Bacto® Neisseria Meningitidis Antisera

Neisseria Meningitidis Antiserum Group A · Neisseria Meningitidis Antiserum Group B · Neisseria Meningitidis Antiserum Group C Neisseria Meningitidis Antiserum Group D · Neisseria Meningitidis Antiserum Group W135 · Neisseria Meningitidis Antiserum Group X · Neisseria Meningitidis Antiserum Group Y · Neisseria Meningitidis Antiserum Group Z · Neisseria Meningitidis Antiserum Group Z´ · Neisseria Meningitidis Antiserum Poly (Groups A, B, C, D) Neisseria Meningitidis Antiserum Poly 2 (Groups X, Y, Z)

Intended Use

Bacto Neisseria Meningitidis Antisera are used in the slide agglutination test for serotyping *Neisseria meningitidis*.

Summary and Explanation

Neisseria meningitidis is found in the oropharynx and nasopharynx of humans. Because the organism survives poorly in the environment, humans are the primary reservoir. In asymptomatic persons, the carrier state lasts for various periods, usually several weeks. The microorganism is transmitted from person-to-person by direct contact with respiratory secretions or airborne droplets.[1,2]

User Quality Control

Identity Specifications

Neisseria Meningitidis Antiserum Poly
Neisseria Meningitidis Antiserum Poly 2
Neisseria Meningitidis Antiserum A
Neisseria Meningitidis Antiserum B
Neisseria Meningitidis Antiserum C
Neisseria Meningitidis Antiserum D
Neisseria Meningitidis Antiserum X
Neisseria Meningitidis Antiserum Y
Neisseria Meningitidis Antiserum Z
Neisseria Meningitidis Antiserum Z´
Neisseria Meningitidis Antiserum W135

Lyophilized Appearance: Light gold to amber button to powdered cake.

Rehydrated Appearance: Light gold to amber liquid.

Performance Response

Rehydrate Neisseria Meningitidis Antisera per label directions. Test as described (see Test Procedure). Known positive and negative control cultures must give appropriate reactions.

In some colonized persons, the organism spreads from the nasopharynx through the bloodstream to produce meningococcemia, meningitis or both. Meningococcemia is characterized by a petechial or purpuric skin rash. In fulminating infections (Waterhouse-Friderichsen syndrome), widespread coagulation and fulminant sepsis occur, resulting in shock and, usually, death.[3] Persons with inherited complement deficiencies are at greater risk for acquiring systemic meningococcal infections and may experience repeated episodes.[2]

Typical human specimens for isolating the organism are cerebrospinal fluid (CSF), blood, skin lesions (in cases where petechiae occur) and nasopharyngeal swabs. *N. meningitidis* occurs in the cervix and vagina of females and can cause serious pelvic disease. Other sources for the organism are the anal canal and, in males, the urethra.

N. meningitidis is divided into serological groups based on the presence of either capsular or outer membrane protein antigens. Among the currently recognized groups are A, B, C, D, 29E, H, I, K, L, X, Y, Z, Z´ and W135. Groups A, B, C, Y, and W135 are most frequently implicated in systemic disease.[4] Classically, group A and C strains cause epidemic meningococcal disease.[3] Group B strains have been associated with sporadic infections. Other serogroups are sporadically isolated from carriers and patients with disease.

N. meningitidis are gram-negative cocci, usually occurring in pairs called diplococci. They are strict aerobes and produce the enzyme, cytochrome oxidase. The growth of *N. meningitidis* is enhanced by a CO_2-enriched atmosphere.

The Quellung reaction (capsular swelling) has been performed for serotyping *N. meningitidis*. However, capsules have not been demonstrated in strains of serogroup B organisms. In addition, the Quellung reaction is very nonspecific. *N. meningitidis* should be defined serologically by the slide agglutination test rather than by the Quellung reaction.

Principles of the Procedure

Identification of *N. meningitidis* includes isolation of the microorganism, biochemical identification and serological confirmation.

Serological confirmation involves the reaction in which the microorganism (antigen) reacts with its corresponding antibody. This *in vitro* reaction produces macroscopic clumping called agglutination. The desired homologous reaction is rapid, has at least a 3+ reaction, does not dissociate (high avidity), and binds (high affinity).

Because a microorganism (antigen) may agglutinate with an antibody produced in response to another species, heterologous reactions are possible. These are characterized as weak in strength or slow in formation. Such unexpected and, perhaps, unpredictable reactions may lead to some confusion in serological identification. Therefore, a positive homologous agglutination reaction should support the morphological and biochemical identification of the microorganism.

Homologous reactions are rapid and strong. Heterologous reactions are slow and weak.

Reagents

Neisseria Meningitidis Antisera are lyophilized, polyclonal rabbit antisera containing approximately 0.02% Thimerosal as a preservative. Neisseria Meningitidis Antisera Poly and Group D are absorbed for detection of Group D; Neisseria Meningitidis Antisera Poly 2, Z´, W135, A, B, C, X, Y and Z are not absorbed for detection of Group D, which is rarely isolated.

Neisseria Meningitidis Antisera detect the following antigenic groups:

ANTISERUM	ANTIGENIC GROUP(S) DETECTED
Poly	A, B, C, D
Poly 2	X, Y, Z
W135	W135
A	A
B	B
C	C
D	D
X	X
Y	Y
Z	Z, Z´
Z´	Z´

When rehydrated and used as described, each 1 ml vial of Neisseria Meningitidis Antiserum contains sufficient reagent for 20 slide tests.

Precautions

1. For In Vitro Diagnostic Use.
2. The Packaging of This Product Contains Dry Natural Rubber.
3. Follow proper established laboratory procedure in handling and disposing of infectious materials.

Storage

Store lyophilized and rehydrated Neisseria Meningitidis Antisera at 2-8°C.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

Neisseria Meningitidis Antiserum Poly
Neisseria Meningitidis Antiserum Poly 2
Neisseria Meningitidis Antiserum A
Neisseria Meningitidis Antiserum B
Neisseria Meningitidis Antiserum C
Neisseria Meningitidis Antiserum D
Neisseria Meningitidis Antiserum X
Neisseria Meningitidis Antiserum Y
Neisseria Meningitidis Antiserum Z
Neisseria Meningitidis Antiserum Z´
Neisseria Meningitidis Antiserum W135

Materials Required But Not Provided

Agglutination slides
Applicator sticks
Sterile distilled or deionized water
Sterile 0.85% NaCl solution

Reagent Preparation

Neisseria Meningitidis Antisera: To rehydrate, add 1 ml sterile distilled or deionized water and rotate gently to completely dissolve the contents.

