 **MMRV IgG Plus Test System**

**Rx Only**

**IVD**

**REF**

**A93101G**

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| Institute Name | Date |
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**PRINCIPLE OF THE ASSAY**

The ZEUS **AtheNA Multi-Lyte** MMRV IgG Plus Test System is designed to detect IgG class antibodies in human sera to Measles (Rubeola), Mumps, Rubella and VZV. The test procedure involves two incubation steps:

1. Test sera (properly diluted) are incubated in a vessel containing a multiplexed mixture Bead Suspension. The Bead Suspension contains a mixture of distinguishable sets of polystyrene microspheres (beads); in this case, there are four primary bead sets, Measles, Mumps, Rubella and VZV. If present in patient sera, specific antibodies will bind to the immobilized antigen on one or more of the bead sets. The beads are rinsed to remove non-reactive serum proteins.
2. Phycoerythrin-conjugated goat anti-human IgG is added to the vessel and the plate is incubated. The Conjugate will react with IgG antibody immobilized on the solid phase in step 1. The Bead Suspension is then analyzed by the **AtheNA Multi-Lyte** instrument. The bead set(s) are sorted (identified) and the amount of reporter molecule (PE conjugate) is determined for each bead set. Using the *Intra-Well* *Calibration Technology*®, internal calibration bead sets are used to convert raw fluorescence into outcome (units).

**TEST SYSTEM COMPONENTS**

**Materials Provided:**

Each Test System contains the following components in sufficient quantities to perform the number of tests indicated on the packaging label. **NOTE: The following components contain Sodium Azide as a preservative at a concentration of <0.1% (w/v): Bead Suspension, Controls, Conjugate and SAVe Diluent®.**

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| **SOLN** | **BEAD** | | 1. | Bead Suspension: Contains separate distinguishable 5.6 micron polystyrene beads that are conjugated with Rubeola antigen (partially purified Edmonston strain from vero cells), Mumps antigen (partially purified Enders strain from LLC-MK2 cells), Rubella antigen (partially purified HPV-77 strain from vero cells), and VZV antigen (partially purified Ellen strain from human fibroblasts). The Bead Suspension also contains one bead set designed to detect non-specific antibodies in the patient sample (if present) and four separate bead sets used for assay calibration. One, amber bottle containing 5.5mL. Ready to use. |
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| **CONJ** | | | 2. | Conjugate: Phycoerythrin conjugated goat anti-human IgG (γ chain specific). One, amber bottle containing 15mL. Ready to use. |
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| **CONTROL** | | **+** | 3. | Positive Control (Human Serum): One, red-capped vial containing 0.2mL. |
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| **CONTROL** | | **-** | 4. | Negative Control (Human Serum): One, green-capped vial containing 0.2mL.. |
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| **DIL** | | **SPE** | 5. | SAVe Diluent®: One, green-capped bottle containing 50mL of phosphate-buffered-saline. Ready to use. **NOTE: The SAVe Diluent**® **will change color when combined with serum.** |
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| **WASHBUF** | | **10X** | 6. | Wash Buffer Concentrate (10X): Dilute 1 part concentrate + 9 parts deionized or distilled water. One, clear-capped bottle containing containing 50mL of 10X concentrated phosphate-buffered-saline. |

**NOTES:**

1. **The following components are not Test System Lot Number dependent and may be used interchangeably with the ZEUS AtheNA Multi-Lyte Test Systems: Wash Buffer and SAVe Diluent®**
2. **Test System also contains:**
   1. **Component Label containing lot specific information inside the Test System box.**
   2. **Calibration CD containing lot specific kit calibration values required for specimen analysis and assay quality control, and Package Inserts.**
   3. **One 96-well dilution plate**.
   4. **One 96-well filter plate.**

