with a number of symptoms including encephalitis. West Nile virus (WNV) is a potentially neuroinvasive agent that causes asymptomatic infection and fevers in humans. Human and animal infections were not documented in the Western Hemisphere until the 1999 outbreak in the New York City metropolitan area (1,2). Since then, the disease has spread across the United States. In 2003, WNV activity occurred in 46 states and caused illness in over 9,800 people. Most WNV infected humans usually have no symptoms. A small proportion develops mild symptoms that include fever, headache, body aches, skin rash and swollen lymph glands. Clinically, WNV fever in humans is a self-limited acute febrile illness accompanied by headache, myalgia, polyarthropathy, rash, gastrointestinal symptoms, and lymphadenopathy (3, 4). Less than 1% of infected people develop more severe illness that includes meningitis or encephalitis (5, 6). The West Nile Detect IgM Capture ELISA employs a

recombinant WNV antigen called WNRA, which can be used as a rapid serological marker for WNV infection. The WNRA protein is a recombinant antigen, which consists of a stretch of sequences from two WNV antigens (encoded by prM-E gene).

PRINCIPLE OF THE TEST

The West Nile *Detect*™ IgM Capture ELISA consists of one enzymatically amplified "two-step" sandwich-type immunoassay. In this assay, controls and unknown serum samples are incubated in microtiter wells which have been coated with anti-human IgM antibodies. This is followed by incubation with the West Nile Virus derived recombinant WNRA protein and a control preparation (NCA) separately. The serum samples may be directly mixed with sample dilution buffer for WN IgM, then added in the wells. After one hour incubation and washing, the wells are treated with a WNRA-specific antibody labeled with the enzyme horseradish peroxidase (HRP). After a second incubation and washing step, the wells are incubated with the tetramethylbenzidine (TMB) substrate. An acidic stopping solution is then added and the degree of enzymatic turnover of the substrate is determined by absorbance measurement at 450 nanometers. Above a certain threshold, the ratio of the absorbance of the WNRA and the control wells presumptively determines whether antibodies to WNV are present. A set of positive and negative controls is provided in order to monitor the integrity of the kit components.

MATERIALS SUPPLIED

The West Nile Detect IgM Capture ELISA Kit contains sufficient reagents for one plate of 96 wells (12 x 8 strips) each. The kit contains the following reagents:

WN Human IgM Assay-specific materials:

1. **Coated Microtiter Strips for WN Human IgM Cat. No. 500116**
96 polystyrene microtiter wells (12x8 strips). Coated with goat anti-human IgM antibody in each well. Ready to use. Stable at 2-8°C until the expiration date.
2. **Sample Dilution Buffer for WN IgM Cat. No. 500117**
One bottle (25 ml). Ready to use. Phosphate Buffered Saline (pH7.2-7.6) with Tween 20, preservative (0.01% thimerosal) and additives. Use for the dilution of test samples, positive and negative controls. Stable at -70° C until the expiration date.

Note: For quick thaw, place the bottle containing Sample Dilution Buffer in a container with clean water maintained at room temperature

(just immerse up to the height of the content). Following complete thaw, take out the bottle, remove excess water on exterior with clean paper towels. *If any precipitate is seen after the thaw process, vortex the tube very well to obtain a homogeneous solution and then use.*

3. **West Nile antigen (WNRA) for IgM**
Cat. No. 500120
One tube (3 ml). Ready to use. Contains Tween 20, preservative (0.002-0.005% Thimerosal), antibiotics (0.0025-0.004% G418 sulphate), WNV antigens (Non-infectious WNV PrM and E antigens) and additives. Stable at -70°C until the expiration date.
Caution: The WNRA should not be repeatedly frozen and thawed. It should be aliquoted in a smaller volume and frozen at -70°C.
4. **Normal cell antigen (NCA) for IgM**
Cat. No. 500121
One tube (3 ml). Ready to use. Contains Tween 20, preservative (0.002-0.005% Thimerosal), culture supernatant of COS-1 cell line and additives. Stable at -70°C until the expiration date.
Caution: To avoid repetitive freezing and thawing, the sample should be aliquoted and stored at -70°C.
5. **Human IgM Negative Control (IgM N)**
Cat. No. 500119
One vial (30µl). Heat-inactivated negative serum. The negative control will aid in monitoring the integrity of the kit as well. Stable at -70°C until the expiration date. Before use, quickly centrifuge the vials so that contents can be collected at the bottom.
Note: For long-term storage, serum should be aliquoted in smaller volumes and stored at -70°C.
6. **Human IgM Positive Control**
Cat. No. 500118
One vial (30µl). Heat-inactivated positive serum containing 0.01% thimerosal. The WN IgM positive control will aid in monitoring the integrity of the kit as well. Stable at -70°C until the expiration date. Before use, quickly centrifuge the vials so that contents can be collected at the bottom.
Note: For long-term storage, serum should be further aliquoted in smaller volumes and stored at -70°C.
7. **10X Wash Buffer**
Cat. No. 500100

One bottle (120 ml). 10X concentrate of phosphate buffered saline with Tween 20, pH6.7-7.1. Stable 2-8°C until the expiration date.
Note: See Preparation of Reagents in Test procedure section to prepare 1X Wash Buffer.