Equilibrate all materials to room temperature prior to performing the tests. Ensure that all glassware and pipettes are clean and free of detergent residues.

Specimen Collection and Preparation

N. meningitidis can be recovered on blood agar or chocolate agar. Determine that the test organism has the following characteristics of *N. meningitidis*:

Morphology:	grayish-white, opaque, smooth, butyrous, non-pigmented
Gram stain:	gram-negative diplococcus
Oxidase:	positive
Catalase:	positive
ONPG reaction:	negative
Nitrate reduction:	negative
Glucose:	positive
Maltose:	positive
Sucrose:	negative
Fructose:	negative
Lactose:	negative

Determine that a pure culture of the microorganism has been obtained and that biochemical test reactions are consistent with the identification of the organism as *N. meningitidis*. For more detailed information on the biochemical identification of *N. meningitidis*, consult appropriate references.[3,5] After these criteria are met, serological identification can proceed.

Testing the Isolate for Autoagglutination

1. From the test culture on chocolate agar, transfer a loopful of growth to a drop of sterile 0.85% NaCl solution on a clean slide and emulsify the organism.
2. Rotate the slide for one minute and then observe for agglutination.

   If agglutination (autoagglutination) occurs, the culture is rough and cannot be tested. Subculture to chocolate agar, incubate, and test the organism again as described in steps 1 and 2.

   If no agglutination occurs, proceed with testing the organism.

Choosing Antisera to Test

1. Test the organism first with Neisseria Meningitidis Antisera Poly, Poly 2 and Group W135.
2. Depending on the reaction, continue testing as follows.

If agglutination occurs with Neisseria Meningitidis Antiserum:	Test with Neisseria Meningitidis Antiserum:
Poly	Groups A, B, C, D
Poly 2	Groups X, Y, Z, Z´ (See NOTE.)
Group W135	No further testing is required.

NOTE: *N. meningitidis* Group Z´ organisms *may* agglutinate monospecific Neisseria Meningitidis Antiserum Group Z. However, *N. meningitidis* Group Z organisms *will not* agglutinate Neisseria Meningitidis Antiserum Group Z´. The expected agglutination reactions of Neisseria Meningitidis Antiserum Groups Z´ and Z with test organisms are:

	Neisseria Meningitidis Antiserum	
Test Organism	Group Z´	Group Z
N. meningitidis Group Z´	3+	+
N. meningitidis Group Z	–	3+

Test Procedure

1. **Neisseria Meningitidis Antiserum**: Dispense 1 drop of the antiserum to be tested on an agglutination slide.
2. **Test isolate**: Transfer a loopful of growth to the drop of antiserum and mix thoroughly.
3. Rotate the slide for one minute and read for agglutination.
4. Repeat this procedure for known positive and negative cultures.

Results

1. Read and record results as follows.
   - 4+ 100% agglutination; background is clear to slightly hazy.
   - 3+ 75% agglutination; background is slightly cloudy.
   - 2+ 50% agglutination; background is moderately cloudy.
   - 1+ 25% agglutination; background is cloudy.
   - – No agglutination.
2. **Positive control**: Should produce 3+ or greater agglutination.

   Negative control: Should produce no agglutination.

   Test isolate: A positive test result is defined as agglutination of 3+ or greater within one minute.

Limitations of the Procedure

1. Correct interpretation of serological reactions depends on culture purity, as well as morphological characteristics and biochemical reactions that are consistent with identification of the microorganism as *N. meningitidis*.
2. Serological methods alone cannot identify the isolate as *N. meningitidis*. Organisms unrelated to *Neisseria*, yet capable of causing meningitis, and other species of *Neisseria* can cross-react with meningococcal antisera. Cultural isolation must precede serological examination.
3. Excessive heat from external sources (hot bacteriological loop, burner flame, light source, etc.) may prevent a smooth suspension of the microorganism or may cause evaporation or precipitation of the test mixture. False-positive reactions may occur.
4. Rough culture isolates occur and will agglutinate spontaneously, causing agglutination of the negative control (autoagglutination). Smooth colonies must be selected and tested in serological procedures.
5. *N. meningitidis* Group A and *N. meningitidis* Group C may cross-react due to the presence of common capsular polysaccharides.
6. Group Z´ meningococci *may* agglutinate group Z antiserum. Group Z meningococci *will not* agglutinate group Z´ antiserum.
7. Neisseria Meningitidis Antisera have been tested using undiluted cultures taken from agar media. These antisera have not been tested using antigen suspensions in NaCl solution or other diluents. If the user employs a variation of the recommended procedure, each lot of antiserum must be tested with known control cultures to verify that expected reactions are obtained under the modified procedure.
8. Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.
9. A rehydrated Neisseria Meningitidis Antiserum that is cloudy or develops a precipitate during use should be discarded.

References

1. **Given, K. F., B. W. Thomas, and A. G. Johnston.** 1977. Isolation of *Neisseria meningitidis* from the urethra, cervix, and anal canal: further observations. Br. J. Vener. Dis. **53:**109-112.
2. **Janda, W. M., M. Bohnhoff, J. A. Morello, and S. A. Lerner.** 1980. Prevalence and site-pathogen studies of *Neisseria meningitidis* and *N. gonorrhoeae* in homosexual men. JAMA **244:**2060-2064.
3. **Knapp, J. S., and R. J. Rice.** 1995. *Neisseria* and *Branhamella*, p. 324-340. *In* P. R. Murray, E. J. Baron, M. A. Pfaller, F. C. Tenover, and R. H. Yolken (ed.), Manual of clinical microbiology, 6th ed. American Society for Microbiology, Washington, D.C.
4. **Zollinger, W. D., B. L. Brandt, and E. C. Tramont.** 1986. Immune response to *Neisseria meningitidis*, p. 346-352. *In* N. R. Rose, H. Friedman, and J. L. Fahey (ed.), Manual of clinical laboratory immunology, 3rd ed. American Society for Microbiology, Washington, D.C.
5. **Pezzlo, M.** 1994. Aerobic bacteriology, p. 1.0.1-1.20.47. *In* H. D. Isenberg (ed.), Clinical microbiology procedures handbook, vol. 1. American Society for Microbiology, Washington, D.C.