**PRECAUTIONS**

1. For *In Vitro* diagnostic use.
2. Follow normal precautions exercised in handling laboratory reagents. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable protective clothing, gloves, and eye/face protection. Do not breathe vapor. Dispose of waste observing all local, state, and federal laws.
3. The **AtheNA Multi-Lyte** Bead Suspension does not contain viable organisms. However, the reagent should be considered **potentially biohazardous materials** and handled accordingly.
4. The Controls are **potentially biohazardous materials**. Source materials from which these products were derived were found negative for HIV-1 antigen, HBsAg and for antibodies against HCV and HIV by approved test methods. However, since no test method can offer complete assurance that infectious agents are absent, handle these products at the Biosafety Level 2 as recommended for any potentially infectious human serum or blood specimen in the Centers for Disease Control/National Institutes of Health manual “Biosafety in Microbiological and Biomedical Laboratories”: Current Edition; and OSHA’s Standard for Bloodborne Pathogens (28, 29).
5. Adherence to the specified time and temperature of incubations is essential for accurate results. **All reagents must be allowed to reach room temperature (20 - 25°C) before starting the assay**. Return unused reagents to refrigerated temperature immediately after use.
6. Improper washing could cause false positive or false negative results. Be sure to minimize the amount of any residual wash solution; (e.g., by blotting or aspiration) before adding Conjugate. Do not allow the wells to dry out between incubations.
7. The SAVe Diluent®, Bead Suspension, Controls, and Conjugate contain Sodium Azide at a concentration of <0.1% (w/v). Sodium Azide has been reported to form lead or copper azides in laboratory plumbing which may cause explosions on hammering. To prevent, rinse sink thoroughly with water after disposing of solution containing Sodium Azide.
8. The Wash Buffer concentrate is an IRRITANT. It is irritating to eyes, respiratory system and skin.
9. Dilution or adulteration of these reagents may generate erroneous results.
10. Do not use reagents from other sources or manufacturers.
11. Never pipette by mouth. Avoid contact of reagents and patient specimens with skin and mucous membranes.
12. Avoid microbial contamination of reagents. Incorrect results may occur.
13. Cross contamination of reagents and/or samples could cause erroneous results.
14. Avoid splashing or generation of aerosols.
15. Do not expose reagents to strong light during storage or incubation. The Bead Suspension and Conjugate are light sensitive reagents. Both have been packaged in light protective containers. Normal exposures experienced during the course of performing the assay will not affect assay performance. Do not expose these reagents to strong sources of visible light unnecessarily.
16. Collect the wash solution in a disposal basin. Treat the waste solution with disinfectant (i.e.: 10% household bleach - 0.5% Sodium Hypochlorite). Avoid exposure of reagents to bleach fumes.
17. Caution: Neutralize any liquid waste at an acidic pH before adding to a bleach solution.
18. Do not allow the Conjugate to come in contact with containers or instruments that may have previously contained a solution utilizing Sodium Azide as a preservative. Residual amounts of Sodium Azide may destroy the Conjugate’s enzymatic activity.
19. Do not expose any of the reactive reagents to bleach-containing solutions or to any strong odors from bleach-containing solutions. Trace amounts of bleach (sodium hypochlorite) may destroy the biological activity of many of the reactive reagents within this Test System.

**MATERIALS REQUIRED BUT NOT PROVIDED**

1. Pipettes capable of accurately delivering 10 - 200µL.
2. Multichannel pipette capable of accurately delivering 10 - 200µL.
3. Reagent reservoirs for multichannel pipettes.
4. Serological pipettes.
5. Disposable pipette tips.
6. Paper towels.
7. Laboratory timer to monitor incubation steps.
8. Disposal basin and disinfectant (i.e.: 10% household bleach - 0.5% Sodium Hypochlorite).
9. **AtheNA Multi-Lyte** System (Luminex® Instrument) with Sheath Fluid (Product Number 40-50035).
10. Distilled or deionized water.
11. Vortex.
12. Small Bath Sonicator.
13. Plate shaker capable of shaking at 800 RPM (optional for mixing).
14. Vacuum aspirator and vacuum manifold for washing the microspheres.

**STORAGE CONDITIONS**

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| storage2-8.bmp | Bead Suspension: Remove only the required amount to analyze the specimens to be tested and return the unused portion to storage. |
| Conjugate: DO NOT FREEZE. |
| Unopened Test System, Positive Control, Negative Control, SAVe Diluent® |
| storage2-25.bmp | Wash Buffer (1X): 20 - 25°C for up to 7 days, 2 - 8°C for 30 days.  Wash Buffer (10X): 2 - 25°C |