8. **EnWash**
Cat. No. 500114
One bottle (20ml). Ready to use. Phosphate buffered saline with Tween 20, pH 7.2-7.6. Stable at 2-8°C until the expiration date.
9. **Enzyme Conjugate-HRP for IgM**
Cat. No. 500122
One bottle (6 ml). Ready to use. Contains 6B6C-1 mAb (to WN virus E protein antigen) conjugated with horseradish peroxidase in phosphate buffered saline (pH7.2-7.6) with Tween 20, preservative (0.01% thimerosal) and additives. Stable at 2-8°C until the expiration date.
10. **Liquid TMB Substrate**
Cat. No. 500140
One bottle (9ml). Ready to use. Contains 3,3',5,5'- tetramethylbenzidine (TMB) and hydrogen peroxide in a citric-acid citrate buffer (pH3.3-3.8). Stable at 2-8°C until the expiration date.
Note: The substrate should always be stored in the light-protected bottle provided.
11. **Stop Solution**
Cat. No. 500102
One bottle (6ml). Ready to use. 1N Sulfuric Acid. Used to stop the reaction. Stable at 2-8°C until the expiration date.
Caution: strong acid, wear protective gloves, mask and safety glasses. Dispose of all materials according to safety rules and regulations.

MATERIALS REQUIRED BUT NOT SUPPLIED

- ELISA Spectrophotometer
- Measurement at 450 nm
- Biological or High-Grade Water
- Vacuum Pump
- 37°C Humidified Incubator without CO₂ supply.
Note: Humidification can be achieved using a water tray at the bottom of incubator.
- Plate washer
- Polypropylene Tubes
- Multipipettors and tips
- Parafilm
- Timer
- Vortex

PRECAUTIONS

FOR *IN VITRO* DIAGNOSTIC USE

- ◆ All human source materials used in the preparation of controls have tested negative for antibodies to Human Immunodeficiency virus 1 & 2 (HIV 1&2), Hepatitis C (HCV) as well as Hepatitis B surface antigen. However no test method can ensure 100% efficiency, thus, all human controls and antigen should be handled as potentially infectious materials. The Center for Disease Control and the National Institute of Health recommend that potentially infectious agents be handled at the Biosafety Level 2.
- ◆ This test must be performed on serum only. The use of whole blood, plasma or other specimen matrix has not been established.
- ◆ Icteric or lipaemic sera, or sera exhibiting hemolysis or microbial growth must not be used.
- ◆ Do not heat inactivate sera.
- ◆ All reagents must be equilibrated to room temperature (20-25°C) before commencing the assay. The assay will be affected by temperature changes.
- ◆ Avoid repeated freezing and thawing cycles of the reagents supplied in the kit and of specimens.
- ◆ Dispense reagents directly from bottles using clean pipette tips. Transferring reagents may result in contamination.
- ◆ Unused microwells must be resealed immediately and stored in the presence of desiccant. Failure to do this may cause erroneous results.
- ◆ Substrate System:
 - (a) As TMB is susceptible to contamination from metal ions, do not allow the substrate system to come into contact with metal surfaces.
 - (b) Avoid prolonged exposure to direct light.
 - (c) Some detergents may interfere with the performance of the TMB.
 - (d) The TMB may have a faint blue color. This will not affect the activity of the substrate or the results of the assay.
- ◆ A thorough understanding of this package insert is necessary for successful use of the product. Reliable results will only be obtained by using precise laboratory techniques and accurately following the package insert.
- ◆ Do not mix lots of any kit component within an individual assay microtiter plate.
- ◆ Do not use any component beyond the expiration date shown on its label.
- ◆ Avoid exposure of the reagents to excessive heat or direct sunlight during storage and incubation.
- ◆ Some reagents may form a slight precipitate, mix gently before use.
- ◆ Incomplete washing will adversely affect the outcome and assay precision.
- ◆ To minimize potential assay drift due to variation in the substrate incubation time, care should be taken to add the stopping solution into the wells in the same order and speed used to add the TMB solution.
- ◆ Avoid microbial contamination of reagents, especially of the Ready to Use Enzyme Conjugate HRP. Avoid contamination of the TMB Substrate Solution with the Enzyme Conjugate-HRP.
- ◆ Wear protective clothing, eye protection and disposable gloves while performing the assay. Wash hands thoroughly afterwards.
- ◆ Do not eat, drink, smoke or apply cosmetics where immunodiagnostic materials are being handled.
- ◆ Do not pipette by mouth.
- ◆ Use a clean disposable pipette tip for each reagent, Standard, Control or specimen.
- ◆ Cover working area with disposable absorbent paper.