Packaging

Neisseria Meningitidis Antiserum Poly	1 ml	2232-50
Neisseria Meningitidis Antiserum Poly 2	1 ml	2910-50
Neisseria Meningitidis Antiserum Group A	1 ml	2228-50
Neisseria Meningitidis Antiserum Group B	1 ml	2229-50
Neisseria Meningitidis Antiserum Group C	1 ml	2230-50
Neisseria Meningitidis Antiserum Group D	1 ml	2231-50
Neisseria Meningitidis Antiserum Group X	1 ml	2880-50
Neisseria Meningitidis Antiserum Group Y	1 ml	2881-50
Neisseria Meningitidis Antiserum Group Z	1 ml	2891-50
Neisseria Meningitidis Antiserum Group Z´	1 ml	2252-50
Neisseria Meningitidis Antiserum Group W135	1 ml	2253-50

Bacto® Proteus Antigens and Antisera · The Weil-Felix Test

Proteus OX2 Antigen (Slide) · Proteus OX2 Antigen (Tube)
Proteus OX19 Antigen (Slide) · Proteus OX19 Antigen (Tube)
Proteus OXK Antigen (Slide) · Proteus OXK Antigen (Tube)
Proteus OX2 Antiserum · Proteus OX19 Antiserum
Proteus OXK Antiserum · Febrile Negative Control

Intended Use

Bacto Proteus OX2, OX19 and OXK Antigens (Slide) and (Tube) are used for detecting antibodies by the slide and tube agglutination tests.

Bacto Proteus OX2, OX19 and OXK Antisera are used in the quality control testing of Proteus OX2, OX19 and OXK Antigens in slide and tube agglutination tests.

User Quality Control

Identity Specifications

Proteus OX2 Antigen (Slide)
Proteus OX19 Antigen (Slide)
Proteus OXK Antigen (Slide)
Appearance: Turquoise-blue-violet suspension.

Proteus OX2 Antigen (Tube)
Proteus OX19 Antigen (Tube)
Proteus OXK Antigen (Tube)
Appearance: Light gray to white suspension.

Proteus OX2 Antiserum
Proteus OX19 Antiserum
Proteus OXK Antiserum
Lyophilized Appearance: Light gold to amber, button to powdered cake.
Rehydrated Appearance: Light gold to amber, clear liquid.

Febrile Negative Control
Lyophilized Appearance: Colorless to light gold, button to powdered cake.
Rehydrated Appearance: Colorless to light gold, clear liquid.

Performance Response

Rehydrate Proteus OX Antisera and Febrile Negative Control per label directions. Perform the slide or tube agglutination test using Proteus OX Antigen (Slide) or (Tube). Both positive and negative controls are diluted in the same proportion as a patient serum and processed in the same manner following procedures for the rapid slide test or the macroscopic tube test (see Test Procedure).

An antigen is considered satisfactory if it does not agglutinate with the negative control, and if it reacts 2+ or greater at a titer of 1:160 or more with the positive control.

Summary and Explanation

Rickettsiae cause a variety of human diseases that share symptoms such as chills, fever, malaise and myalgia. These symptoms occur suddenly, usually within 3 to 14 days after exposure. Patients frequently have a rash and may have mild pulmonary symptoms. The rickettsiae are obligate intracellular bacteria and multiply within arthropods (lice, ticks, fleas, etc.) which may serve as the vectors of infection.

The spotted fevers are caused by species of *Rickettsia*, with Rocky Mountain spotted fever caused by *Rickettsia rickettsii* being well known. Epidemic and murine typhus are caused by *R. prowazekii* and *R. typhi*, respectively. Scrub typhus is caused by *Orientalis tsutsugamushi*. For a complete discussion of the rickettsiae, consult an appropriate reference.[1-5]

Because rickettsial diseases develop as a febrile illness, patient diagnosis has frequently involved measurements of antibody response. The Weil-Felix test became popular in the 1920's after it was observed that certain strains of *Proteus* would agglutinate early-convalescent-phase sera from patients with suspected rickettsial disease.[6] *Proteus* antigens (OX2, OX19 and OXK) will cross-react in predictable patterns, although the reactions are not highly sensitive or specific. *Rickettsiae* are pathogenic microorganisms that, upon invasion, produce a fever in their host. *Proteus* antigens are often called "Febrile Antigens" because they are used to detect the response to a rickettsial infection.

The human immune response to a particular microorganism results in measurable antibody production that in some cases can help in completing the patient's clinical diagnosis. In blood samples, the antibody titer during the initial phase of the infection (acute) is compared to the antibody titer 7 to 14 days later (convalescent). Antibody titers that are high initially in the acute phase or an acute or convalescent pair of samples that shows an increase in antibody titer are helpful in the diagnosis of disease.

Diagnosis of the cause of febrile disease cannot be based solely on analysis of serum samples for antibody response. Many factors may affect measurable antibody levels. For example, the patient's immune response can be affected by age, immune status, general state of health and previous immunizations.

Certain organisms may share cross-reacting antigens leading to the production of heterologous antibodies. These heterologous antibodies may react with one or more antigens in an antibody test procedure resulting in low-level antibody titers that may not, as a single result, suggest disease. The Weil-Felix test is not specific for rickettsial diseases.

Principles of the Procedure

Agglutination tests involving the use of *Proteus* antigens determine the presence of antibodies that react with the test antigen. The serological procedure involves serially diluting the patient serum and then adding a standard volume of an antigen. The end point of the test is the last dilution of the serum that shows a specific amount of agglutination. The end point converted to a dilution of the serum is called the patient's antibody "titer."

Reagents

Antigens

1. **Proteus Antigens** are ready to use, nonmotile strains of the organisms listed below. Proteus Antigen (Slide) contains 20% glycerin. Each vial of Proteus Antigen (Slide) contains sufficient reagent for 33 slide tests. Each vial of Proteus Antigen (Tube) contains sufficient reagent for 6 tube tests.

   Proteus OX2 Antigen (Slide) and (Tube) - *Proteus vulgaris* OX2

   Proteus OX19 Antigens (Slide) and (Tube) - *Proteus vulgaris* OX19

   Proteus OXK Antigen (Slide) and (Tube) - *Proteus mirabilis* OXK

2. **Concentration of Antigen**: Antigen density may vary because it is adjusted for optimum performance when standardized with hyperimmune sera obtained from laboratory animals.

   Variation in color intensity is normal and will not affect test performance.

3. Proteus antigens contain the following preservative(s):

   Proteus OX2, OX19 and OXK Antigens (Slide): 0.5% formaldehyde, and approximately 0.002% crystal violet and 0.005% brilliant green.

   Proteus OX2, OX19 and OXK Antigens (Tube): 0.25% formaldehyde.