**SPECIMEN COLLECTION**

1. ZEUS Scientific recommends that the user carry out specimen collection in accordance with CLSI document M29: Protection of Laboratory Workers from Infectious Disease (Current Edition).
2. No known test method can offer complete assurance that human blood samples will not transmit infection. Therefore, consider all blood derivatives potentially infectious.
3. Use only freshly drawn and properly refrigerated sera obtained by approved aseptic venipuncture procedures in this assay. Do not use if there are any added anticoagulants or preservatives. Avoid using hemolyzed, lipemic, or bacterially contaminated sera.
4. Store sample at room temperature for no longer than 8 hours. If testing is not performed within 8 hours, sera may be stored between 2 - 8°C, for no longer than 48 hours. If a delay in testing is anticipated, store test sera at –20°C or lower. Avoid multiple freeze/thaw cycles which may cause loss of antibody activity and give erroneous results. It is the responsibility of the individual laboratory to use all available references and/or its own studies to determine stability criteria for its laboratory (33).

**ASSAY PROCEDURE**

1. Remove the individual components from storage and allow them to warm to room temperature (20 - 25°C).
2. Determine the total number of Controls and samples to be tested. It is necessary to include the Negative and Positive Control with each run. The Negative Control should be tested in well A1 and Positive Control in well B1. Each Control and sample requires one microwell for processing.
   1. To optimize read times, the Bead Suspension must be thoroughly mixed just prior to use. The most effective for re-suspension is to first vortex for approximately 30 seconds followed by sonication for approximately 30 seconds in a small bath sonicator.
   2. For proper performance, it is important that the contents of the assay are thoroughly mixed. Suitable means of mixing include mixing the plate on a plate shaker for approximately 30 seconds at approximately 800 RPMs or to set a pipettor to roughly ½ of the volume in the plate and repeatedly aspirate and expel (pump up and down) the contents of the well for a minimum of 5 cycles.

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| **EXAMPLE PLATE SET-UP** | | |
|  | 1 | 2 |
| A | Negative Control | Etc. |
| B | Positive Control |  |
| C | Patient 1 |  |
| D | Patient 2 |  |
| E | Patient 3 |  |
| F | Patient 4 |  |
| G | Patient 5 |  |
| H | Patient 6 |  |

1. Prepare a 1:21 dilution (e.g.: 10µL of serum + 200µL of SAVe Diluent®) of the Negative Control, Positive Control, and each patient serum. **NOTE: The SAVe Diluent® will undergo a color change confirming that the specimen has been combined with the diluent.** For proper performance, it is important that the sample dilutions are thoroughly mixed according to 2b above.
2. After determining the total number of wells to process, use a multichannel or a repeating pipette to dispense 50µL of the Bead Suspension into each of the wells of the filtration plate.
3. Transfer 10μL of each diluted sample (1:21) and Control from the dilution plate to the filtration plate. For proper performance, it is important that the sample dilution and Bead Suspension are thoroughly mixed according to 2b above.
4. Incubate the plate at room temperature (20 - 25°C) for 30 ± 10 minutes.
5. After the incubation, rinse the Beads by vacuum filtration using the supplied Wash Buffer diluted to the 1X concentration.
6. Place the filtration plate on the vacuum manifold and remove the solution, leaving the beads behind.
7. Turn off the vacuum and add 200µL of 1X Wash Buffer.
8. Apply the vacuum and remove the solution.
9. Repeat steps 7b and 7c for a total of three rinses.
10. Following the final wash, gently blot the bottom of the filter plate and allow the plate to air dry for 3 - 5 minutes before proceeding to the next step.
11. Add 150µL of the Conjugate to each well, at the same rate and same order as the specimens. For proper performance, it is important that the Conjugate and Bead Suspension are thoroughly mixed according to 2b above. As an option, while mixing the Conjugate one may transfer the mixture to empty wells of a polystyrene reaction plate.
12. Incubate the plate at room temperature (20 - 25°C) for 30 ± 10 minutes.
13. Set the **AtheNA Multi-Lyte** instrument to analyze the reactions by selecting the MMRV IgG Plus template. Refer to the operators manual for details regarding the operation of the **AtheNA Multi-Lyte** instrument. Results may be read from the filter plate or a reaction plate. **NOTE: For proper specimen analysis, it is important that the instrument is set-up, calibrated and maintained according to the manufacturer’s instructions.** Please review the instrument manual for instrument preparation prior to reading the assay results.
14. The plate should be read within 60 minutes after the completion of the Conjugate incubation. One may decide to shake the plate for approximately 15 seconds prior to reading. This optional step may reduce the amount of time required to read the plate.