WARNING: POTENTIAL BIOHAZARDOUS MATERIAL

This kit contains reagents made with human serum or plasma. The serum or plasma used has been heat inactivated unless otherwise stated. Handle all sera and kits used as if they contain infectious agents. Observe established precautions against microbiological hazards while performing all procedures and follow the standard procedures for proper disposal of specimens.

CHEMICAL HAZARD:

Material Safety Data Sheets (MSDS) are available for all components of this kit. MSDS sheets are available through our website or it can be sent upon request. Review all appropriate MSDS before performing this assay. Avoid all contact between hands and eyes or mucous membranes during testing. If contact does occur, consult the applicable MSDS for appropriate treatment.

SPECIMEN COLLECTION AND PREPARATION

Blood obtained by venipuncture should be allowed to clot at room temperature (20-25°C) for 30 to 60 minutes and then centrifuged according to the National Committee for Clinical Laboratory Standards (NCCLS)⁷ (Approved Guideline – Procedures for the Handling and Processing of Blood Specimens; Second Edition. H18-A2 [ISBN 1-56238-388-4]).

- Only Human serum can be used with this assay. Whole blood or plasma cannot be used.
- Remove serum from the clot of red cells as soon as possible to avoid hemolysis.

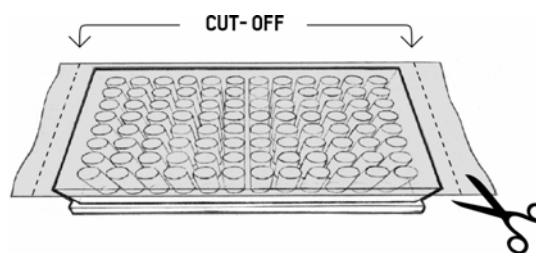
- Testing should be performed as soon as possible after collection. Do not leave sera at room temperature for prolonged periods.
- Serum should be used and the usual precautions for venipuncture should be observed. The samples may be stored at 2-8°C for up to 48 hours or frozen at -70°C or lower for up to 30 days. To maintain long-term longevity of the serum, store at -70°C. Avoid repeated freezing and thawing of samples.
- Do not use hemolyzed or lipemic samples.
- Frozen samples should be thawed to room temperature and mixed thoroughly by gentle swirling or inversion prior to use.
- If sera is shipped, pack in compliance with Federal Regulations covering transportation of infectious agents.

2. Mark the microtitration strips to be used.
3. Dilute test sera and the controls to 1/100 using the provided Sample Dilution Buffer for WN IgM (SD). (You may use small polypropylene tubes, multi-well untreated plastic strips, or plates for these dilutions and use at least 4 µL of unknown serum samples, positive, and negative controls. For example, 4 µL serum plus 396 µL of Sample Dilution Buffer for WN IgM to make 1/100 dilution.)
4. Apply the 50 µL/well of 1/100 diluted test sera, and controls to the plate by appropriate pipette. An exemplary arrangement for twenty-two test serum samples in duplicate is shown below.

Example for sera Application

	1	2	3	4	5	6	7	8	9	10	11	12
A	IgM Neg.	S#1	S#3	S#5	S#7	S#9	S#11	S#13	S#15	S#17	S#19	S#21
B	IgM Neg.	S#1	S#3	S#5	S#7	S#9	S#11	S#13	S#15	S#17	S#19	S#21
C	IgM Pos.	S#2	S#4	S#6	S#8	S#10	S#12	S#14	S#16	S#18	S#20	S#22
D	IgM Pos.	S#2	S#4	S#6	S#8	S#10	S#12	S#14	S#16	S#18	S#20	S#22
E	IgM Pos.	S#2	S#4	S#6	S#8	S#10	S#12	S#14	S#16	S#18	S#20	S#22
F	IgM Pos.	S#2	S#4	S#6	S#8	S#10	S#12	S#14	S#16	S#18	S#20	S#22
G	IgM Neg.	S#1	S#3	S#5	S#7	S#9	S#11	S#13	S#15	S#17	S#19	S#21
H	IgM Neg.	S#1	S#3	S#5	S#7	S#9	S#11	S#13	S#15	S#17	S#19	S#21

5. Cover the plate with parafilm or plate cover just on the well opening surface so the bottom of the plate is not covered.



Note: This is to make sure the temperature distribution is evenly spread out in all wells from bottom and sides; once the top is sealed to block evaporation, any extra parafilm should be cut off.

TEST PROCEDURE

CAUTION: The test procedure must be adhered to. Any deviations from the procedure may produce erroneous results. Bring all kit reagents and specimens **to room temperature (20-25°C) before use**. Thoroughly mix the reagents and samples before use by gentle inversion.

Note: For long-term storage, all serum, including the experimental, cannot be repeatedly thawed and frozen. Sera should be further aliquoted in a smaller volume and stored at -70°C.