Antisera

1. **Proteus Antisera** are lyophilized, polyclonal rabbit antisera containing approximately 0.04% Thimerosal as a preservative. Each vial contains sufficient reagent for 19 slide tests or 30 tube tests.
2. Febrile Negative Control is a standard protein solution containing 0.02% Thimerosal as a preservative. Each vial of Febrile Negative Control contains sufficient reagent for 32 slide tests.

Precautions

1. For In Vitro Diagnostic Use.
2. Observe universal blood and body fluid precautions in the handling and disposing of specimens.[7,8]
3. **Proteus OX2 Antigen (Slide)**
   Proteus OX2 Antigen (Tube)
   Proteus OX19 Antigen (Slide)
   Proteus OX19 Antigen (Tube)
   Proteus OXK Antigen (Slide)
   Proteus OXK Antigen (Tube)

   POSSIBLE RISK OF IRREVERSIBLE EFFECTS. (US) Avoid contact with skin and eyes. Do not breathe mist. Wear suitable protective clothing. Keep container tightly closed. TARGET ORGAN(S): Eyes, Kidneys, Lungs, Skin.

   FIRST AID: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice. If swallowed seek medical advice immediately and show this container or label.
4. **Proteus OX2 Antiserum**
   Proteus OX19 Antiserum
   Proteus OXK Antiserum

   The Packaging of This Product Contains Dry Natural Rubber.
5. Follow proper established laboratory procedure in handling and disposing of infectious materials.
6. Proteus Antigens are not intended for use in the immunization of humans or animals.

Storage

Store Proteus OX2, OX19 and OXK Antigens (Slide) and (Tube) at 2-8°C.

Store lyophilized and rehydrated Proteus OX2, OX19 and OXK Antisera at 2-8°C.

Store lyophilized and rehydrated Febrile Negative Control at 2-8°C.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

Proteus OX2 Antigen (Slide)
Proteus OX2 Antigen (Tube)
Proteus OX19 Antigen (Slide)
Proteus OX19 Antigen (Tube)
Proteus OXK Antigen (Slide)
Proteus OXK Antigen (Tube)
Proteus OX2 Antiserum
Proteus OX19 Antiserum
Proteus OXK Antiserum
Febrile Negative Control

Materials Required But Not Provided

Slide test

Agglutination slides, 5 squares, 1" each
Applicator sticks
Sterile 0.85% NaCl solution
Sterile distilled or deionized water
Serological pipettes, 0.2 ml

Tube Test

Culture tubes 12 x 75 mm and rack
Waterbath, 35-37°C
Serological pipettes, 1 ml and 5 ml
Sterile 0.85% NaCl solution
Sterile distilled or deionized water

Reagent Preparation

Proteus OX2, OX19 and OXK Antigens (Slide) and (Tube) are ready to use.

Equilibrate all materials to room temperature before performing the tests. Ensure that all glassware and pipettes are clean and free of residues such as detergent.

Proteus OX2, OX19 and OXK Antisera: To rehydrate, add 3 ml sterile 0.85% NaCl solution and rotate gently to completely dissolve the contents. The rehydrated antiserum is considered a 1:2 working dilution.

Febrile Negative Control: To rehydrate, add 5 ml sterile distilled or deionized water and rotate gently to completely dissolve the contents.

Specimen Collection and Preparation

Collect a blood specimen by aseptic venipuncture. Serum is required for the test. Store serum specimens at room temperature for no longer than 4 hours; for prolonged storage, keep at 2-8°C for up to 5 days or maintain below -20°C.

Serum specimens must be clear, free of hemolysis and show no visible evidence of bacterial contamination (turbidity, hemolysis or particulate matter). Consult appropriate references for more information on collection of specimens.[9,10] Serum specimens must not be heated. Heat may inactivate or destroy certain antibodies.

Test Procedure

Slide Test

Use the slide test only as a screening test. Confirm positive results with the tube test.

1. **Test serum**: Using a 0.2 ml serological pipette, dispense 0.08, 0.04, 0.02, 0.01 and 0.005 ml of serum into a row of squares on the agglutination slide.
2. **Positive control**: Using a 0.2 ml serological pipette, dispense 0.08, 0.04, 0.02, 0.01 and 0.005 ml of Proteus Antiserum into a row of squares on the agglutination slide.
3. **Negative control**: Using a 0.2 ml serological pipette, dispense 0.08, 0.04, 0.02, 0.01 and 0.005 ml of Febrile Negative Control into a row of squares on the agglutination slide.
4. **Proteus Antigen**: Shake the vial of antigen well to ensure a smooth, uniform suspension. Add one drop (approximately 35 µl) of antigen to each drop of diluted test serum, positive control and negative control.
5. Mix each row of test sera and control sera, using a separate applicator stick for each row. Start with the most dilute mixture (0.005 ml) and work to the most concentrated (0.08 ml).
6. Rotate the slide for 1 minute and read for agglutination.
7. The final dilutions in squares 1-5 correspond with tube dilutions of 1:20, 1:40, 1:80, 1:160, 1:320, respectively.

Results

1. Read and record results as follows.
   - 4+ 100% agglutination; background is clear to slightly hazy.
   - 3+ 75% agglutination; background is slightly cloudy.
   - 2+ 50% agglutination; background is moderately cloudy.
   - 1+ 25% agglutination; background is cloudy.
   - – No agglutination.
2. **Positive control**: Should show 2+ or greater agglutination at 1:160.
3. **Negative control**: Should show no agglutination.
4. If results for either the positive or negative controls are not as described, the test is invalid and results cannot be read.
5. **Test specimens**: The serum titer is that dilution which shows 2+ or greater agglutination.
6. The slide test is a screening test, only; results must be confirmed with the tube test.