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| Step | **Abbreviated Assay Procedure** |
| 1 | Dilute specimens 1:21 in SAVe Diluent®. Mix well. |
| 2 | Combine 50µL of Bead Suspension and 10µL of diluted specimen in an empty well. Mix well. |
| 3 | Incubate at room temperature for 30 ± 10 minutes. |
| 4 | Rinse the microspheres 3 times with 200µL of 1X Wash Buffer. |
| 5 | Gently blot the bottom of the plate and air dry for 3 - 5 minutes. |
| 6 | Add 150µL of Conjugate to each well. Mix well. |
| 7 | Transfer to a reaction plate (optional). |
| 8 | Incubate at room temperature for 30 ± 10 minutes |
| 9 | Shake plate (optional). |
| 10 | Read results within 60 minutes. |

**QUALITY CONTROL**

1. Each time the assay is run it is necessary to include the Negative Control (in well A1) and the Positive Control (in well B1).
2. Run validity is determined through the performance of the Positive and Negative Controls. These criteria are analyzed automatically through *Intra-Well Calibration Technology*.
   1. The Negative and Positive Controls must all be negative on the non-specific or control antigen bead.
   2. The Negative Control must be negative for each and every analyte included in the Bead Suspension.
   3. ThePositive Control must be positive for all three analytes included in the Bead Suspension. These ranges are lot specific and are encoded within the Calibration CD. PC ranges may be viewed by clicking on the “Control Graphs” button of the **AtheNA Multi-Lyte** software and then clicking “Control Upper/Lower Limits”.
   4. If any of the above criteria are not met, the entire run will be considered invalid and should be repeated. **Do not report the patient results.**
3. Specimen validity is based upon the characteristics of the calibration beads and their interactions with the patient sera. There are various parameters monitored automatically through *Intra-Well Calibration Technology*. If any of the criteria are found to be out of specification, the patient’s results are considered invalid and should be repeated. Should this occur, the data report will indicate the particular specimen which has been invalidated as well as a trouble shooting code. If a specimen is repeatedly invalid, it must be tested using an alternate methodology since it is incompatible with the **AtheNA Multi-Lyte** Plus Test System.
4. Additional Controls may be tested according to guidelines or requirements of local, state, and/or federal regulations or accrediting organizations. External Controls must be representative of normal human serum since **AtheNA Multi-Lyte’s** calibration system is partially based upon the characteristics of the serum sample. If the specimen formulation is artificial (not human serum), erroneous results may occur.
5. Good laboratory practice recommends the use of positive and negative controls to assure functionality of reagents and proper performance of the assay procedure. Quality control requirements must be performed in conformance with local, state and/or federal regulations or accreditation requirements and the user’s laboratory standard Quality Control procedures. It is recommended that the user refer to CLSI EP12-A and 42 CFR 493.1256 for guidance on appropriate QC practices.

**INTERPRETATION OF RESULTS**

1. **Calculations**
2. Assay Calibration: The ZEUS **AtheNA Multi-Lyte** MMRV IgG Plus Test System utilizes *Intra-Well Calibration Technology*. *Intra-Well Calibration Technology* includes a multi-point standard curve within the Bead Suspension. With *Intra-Well Calibration Technology*, each well of the assay is calibrated internally without any user intervention. The standard curve is designed to self-adjust based upon the unique characteristics of the patient or Control serum. Calibrator values are assigned to the internal standards by ZEUS, are lot specific and are encoded within the lot specific Calibration CD.

##### Analyte Cutoff Values: Each analyte of the ZEUS AtheNA Multi-Lyte MMRV IgG Plus Test System has an assigned cutoff value. Cutoff values are determined by ZEUS for each test system lot, and are encoded within the lot specific Calibration CD.

##### Through *Intra-Well Calibration Technology*, all calculations are performed automatically when using the AtheNA Multi-Lyte system. *Intra-Well Calibration Technology* performs a regression analysis of the internal standards and then adjusts the calculated unit values based upon an additional standard and the characteristics of the serum sample.