Preparation of Reagents:

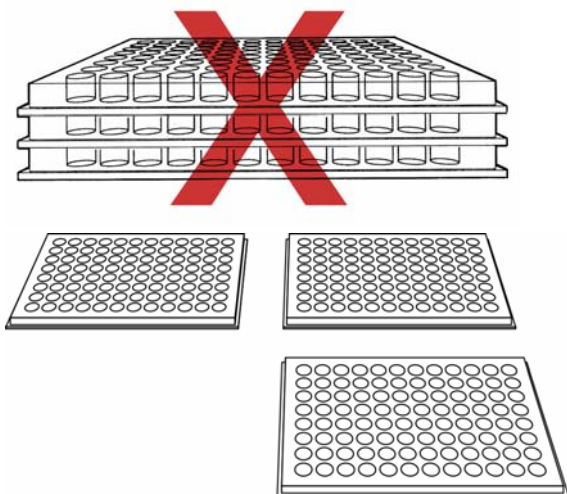
- Preparation of 1X Wash Buffer
Dilute the 10X Wash Buffer to 1X using Biological or High-Grade Water. The bottle contains 120ml of 10X Wash Buffer. Mix 120ml of 10X Wash Buffer with 1080 ml of biological or High-Grade Water to make 1X Wash Buffer. After diluting to 1X, store at room temperature for a maximum of four months.
Note: Discard the 1X Wash Buffer if you see any microbial growth.
- Microtitration Wells
Select the number of coated wells required for the assay. The remaining unused wells should be covered and immediately returned to the foil pouch with desiccant on top of the plate, resealed and stored at 2-8°C until ready to use or expiration.

Assay Procedure:

1. Positive, negative, and unknown serum to be tested should be assayed in duplicate. Refer to flow chart at the end of this section for illustration of this procedure. Twenty-two test specimens can be tested on one 96 well plate

6. Incubate the plate at 37°C for 1 hour in a humidified incubator. Humidification can be achieved using a water tray at the bottom of incubator.

Note: Do not stack plates on top of each other. They should be spread out as a single layer. This is very important for even temperature distribution. Do not use CO₂, or any other gases used for tissue culture work.



CORRECT METHOD

7. After the incubation, wash the plate 6 times with automatic plate washer using 1X Wash buffer. Use 300µl /well in each wash cycle.

8. Add 50µl per well of WNRA into row A-D and 50µl /well of NCA into row E-H by multi-pipette. An exemplary application for WNRA and NCA is shown below.

Example for WN Antigens Application												
	1	2	3	4	5	6	7	8	9	10	11	12
A	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA
B	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA
C	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA
D	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA	WN NRA
E	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA
F	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA
G	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA
H	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA	NCA

9. Cover the plate with parafilm just on the well opening surface, so the bottom of the plate is not

covered. (as described in step 5)

10. Incubate the plate at 37°C for 1 hour in a humidified incubator. (as described in step 6)

11. After the incubation, wash the plate 6 times with automatic plate washer using 1X Wash buffer. Use 300µl /well in each wash cycle.

12. Add 50µl /well of ready to use Enzyme-HRP conjugate into all wells by multi-pipetter.

13. Cover the plate with parafilm just on the well opening surface, so the bottom of the plate is not covered. (as described in step 5)

14. Incubate the plate at 37°C for 1 hour in a humidified incubator (as described in step 6)

15. After the incubation, wash the plate 6 times with automatic plate washer using 1X wash buffer. Use 300µl /well in each wash cycle.

16. Add 150µl /well of EnWash into all wells by a multi-channel pipette.

17. Incubate the plate at room temperature (20-25⁰ C) for 5 minutes. Do not cover the plate.

18. Wash the plate 6 times with automatic plate washer using 1X wash buffer. Use 300µl /well in each wash cycle.

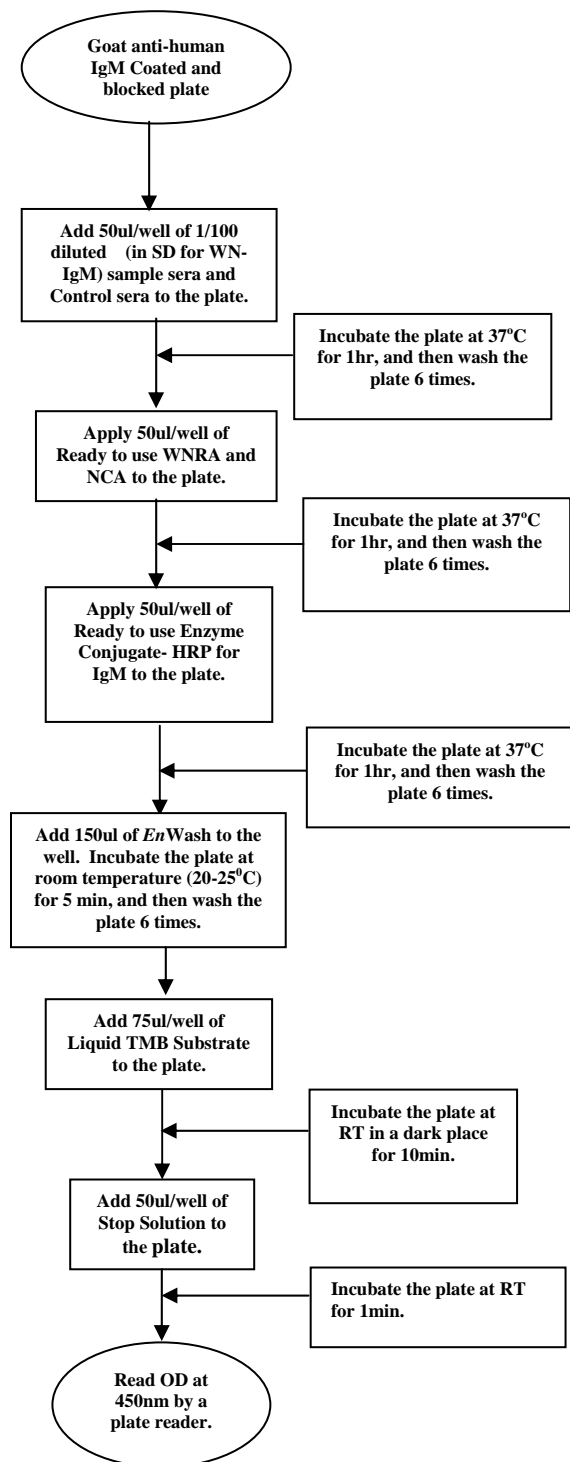
19. Add 75µl /well of Liquid TMB substrate into all wells by multi-channel pipetter.