Tube Test

1. Prepare a row of 8 culture tubes (12 x 75 ml) for each test serum, including a row for the appropriate Proteus Antiserum.
2. **Sterile 0.85% NaCl solution**: Dispense 0.9 ml in the first tube of each row and 0.5 ml in the remaining tubes.
3. **Test serum**: Using a 1 ml serological pipette, add 0.1 ml of the serum in the first tube in the row and mix thoroughly. Transfer 0.5 ml from tube 1 to tube 2 and mix thoroughly. In like manner, continue transferring 0.5 ml through tube 7, discarding 0.5 ml from tube 7 after mixing. Tube 8 is the antigen control tube and contains only sterile 0.85% NaCl solution.
4. **Positive control**: Using a 1 ml serological pipette, add 0.1 ml of the appropriate Proteus Antiserum to the first tube in the row and mix thoroughly. Transfer 0.5 ml from tube 1 to tube 2 and mix thoroughly. Continue transferring 0.5 ml through tube 7, discarding 0.5 ml from tube 7 after mixing. Tube 8 is the antigen control tube and contains only sterile 0.85% NaCl solution.
5. **Proteus Antigen**: Shake the vial of antigen to ensure a smooth, uniform suspension. Add 0.5 ml of the antigen to each of the 8 tubes in each row and shake the rack to mix the suspensions. Final dilutions in tubes 1-7 are 1:20, 1:40, 1:80, 1:160, 1:320, 1:640 and 1:1280, respectively.
6. Incubate in a waterbath at 35-37°C for 2 hours; then refrigerate at 2-8°C for 22 ± 2 hours.
7. Remove from incubation. Avoid excessive shaking before reading the reactions either when the tubes are incubated or when removing them from the incubation.
8. Read and record the results.

Results

1. Read and record results as follows.
   - 4+ 100% agglutination; background is clear to slightly hazy.
   - 3+ 75% agglutination; background is slightly cloudy.
   - 2+ 50% agglutination; background is moderately cloudy.
   - 1+ 25% agglutination; background is cloudy.
   - – No agglutination.
2. **Positive control**: Should show a 2+ or greater agglutination at 1:160.
3. **Antigen control (tube 8 of each row)**: Should show no agglutination.
4. If results of the positive control or antigen control are not as described, the test is invalid and results cannot be read.
5. For each test serum, the serum titer is that dilution which shows 2+ or greater agglutination.

Interpretation[1]

Compare results:

DISEASE	AGENT	PROTEUS OX2	PROTEUS OX19	PROTEUS OXK
Epidemic Typhus*	*R. prowazekii*	+	+	–
Murine Typhus*	*R. typhi*	+	+	–
Scrub Typhus	*O. tsutsugamushi*	–	–	+
Rocky Mountain Spotted Fever**	*R. rickettsii*	+	+	–
Other Spotted Fevers**	*Rickettsia* sp.	+	+	–

*In cases of epidemic and murine typhus, the strength of the antibody agglutination with Proteus OX19 is usually stronger (4+) than the agglutination with Proteus OX2 (2+).

**In cases of spotted fevers, antibodies may agglutinate either or both strains of Proteus OX19 or OX2, and the strength of agglutination may vary from 1+ to 4+.

For a single serum specimen, a titer of 1:160 is suggestive of infection.

A pair of serum specimens (acute and convalescent) showing a two-dilution difference in the titers is a significant increase in antibody level and is suggestive of infection. A one dilution difference is within the limits of laboratory error.

Limitations of the Procedure

1. The slide test is for screening only and results should be confirmed by performing the tube test. The slide test dilutions are made to detect a prozone reaction and do not represent true quantitation of the antibody. A serum specimen with a prozone reaction shows no agglutination because of excessively high antibody concentrations. To avoid this occurrence, all 5 serum dilutions (slide test) should be run.
2. The detection of antibodies in serum specimens may complete the clinical picture of a patient having infection. However, the isolation of the causative agent from patient specimens may be required. A definitive diagnosis must be made by a physician based on patient history, physical examination and data from all laboratory tests.
3. Cross-reacting heterologous antibodies are responsible for many low titer reactions. Infections with other organisms, vaccinations and past history of disease may result in low level of antibody titers. Antimicrobial therapy may suppress antibody production.

   The Weil-Felix test is not specific for rickettsial diseases. *Rickettsia* species cause cross-reacting antibodies, and infections with *Proteus* species can also cause cross-reacting antibodies.
4. While a single serum specimen showing a titer of 1:160 suggests infection, it is not diagnostic.
5. To test for a significant rise in antibody titer, at least two specimens are necessary, an acute specimen obtained at time of initial symptoms and a convalescent specimen obtained 7 to 14 days later. A two-dilution difference in titer is a significant increase in antibody level and is suggestive of infection.
6. The Weil-Felix test does not differentiate between epidemic and murine typhus.
7. Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.
8. Exposure of the antigen reagents to temperatures below 2°C can result in autoagglutination. Antigens must be smooth, uniform suspensions. Examine antigen vials for agglutination before use. Suspensions with agglutination are not usable and should be discarded.
9. Rehydrated Proteus OX2, OX19 and OXK Antisera that is cloudy or has a precipitate during use should be discarded.

References

1. **Eisemann, C. S., and J. V. Osterman.** 1986. *Rickettsiae*, p. 593-599. *In* N. R. Rose, H. Friedman, and J. L. Fahey, (ed.), Manual of clinical laboratory immunology, 3rd ed. American Society for Microbiology, Washington, D.C.
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3. **Olson, J. G, and J. E. McDade.** 1995. *Rickettsia* and *Coxiella*, p. 678-685. *In* P. R. Murray, E. J. Baron, M A. Pfaller, F. C. Tenover, and R. H. Yolken (ed.), Manual of clinical microbiology, 6th ed. American Society for Microbiology, Washington, D.C.
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5. **Turgeon, M. L.** 1990. Immunology and serology in laboratory medicine. The C. V. Mosby Company, St. Louis, MO.
6. **Weil, E., and A. Felix.** 1916. Zur serologischen Diagnosis des Fleckfiebers. Wien. Klin. Wochenschr. **29:**33-35.
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8. **Occupational Safety and Health Administration, U.S. Department of Labor.** 1991. 29 CFR, part 1910. Occupational exposure to bloodborne pathogens; final rule. Federal Register **56:**64175-64182.
9. **Pezzlo, M.** 1992. Aerobic bacteriology, p. 1.0.1-1.20.47. *In* H. D. Isenberg (ed.), Clinical microbiology procedures handbook, vol. 1. American Society for Microbiology, Washington, D.C.
10. **Miller, J. M., and H. T. Holmes.** 1995. Specimen collection, transport and storage. *In* P. R. Murray, E. J. Baron, M. A. Pfaller, F. C. Tenover, and R. H. Yolken (ed.), Manual of clinical microbiology, 6th ed. American Society for Microbiology, Washington, D.C.