##### Interpretations

* 1. **Cutoff Determination:** The cutoff for this assay was originally set against a panel of negative specimens. Each subsequent kit lot has been tested against a panel of characterized specimens, and reported values are normalized using the lot specific Calibration CD.
  2. **Measles, Mumps and VZV Analytes Interpretation**: Specimen unit values for the analyte is interpreted as follows:

1. An **AtheNA Multi-Lyte** result of <100 AU/mL indicates no detectable IgG antibody to Measles, Mumps or VZV - report as non-reactive to IgG antibodies.
2. An **AtheNA Multi-Lyte** result of >120 AU/mL is presumptive positive for IgG antibody to Measles Mumps or VZV. A positive test result presumes a current or past infection, or prior immunization to Measles Mumps or VZV - report as presumptive positive for IgG antibodies.
3. Re-test specimens with **AtheNA Multi-Lyte** results in the equivocal range (100 - 120 AU/mL) in duplicate. Test repeatedly equivocal specimens by an alternate serologic procedure, such as the ZEUS ELISA test procedure. Additionally, re-evaluate repeatedly equivocal specimens by drawing another sample one to three weeks later.
4. If there is too much activity on the NSC (non-specific control) bead, *Intra-Well Calibration Technology* will invalidate that particular specimen.
5. The numeric value of the final result above the cutoff is not indicative of the amount of anti-IgG antibody present. Significant antibody increases between acute and convalescent specimens may not be determined.
6. A negative test result does not preclude immunity to Measles, Mumps or VZV infection. In some patients levels of the IgG antibody may fall below the detection limit of this assay.
   1. **Rubella Analyte Interpretation**: Specimen unit values for the analytes are interpreted as follows:
      1. Report an **AtheNA Multi-Lyte** result of 0 - 9 as negativefor IgG antibody to Rubella virus*.* A negative result suggests insufficient IgG antibodiesto Rubella virus to provide protection from infection.
      2. Report an **AtheNA Multi-Lyte** result of >11 as positivefor IgG antibody to Rubella virus. A positive test result suggests a recent or past infectionwith the Rubella virus, or prior immunization with the Rubella virus.
      3. Report specimens with an **AtheNA Multi-Lyte** results of 10 as indeterminatefor presence of IgG antibody to Rubella virus. Re-test indeterminate specimens in duplicate. Re-test repeatedly indeterminate specimens by an alternate serologic procedure, such as a ZEUS ELISA Test System. Additionally, re-evaluate repeatedly indeterminate specimens by drawing another sample one to three weeks later.
      4. If there is too much activity on the NSC (non-specific control) bead, the specimen will be called invalid.
      5. The magnitude of the final result above or below the cut-off is not indicative of the amount of anti-Rubella IgG antibody present. Do not use as a measure of degree of immunity. Negative results do not preclude infection with Rubella virus.

**LIMITATIONS OF THE ASSAY**

1. The ZEUS **AtheNA Multi-Lyte** MMRV IgG Plus Test System is a diagnostic aid and by itself is not diagnostic. Test results should be interpreted in conjunction with the clinical evaluation and the results of other diagnostic procedures.
2. Performance characteristics of this device have not been established with syphilis-associated disease.
3. Do not perform testing as a screening procedure for the general population. The predictive value of a positive or negative result depends on the prevalence of analyte in a given patient population.
4. Hemolytic, icteric, or lipemic samples may interfere with the outcome of this assay. Additionally, specimens with abnormal IgG and RF antibody concentrations may interfere with the outcome of this assay. Avoid the use of these types of specimens.
5. Test results of specimens from immunosuppressed patients may be difficult to interpret.
6. Performance characteristics of this device have not been established for matrices other than serum.
7. Performance characteristics of this device have not been established with specimens containing heterophile antibodies which are known to cause false positive results in various immunoassays.
8. The performance characteristics of this assay have not been established with vaccine recipients to determine if the assay will detect an immune response to a vaccine.
9. A single positive result only indicates previous immunologic exposure; level of antibody response or class of antibody response may not be used to determine active infection or disease stage.
10. Samples collected too early in the course of an infection may not have detectable levels of IgG. In such cases, a second sample may be collected after two to seven weeks and tested concurrently with the original sample to look for seroconversion.
11. Positive results from patients who have received blood products within the previous six months may be due to transient antibody levels acquired during transfusion.
12. Usage for cord blood, the neonatal population and pre-transplant patients has not been established.

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