20. Place and incubate the plate at room temperature (20-25⁰ C) in a dark place (or container) for 10 minutes without any cover on the plate.

21. After the incubation, add 50µl per well of Stop Solution into all wells by multi-channel pipetter and incubate at room temperature (20-25⁰ C) for 1 minute. Do not cover the plate.

22. After the incubation, read the OD 450 value with a Microplate reader.

West Nile Detect™ IgM Capture ELISA Flow Chart



QUALITY CONTROL

Each kit contains positive and negative control sera. Acceptable Immune Status Ratio (ISR) values for these controls are found on the specification table below. The negative and positive controls are intended to monitor for substantial reagent failure. The positive control will not ensure precision at the assay cutoff. The test is invalid and must be repeated if the ISR value of either of the controls

do not meet the specifications. If the test is invalid, patient results cannot be reported. Quality control requirements must be performed in conformance with local, state, and/or federal regulations or accreditation requirements and your laboratory's standard Quality Control procedures. It is recommended that the user refer to NCCLS C24-A and 42 CFR 493.1256 for guidance on appropriate QC practices. The results below are given strictly for guidance purposes only and are applicable solely for spectrophotometric readings.

Calculation of the Negative Control: Calculate the mean Negative Control values with WNRA and with the Control antigen:

Example: Negative Control (NC)

	OD	
	WNRA	NCA
No 1	0.085	0.076
No 2	0.075	0.060
Total	0.160	0.136

Averages (WNRA) = $0.160 \div 2 = 0.080$

(NCA) = $0.136 \div 2 = 0.068$

Compute the WNRA/NCA ratio: $0.080 \div 0.068 = 1.18$

Any Negative Control WNRA/NCA ratio greater than 4.47 indicates that the test is invalid and the assay must be repeated.

Calculation of the Positive Control: Calculate Positive Control values with WNRA and with the NCA.

Example: Positive Control (PC)

	OD	
	WNRA	NCA
No 1	0.935	0.090
No 2	0.955	0.078
Total	1.890	0.168

Averages (WNRA) = $1.890 \div 2 = 0.945$

(NCA) = $0.168 \div 2 = 0.084$

Calculate the WNRA/NCA ratio: $0.945 \div 0.084 = 11.3$

Any Positive Control WNRA/NCA ratio less than 5.66 indicates that the test is invalid and the assay must be repeated.

The results in the table below must be obtained in order that the results of the run may be reported. Non-fulfillment of these criteria is an indication of deterioration of reagents or an error in the test procedure and the assay must be repeated.

Factor	Tolerance
Mean Negative Control (NC) OD in WNRA	< 0.300
Mean Positive Control (PC) OD in	> 0.500

WNRA	
PC Immune Status Ratio (ISR)	> 5.66
NC Immune Status Ratio (ISR)	< 4.47

CALCULATIONS

Calculation of the Immune Status Ratio (ISR):

Compute the average of the two negative control replicates with the WNRA, the two negative control replicates with the NCA, and then calculate the WNRA/NCA ratio (ISR). Likewise, compute the averages of the two positive control replicates and the two sample replicates with the two antigens and the corresponding ISR. The ISR for the positive control must be greater than 5.66, while the ISR for the negative control must be less than 4.47.

Calculation of the ISR values for the test sera:

Calculate the mean serum ISR values:

Example: Test Serum #1

	OD	
	WNRA	NCA
No. 1	0.195	0.066
No. 2	0.205	0.070
Total	0.400	0.136

Averages (WNRA) = $0.400 / 2 = 0.200$ (NCA) = $0.136 / 2 = 0.068$

Compute the WNRA/NCA ratio: $0.200 / 0.068 = 2.94$

Any serum WNRA/NCA ratio less than 4.47 indicates no detectable IgM antibody is present. See interpretation of results section.