Packaging

Proteus OX2 Antigen (Slide)	5 ml	2243-56
Proteus OX2 Antigen (Tube)	25 ml	2248-65
Proteus OX19 Antigen (Slide)	5 ml	2234-56
Proteus OX19 Antigen (Tube)	25 ml	2247-65
Proteus OXK Antigen (Slide)	5 ml	2244-56
Proteus OXK Antigen (Tube)	25 ml	2249-65
Proteus OX2 Antiserum	3 ml	2245-47
Proteus OX19 Antiserum	3 ml	2235-47
Proteus OXK Antiserum	3 ml	2246-47
Febrile Negative Control	5 ml	3239-56

Bacto® QC Antigens Salmonella

QC Antigen Salmonella O Group A · QC Antigen Salmonella O Group B · QC Antigen Salmonella O Group C_1 · QC Antigen Salmonella O Group C_2 · QC Antigen Salmonella O Group D QC Antigen Salmonella O Group E_1 · QC Antigen Salmonella O Group E_2 · QC Antigen Salmonella O Group E_4 · QC Antigen Salmonella O Group F · QC Antigen Salmonella O Group G_1 QC Antigen Salmonella O Group H · QC Antigen Salmonella O Group I · QC Antigen Salmonella Vi Febrile Negative Control

Intended Use

Bacto QC Antigens Salmonella are used in the quality control testing of Salmonella Antisera by the slide agglutination test.

User Quality Control

Identity Specifications

QC Antigens Salmonella O Groups A, B, C_1, C_2, D, E_1, E_2, E_4, F, G_1, H, I and Salmonella Vi

Appearance:	Liquid, light gray to white, may settle on standing.

Febrile Negative Control

Lyophilized appearance:	Colorless to light gold, button to powdered cake.
Rehydrated appearance:	Colorless to light gold, clear liquid.

Cultural Response

Rehydrate the Salmonella antiserum per label directions. Perform the slide agglutination test using an appropriate QC Antigen Salmonella as the homologous (positive) or heterologous (negative) control. The homologous control should produce 3+ or greater agglutination. The heterologous control should not produce agglutination. Infrequently, a +/- reaction will occur.

The following chart lists the identifying antigen(s) of various Salmonella Antisera and the recommended homologous QC Antigen(s) Salmonella (positive control). To demonstrate a heterologous (negative control) reaction, use a QC Antigen Salmonella that contains antigens unrelated to those in the homologous control.

continued on following page

Summary and Explanation

Salmonella species cause a variety of human diseases called salmonelloses. The range of disease is from mild self-limiting gastroenteritis to a more severe form, possibly with bacteremia to typhoid fever, which can be severe and life-threatening. Severe disease and bacteremia are associated primarily with *S. choleraesuis*, *S. paratyphi* A and *S. typhi*, while most of the other 2300 or more strains are associated with gastroenteritis. The severity of the diarrheal disease depends on the virulence of the strain and the condition of the human host.

Salmonellae are found in nature and occur in the intestinal tract of many animals, both wild and domestic. The microorganism can spread to man through environmental contact or from eating contaminated meat or vegetable food products.

The genus *Salmonella* is in the family *Enterobacteriaceae*. Salmonellae are facultatively anaerobic, gram-negative bacilli that typically are oxidase negative, lactose negative, H_2S positive and produce gas.

Serotypes of *Salmonella* are defined based on the antigenic structure of both the somatic or cell wall (O) antigens and the flagellar (H) antigens. The antigenic formula provides the O antigen(s) first, followed by the H antigen(s). In characterizing serotypes of *Salmonella*, the somatic O heat-stable antigens are identified first and are numbered 1-67 using Arabic numerals. The numbers are not completely continuous because certain strains were reclassified to other genera and the antigenic Arabic numbers were deleted from the scheme.

Serogroups, which represent the organization of the *Salmonella* strains based on the antigen(s) shared in common, are designated by the letters A-Z. After exhausting the alphabet, the serogroups were numbered beginning with the numeral 51 (the serogroup Z organism having antigen number 50). While one somatic antigen identifies each serogroup, certain other antigens may be shared among several serogroups.

The use of Salmonella antisera in the serological identification of *Salmonella* requires the use of quality control test suspensions to verify that the antisera are performing as expected. Most laboratories are required to test antisera with positive and negative controls prior to use.[1,2] QC Antigens Salmonella are designed as homologous controls for testing the efficacy of the *Salmonella* grouping antisera employed in routine laboratory procedures.

Principles of the Procedure

Serological procedures that confirm the identification of an organism are usually agglutination reactions. Agglutination reactions may be either homologous or heterologous. Homologous reactions occur between a microorganism (antigen) and the corresponding antibody. These reactions occur rapidly and are strong. Heterologous reactions occur when a microorganism (antigen) reacts with an antibody produced in response to some other species or serotype. These reactions occur slowly and are weak.

Heterologous reactions may be unexpected and unpredictable and may lead to confusion in serological identification. Therefore, only strongly positive homologous agglutination reactions should be regarded as significant.

User Quality Control cont.

SALMONELLA ANTISERUM	QC ANTIGEN SALMONELLA HOMOLOGOUS CONTROL(S)
Poly A-I & Vi	A, B, D, E_1, E_2, E_4, F, G_1, H, I, Vi
Poly A	A, B, D, E_1, E_2, E_4
Poly B	C_1, C_2, F, G_1, H
Poly C	I
Group A Factors 1, 2, 12	A
Group B Factors 1, 4, 5, 12	B
Group B Factors 1, 4, 12, 27	B
Group C_1 Factors 6, 7	C_1
Group C_2 Factors 6, 8	C_2
Group D_1 Factors 1, 9, 12	D
Group E Factors 1, 3, 10, 15, 19, 34	E_1, E_2, E_4
Group E_1 Factors 3, 10	E_1
Group E_2 Factors 3, 15	E_2
Group E_4 Factors 1, 3, 19	E_4
Group F Factor 11	F
Group G Factors 13, 22, 23, (36), (37)	G_1
Group G_1 Factors 13, 22, (36), (37)	G_1
Group H Factors 1, 6, 14, 24, 25	H
Group I Factor 16	I
Vi	Vi
Factor 2	A
Factor 4	B
Factors 4, 5	B
Factor 5	B
Factor 7	C_1
Factor 8	C_2
Factor 9	D
Factor 10	E_1
Factor 15	E_2
Factor 19	E_4
Factor 22	G_1
Factor 14	H

Note: Parentheses ( ) indicate that the antigen is poorly developed or agglutinates weakly. For a complete and current explanation of the classification of *Salmonella*, consult appropriate references.[3,4,5]

Reagents

QC ANTIGEN SALMONELLA	ORGANISM USED FOR ANTIGEN PREPARATION	HOMOLOGOUS IDENTIFYING ANTIGEN(S)
O Group A	*S. paratyphi* A var. Durazzo, Factors 2, 12	2
O Group B	*S. typhimurium* Factors 1, 4, [5], 12	4, 5
O Group C_1	*S. choleraesuis* factors 6, 7	7
O Group C_2	*S. newport* factors 6, 8	8
O Group D	*S. gallinarum* factors 1, 9, 12	9
O Group E_1	*S. anatum* factors 3, 10	10
O Group E_2	*S. newington* factors 3, 15	15
O Group E_4	*S. senftenberg* factors 1, 3, 19	19
O Group F	*S. rubislaw* factor 11	11
O Group G_1	*S. poona* factors [1], 13, 22, [36], [37]	22
O Group H	*S. carrau* factors 6, 14, 24	14
O Group I	*S. hvittingfoss* factor 16	16
Vi	*Citrobacter ballerup* O29	Vi

Note: Brackets [ ] indicate that the antigen may be absent.

Underlining indicates that the O antigen has been lysogenized in that strain.

These antigen suspensions are ready to use. QC Antigens Salmonella O are preserved with 0.5% phenol USP; QC Antigen Salmonella Vi contains 0.01% Thimerosal. When used as described, each vial of QC Antigen Salmonella has sufficient reagent for 20 slide tests.

Febrile Negative Control is a lyophilized standard protein solution, containing approximately 0.04% Thimerosal as a preservative. When used as described, each vial of Febrile Negative Control has sufficient reagent for 100 slide tests.

Precautions

1. For In Vitro Diagnostic use.
2. **QC Antigens Salmonella**
   The Packaging of This Product Contains Dry Natural Rubber.
3. Follow proper established laboratory procedure in handling and disposing of infectious materials.
4. QC Antigens Salmonella are not to be used for immunization of humans or animals.

Storage

Store QC Antigens Salmonella at 2-8°C.

Store lyophilized and rehydrated Febrile Negative Control at 2-8°C.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

QC Antigens Salmonella
Febrile Negative Control

Materials Required But Not Provided

Agglutination slides
Applicator sticks
Sterile distilled or deionized water

Reagent Preparation

QC Antigens Salmonella are ready to use.

Equilibrate all materials to room temperature before performing the tests. Ensure that all glassware and pipettes are clean and free of residues such as detergents.

Febrile Negative Control: To rehydrate, add 5 ml sterile distilled or deionized water and rotate gently to completely dissolve the contents.

Before using QC Antigens Salmonella, examine the Salmonella antisera (Poly, Group or Factor) chosen for use. The antisera must meet all product specifications.

Test Procedure

1. **Positive control**: Dispense 1 drop (35 Fl) of the Salmonella Antiserum to be tested on an agglutination slide. Add 1 drop of the QC Antigen Salmonella chosen as the positive control and mix thoroughly.
2. **Negative control**: Dispense 1 drop of Febrile Negative Control on the agglutination slide. Add 1 drop of the QC Antigen Salmonella chosen as the positive control and mix thoroughly.
3. Rotate the slide for 1 minute and read for agglutination. Results must be read within 1 minute.

Results

1. Read and record results as follows.
   - 4+ 100% agglutination; background is clear to slightly hazy.
   - 3+ 75% agglutination; background is slightly cloudy.
   - 2+ 50% agglutination; background is moderately cloudy.
   - 1+ 25% agglutination; background is cloudy.
   - – No agglutination.
2. **Positive control**: Should show 3+ or greater agglutination.
3. **Negative control**: Should show no agglutination. Rarely, a +/- reaction is possible.

Limitations of the Procedure

1. Excessive heat from external sources (hot bacteriological loop, burner flame, light source, etc.) may prevent a smooth suspension of the microorganism or cause evaporation or precipitation of the test mixture. False-positive reactions may occur.
2. QC Antigens Salmonella will react with their corresponding homologous Salmonella polyvalent, group or factor antiserum. Some single factor antisera may give weaker reactions than polyvalent or grouping antisera due to specificity of the single factor antiserum for the identifying antigen(s).
3. The density of QC Antigens Salmonella is adjusted so that they give negative reactions with heterologous Salmonella Group Antisera. However, an antiserum may have a particular avidity for a given factor and agglutinate with another QC Antigen Salmonella having the common factor. For example, Salmonella O Group E_1 Antiserum Factors 3, 10 will agglutinate QC Antigen Salmonella O Group E_1 (3, 10) but may also agglutinate QC Antigen Salmonella O Group E_2 (3, 15) if the antiserum is of high titer for factor 3.
4. Exposure to temperatures below 2°C can result in autoagglutination. Antigens must be smooth, uniform suspensions. Examine the antigen vial for agglutination before use. Suspensions with agglutination are not usable and should be discarded.

References

1. **Murray, P. R., E. J. Baron, M. A. Pfaller, F. C. Tenover, and R. H. Yolken (ed.).** 1995. Manual of clinical microbiology, 6th ed. American Society for Microbiology, Washington, D. C.
2. **Isenberg, H. D. (ed.)**. 1992. Clinical microbiology procedures handbook, vol. 1. American Society for Microbiology, Washington, D. C.
3. **Ewing, W. H. (ed.).** 1986. Edwards and Ewing's identification of Enterobacteriaceae, 4th ed. Elsevier Science Publishing Co., Inc., New York, NY.
4. **McWhorter-Murlin, A. C., and F. W. Hickman-Brenner.** 1994. Identification and serotyping of *Salmonella* and an update of the Kauffmann-White Scheme. U. S. Dept. Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, Atlanta, GA.
5. **Popoff, M. Y., and L. LeMinor.** 1997. Antigenic formulas of the *Salmonella* serovars. WHO Collaborating Centre for Reference and Research on *Salmonella*. Institut Pasteur, Paris, France.