Example: Test Serum #2

	OD	
	WNRA	NCA
No. 1	0.695	0.085
No. 2	0.725	0.100
Total	1.420	0.185

Averages (WNRA) = $1.42 / 2 = 0.71$ (NCA) = $0.185 / 2 = 0.0925$

Compute the WNRA/NCA ratio: $0.710 / 0.0925 = 7.68$

Any serum WNRA/NCA ratio greater than 5.66 indicates presence of detectable WN IgM antibody. See interpretation of results section.

Example: Test Serum #3

	OD	
	WNRA	NCA
No. 1	0.310	0.065
No. 2	0.295	0.070
Total	0.605	0.135

Averages (WNRA) = $0.605 / 2 = 0.3025$ (NCA) = $0.135 / 2 = 0.0675$

Compute the WNRA/NCA ratio: $0.3025 / 0.0675 = 4.48$

Any serum WNRA/NCA ratio greater than 4.47 but less than 5.66 is an equivocal result and no conclusion can be made. See interpretation of results section.

Selection of the Cut-off: The cut-off was selected using sera from an endemic population in the United States. The 282 samples consisted of 163 positive samples and 119 negative samples characterized by the CDC IgM Antibody Capture ELISA. The cut-off was determined by two-graph receiver operating characteristic analysis (TG-ROC).

Interpretation of Results: The West Nile Detect IgM Capture ELISA determines the presence of IgM antibodies to WN virus in serum of patients with clinical symptoms of meningoencephalitis. A positive result is indicative of presumptive WNV meningoencephalitis. The table below shows how the results should be interpreted.

ISR	Result	Interpretation
<4.47	Negative	No detectable IgM antibody, individual does not appear to be infected with WN virus. The result does not rule out WN virus infection. An additional sample should be tested within 7-14 days if early infection is suspected. Other WN virus assays should be performed to rule out acute infection. Refer to the current CDC guidelines for diagnosis of this disease ¹⁰ .
4.47-5.66	Equivocal	Equivocal samples should be repeated in duplicate. If both duplicates are above or below the cut-off the specimens may be reported as positive or negative respectively. Samples that remain equivocal after repeat testing should be reported, that WN virus IgM antibody cannot be determined, and repeated by an alternative method or another sample should be collected.
>5.66	Positive	Presence of detectable IgM antibody, presumptive infection with WN virus. The result must be confirmed by plaque reduction neutralization test (PRNT), or alternatively, consult the current CDC guidelines for diagnosis of this disease ¹⁰ . A positive IgM result may not indicate a recent infection. IgM antibodies to WN virus have been shown to persist for more than 500 days ⁶ . Serological cross-reactivity across the flavivirus group is common (i.e. between Saint Louis encephalitis; dengue serotypes 1, 2, 3 and 4; Murray Valley encephalitis; Japanese encephalitis; and yellow fever viruses). Additionally, cross-reactivity has been noted with some West Nile virus assays to enteroviruses. Reactive results reported for children must contain a caution statement

	regarding possible cross-reactivity with enterovirus. These diseases must be excluded before confirmation of diagnosis.
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The following is a recommended method for reporting the results obtained: “The following results were obtained with the InBios West Nile Detect IgM Capture ELISA. Values obtained with other assays may not be used interchangeably. The magnitude of the measured result, above the cut-off, is not indicative of the total amount of antibody present.” The result should be reported as positive, negative or equivocal, and not as a numeric value. The reported results should contain an appropriate interpretation.

EXPECTED VALUES

West Nile virus infection is generally recognized by the presence of IgM antibodies within one week from the beginning of symptoms. Detectable levels of IgM may be low in early infection. Two hundred samples were prospectively collected from Florida, Texas and Pennsylvania during March 2004. The distribution of females was 50% (100/200) and males were 50% (100/200). The data in Table 1 illustrates the prevalence of IgM antibodies in different age groups when using the West Nile Detect IgM Capture ELISA Test.

Of the 200 normal sera, one was positive and one was equivocal. The latter specimen was repeated in duplicate and remained equivocal on the West Nile Detect IgM Capture ELISA Test. The positive and equivocal sera were from Pennsylvania. Of the 200 sera, 66 were from Pennsylvania, resulting in a 3.0% prevalence (2/66) in Pennsylvania.

Table 1

Age	Total	Equivocal	Positive	Prevalence
10-70	12	0	0	0.0%
21-30	68	1	0	1.5%
31-40	63	0	0	0.0%
41-50	47	0	1	2.1%
51-60	10	0	0	0.0%
Total	200	1	1	1.0%

LIMITATIONS

- All positive WN IgM Capture ELISA test results are presumptive and require confirmation by Plaque Reduction Neutralization Test or by using the latest CDC guideline for diagnosis of this disease.
- Testing should only be performed on patients with clinical symptoms of meningoencephalitis. This test is not intended for screening the general population. The positive predictive value depends on the likelihood of the virus being present.
- Serological cross-reactivity across the flavivirus group is common (i.e. between St. Louis encephalitis, Eastern Equine, Dengue 1, 2, 3, and 4; Murray Valley

encephalitis, Japanese encephalitis and yellow fever viruses). These diseases must be excluded before confirmation of diagnosis.

- IgM antibodies may persist for more than 500 days in up to 60% of cases. Positive results should be interpreted in the context of clinical and other laboratory findings and may not indicate active West Nile virus induced disease.
- Assay results should be interpreted only in the context of other laboratory findings and the total clinical status of the patient.
- The reagents supplied in this kit are optimized to measure WNRA reactive antibody levels in serum.
- The assay performance characteristics have not been established for visual result determination.
- Results from immunosuppressed patients must be interpreted with caution.
- Generally primary responders exhibit mainly monotypic antibody responses, However, during successive infections the antibody response broadens to include heterotypic reactivity to other flaviviruses in the same or different antigenic groups ⁵.

PERFORMANCE CHARACTERISTICS

Clinical Sensitivity and Specificity:

Table 1 – Study Site 1

A clinical laboratory located in the mid-western U.S. tested 50 retrospective samples with clinically and laboratory confirmed cases of WNV (n=50) or undetermined flavivirus (positive for both WNV and SLE; n=2). The samples were suspected to have come from patients that had exhibited signs or symptoms of WN but specific clinical information could not be confirmed. In addition, 125 retrospective sequential endemic samples were tested. The sera were sequentially submitted to the laboratory, archived, and masked. Two were confirmed with undetermined flavivirus or WNV by PRNT.

Clinical Category	Positive	Negative	Equivocal	Total
PRNT Positive	50	2	0	52
Negative	1	121	1	123
Total	51	123	1	175

WN Virus Positive:

Serological Sensitivity = $50/52 = 96.2\%$ 95%
Confidence Interval: 87.0 – 98.9%

WN Virus Negative:

Serological Specificity = $121/123 = 98.4\%$ 95%
Confidence Interval: 94.3 - 99.6%

Table 2 – Study Site 2

A State Department of Health laboratory located in Midwestern U.S. tested 88 retrospective samples clinically and laboratory confirmed cases of WNV and/or SLE and confirmed by PRNT. Seven patient samples were suspected of having either viral encephalitis or viral meningitis. The remaining patient samples had signs or symptoms of WN fever and headache. In addition, 130 retrospective, sequential endemic samples were tested. The sera were sequentially submitted to the laboratory, archived, and masked. Fourteen (14) were confirmed with SLE and/or WNV by PRNT.

Clinical Category	Positive	Negative	Equivocal	Total
PRNT Positive	99	2	1	102
Negative	1	115	0	116
Total	100	117	1	218

Footnote: Some of these specimens may have been previously tested for WNV antibodies before being sent to this laboratory for confirmation by PRNT. The possible bias effect on the performance of this assay is unknown."

WN Virus Positive:

Clinical Sensitivity = $99/102 = 97.1\%$ 95%

Confidence Interval: 91.7 – 99.0%

WN Virus Negative:

Clinical Specificity = $115/116 = 99.1\%$ 95%

Confidence Interval: 95.3 - 99.9%

Table 3 – Study Site 3

A State Department of Health laboratory located in Southeastern U.S. tested 150 retrospective samples clinically and laboratory confirmed cases of WNV by PRNT. In addition, 150 retrospective, sequential endemic samples were tested. The sera were sequentially submitted to the laboratory, archived, and masked. Twenty-three (23) were confirmed with SLE and/or WNV by CDC ELISA.

Clinical Category	Positive	Negative	Equivocal	Total
PRNT Positive	172	1	0	173
Negative	0	127	0	127
Total	172	128	0	300

WN Virus Positive:

Serological Sensitivity = $172/173 = 99.4\%$ 95%

Confidence Interval: 96.8 – 99.9%

WN Virus Negative:

Serological Specificity = $127/127 = 100.0\%$ 95%

Confidence Interval: 97.1 - 100%

Table 4 - Study Site 4

A State Department of Health laboratory located in Northeastern U.S. tested 210 retrospective, sequential endemic samples with the West Nile Detect IgM Capture

ELISA and with the CDC MAC ELISA. The sera were sequentially submitted to the laboratory, archived, and masked. None of the samples gave a positive result with both tests.

Clinical Category	Positive	Negative	Equivocal	Total
CDC MAC ELISA Positive	0	0	0	0
Negative	0	210	0	210
Total	0	210	0	210

Negative Presumptive Agreement

$210/210 = 100.0\%$

95% Confidence Interval: 98.2

– 100.0%

Freeze Thaw Study: Eight serum samples were exposed to five freeze-thaw cycles and assayed for IgM antibodies to West Nile recombinant antigen after each cycle. All five serum samples that were positive in the untreated version of the assay were positive after all five freeze-thaw cycles. One sample that was negative but close to being equivocal in the beginning became equivocal at cycles 1, 3, 4 and 5, but not at cycle 2. It is recommended that serum samples for use in the West Nile Detect IgM Capture ELISA Test not be frozen and thawed for more than five times.

IgM Specificity Study: Thirteen serum samples, including a positive and a negative control, were treated with dithiothreitol and assayed for IgM antibodies to West Nile recombinant antigen. All nine WNV infected serum samples that were positive in the untreated version of the assay were negative in the dithiothreitol treated version. No substantial effect was seen in the IgG assay. This study indicates that the West Nile Detect IgM Capture ELISA assay is specific for IgM.

Interference Study

Four potentially interfering substances commonly occurring in serum were tested for their effect on the West Nile Detect IgM Capture ELISA test. Pools of two West Nile positive sera and one West Nile negative serum were used. The four potentially interfering substances were Bilirubin (1& 2 mg/dL), Triglycerides (500 and 3000 mg/dL), Hemoglobin (1600 and 16,000 mg/dL) and Cholesterol (300 and 500 mg/dL). The results of this study indicate that West Nile low positive results with high levels of triglycerides may increase ISR values of WNRA reactive sera. The other interfering substances did not exhibit a deleterious effect on the sensitivity and specificity of the assay.

Reproducibility Study:

The reproducibility of the West Nile Detect IgM Capture ELISA was evaluated at three sites. One site was InBios International. Ten serum specimens using clinical specimens diluted into an analyte-negative matrix was used. The ten serum specimens (not including positive

and negative controls) included specimens that were below the cutoff values (negative samples) and above the cutoff value (positive and weak positive or borderline samples). The serum dilutions selected also ensured that the analyte concentration in the specimens represented a clinically relevant range. The results were analyzed by an outside statistician and are shown in the table below.

Reproducibility Results from three sites after deleting 2 outlying data points from Site #3

Sample ID	n	Mean	Intra-Assay		Between Day		Between Lab		Total	
			*S.D.	%CV	*S.D.	%CV	*S.D.	%CV	*S.D.	%CV
1	27	1.18	0.07	5.8%	0.14	11.4%	0.29	24.5%	0.33	27.6%
2	27	9.39	1.04	11.0%	3.10	33.1%	1.46	15.5%	3.58	38.2%
3	27	17.98	1.50	8.3%	4.00	22.2%	4.18	23.3%	5.98	33.2%
4	27	6.48	1.04	16.1%	1.98	30.5%	2.47	38.2%	3.33	51.4%
5	26	21.07	2.54	12.0%	5.53	26.3%	7.56	35.9%	9.70	46.1%
6	27	7.92	0.74	9.4%	2.33	29.5%	3.46	43.7%	4.24	53.5%
7	26	12.75	1.46	11.4%	2.21	17.3%	3.85	30.2%	4.67	36.6%
8	27	5.94	0.64	10.8%	1.62	27.3%	1.87	31.5%	2.56	43.1%
9	27	24.81	2.53	10.2%	8.86	35.7%	4.23	17.0%	10.14	40.9%
10	27	1.14	0.07	5.8%	0.04	3.2%	0.16	14.3%	0.18	15.8%

All values are calculated as WNRA/NCA ratios

SD = Standard Deviation; %CV = % Coefficient of Variation

26*: 1 statistically outlying (>5.5 x Standard Deviation of previous run) data point was removed.

Cross reactivity Study:


Two hundred and seventy-one sera that tested positive for other potentially cross-reactive pathogens were tested with the West Nile Detect IgM Capture ELISA test to determine the potential for cross-reactivity. The table below summarizes the results of this study.

Disease	Number of Samples	West Nile Detect IgM ELISA		Total of Positive and Equivocal
		Equivocal	Positive	
Eastern Equine encephalitis	17	0	0	0/17
Japanese encephalitis	2	0	0	0/2
Saint Louis encephalitis	32	1	16	17/32
La Crosse Virus	6	0	0	0/6
Dengue virus	7	0	2	2/7
Epstein-Barr virus	15	0	0	0/15
Hepatitis A virus	10	0	0	0/10
Hepatitis B virus	49	0	0	0/42
Hepatitis C virus	30	0	0	0/20
Herpes simplex virus	32	0	0	0/32
California Encephalitis (CE)	1	0	0	0/1
HIV	20	0	0	0/20
Syphilis	5	0	0	0/5


Disease	Number of Samples	West Nile Detect IgM ELISA		Total of Positive and Equivocal
		Equivocal	Positive	
Cytomegalovirus	12	0	0	0/12
Varicella zoster virus	10	0	0	0/10
Coxsackievirus B 1-6	1	0	0	0/1
Echovirus 16	1	0	0	0/1
Measles	1	0	0	0/1
Mumps	1	0	0	0/1
Polio Blend	1	0	0	0/1
Legionaries' disease	3	0	0	0/3
Rheumatoid factor	5	0	0	0/5
Anti-nuclear antibody	10	0	0	0/10
Total	271	1	18	19/271

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