Packaging

QC Antigen Salmonella O Group A	1 ml	2130-50
QC Antigen Salmonella O Group B	1 ml	2131-50
QC Antigen Salmonella O Group C_1	1 ml	2132-50
QC Antigen Salmonella O Group C_2	1 ml	2133-50
QC Antigen Salmonella O Group D	1 ml	2134-50
QC Antigen Salmonella O Group E_1	1 ml	2135-50
QC Antigen Salmonella O Group E_2	1 ml	2136-50
QC Antigen Salmonella O Group E_4	1 ml	2137-50
QC Antigen Salmonella O Group F	1 ml	2138-50
QC Antigen Salmonella O Group G_1	1 ml	2139-50
QC Antigen Salmonella O Group H	1 ml	2140-50
QC Antigen Salmonella O Group I	1 ml	2141-50
QC Antigen Salmonella Vi	1 ml	2142-50
Febrile Negative Control	5 ml	3239-56

Bacto® QC Antigens Shigella

QC Antigen Shigella Group A · QC Antigen Shigella Group A_1 QC Antigen Shigella Group B · QC Antigen Shigella Group C QC Antigen Shigella Group C_1 · QC Antigen Shigella Group C_2 QC Antigen Shigella Group D · QC Antigen Alkalescens-Dispar Group 1

Intended Use

Bacto QC Antigens Shigella and Bacto QC Antigen Alkalescens-Dispar Group 1 are used in the quality control testing of Shigella Antisera Poly and Alkalescens-Dispar Antiserum Poly by the slide agglutination test.

User Quality Control

Identity Specifications

QC Antigens Shigella

Appearance: Light gray to white suspension.

QC Antigen Alkalescens-Dispar Group 1

Appearance: Light gray to white suspension.

Febrile Negative Control

Lyophilized appearance: Colorless to light gold, button to powdered cake.

Rehydrated appearance: Colorless to light gold, clear liquid.

Performance Response

Rehydrate Shigella Antiserum Poly and Alkalescens-Dispar Antiserum Poly per label directions. Perform the slide agglutination test using an appropriate QC Antigens Shigella or Alkalescens-Dispar Group 1.

The following chart lists the QC Antigens Shigella or QC Antigen Alkalescens-Dispar Group 1 recommended as the homologous (positive) control antigen. The homologous control antigen has certain identifying antigen(s) in common with the antiserum.

ANTISERUM	QC ANTIGEN HOMOLOGOUS CONTROL
Shigella Antiserum Poly Group A	Shigella Group A
Shigella Antiserum Poly Group A_1	Shigella Group A_1
Shigella Antiserum Poly Group B	Shigella Group B
Shigella Antiserum Poly Group C	Shigella Group C
Shigella Antiserum Poly Group C_1	Shigella Group C_1
Shigella Antiserum Poly Group C_2	Shigella Group C_2
Shigella Antiserum Poly Group D	Shigella Group D
Alkalescens-Dispar Antiserum Poly	Alkalescens-Dispar Group 1

Summary and Explanation

Shigella species cause the diarrheal disease known as shigellosis (classic bacillary dysentery) in humans. The range of illness is from mild diarrhea to severe dysentery characterized by abdominal cramps and frequent passage of bloody, mucoid stools. While the disease is usually self-limiting, it can be life threatening to the young, the elderly and malnourished persons. *Shigella* species are carried primarily in humans and are not generally distributed in nature. While transmission is usually direct person-to-person or through contaminated water supplies, food borne outbreaks do occur.

The genus *Shigella* belongs to the family Enterobacteriaceae. *Shigella* are facultatively anaerobic, gram-negative bacilli that typically are oxidase negative, lactose negative, H_2S negative and do not produce gas. *Shigella* and *Escherichia* are genetically related. Certain strains of *E. coli* may resemble *Shigella* biochemically because both can be lactose negative, nonmotile and non-gas-producing. These anaerogenic, nonmotile types have historically been called the Alkalescens-Dispar group and are presently classified as *E. coli*.[1-6]

Serological testing with polyvalent and group specific antisera should be used to confirm the identification of isolates that are morphologically and biochemically identified as *Shigella* species. *Shigella* are nonmotile, so serological identification is based on somatic ("O") antigens. However, some strains have envelope antigens that prevent agglutination in somatic antisera. Heating the suspension at 100°C for 15-60 minutes destroys these interfering antigens. The four named species or serotypes of *Shigella* are *S. dysenteriae* (10 serovars), *S. flexneri* (six serovars), *S. boydii* (15 serovars) and *S. sonnei*. For a complete and current explanation of the classification of *Shigella*, consult appropriate references.[1]

Shigella Antisera Poly and Alkalescens-Dispar Antiserum Poly are used in the serological identification of *Shigella* species and the Alkalescens-Dispar (A-D) Group. QC Antigens Shigella and Alkalescens-Dispar Group 1 are designed as positive controls for testing the efficacy of the *Shigella* grouping antisera used in laboratory procedures.

QC Antigens Shigella and QC Antigen Alkalescens-Dispar Group 1 may also be used as negative controls by using a heterologous antigen (possessing no common antigen) with a given test serum. However, cross reactivity may occur. Consult appropriate references for further details on cross reactivity.[1]

Principles of the Procedure

Serological procedures that confirm the identification of an organism are usually agglutination reactions. Agglutination reactions may be either homologous or heterologous. Homologous reactions occur between a microorganism (antigen) and the corresponding antibody. These reactions occur rapidly and are strong. Heterologous reactions occur when a microorganism (antigen) reacts with an antibody produced in response to another species or serotype. These reactions occur slowly and are weak.

Heterologous reactions may be unexpected and unpredictable and may lead to confusion in serological identification. Therefore, only strongly positive homologous agglutination reactions should be regarded as significant.

Reagents

QC ANTIGEN	ORGANISM IDENTITY
Shigella Group A	*Shigella dysenteriae* type 1
Shigella Group A_1	*Shigella dysenteriae* type 8
Shigella Group B	*Shigella flexneri* type 6
Shigella Group C	*Shigella boydii* type 3
Shigella Group C_1	*Shigella boydii* type 8
Shigella Group C_2	*Shigella boydii* type 12
Shigella Group D	*Shigella sonnei*
Alkalescens-Dispar Group 1	*E. coli* A-D Group 1

QC Antigens Shigella and QC Antigen Alkalescens-Dispar Group 1 contain killed whole organisms preserved in 0.5% formaldehyde. They are ready to use.

When used as described, each vial of antigen contains sufficient reagent for 20 slide tests.

Precautions

1. For In Vitro Diagnostic Use.
2. **QC Antigen Shigella Group A**
   QC Antigen Shigella Group A_1
   QC Antigen Shigella Group B
   QC Antigen Shigella Group C
   QC Antigen Shigella Group C_1
   QC Antigen Shigella Group C_2
   QC Antigen Shigella Group D
   QC Antigen Alkalescens-Dispar Group 1

   POSSIBLE RISK OF IRREVERSIBLE EFFECTS. (US) Avoid contact with skin and eyes. Do not breathe mist. Wear suitable protective clothing. Keep container tightly closed. TARGET ORGAN(S): Eyes, Kidneys, Lungs, Skin.

   FIRST AID: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice. If swallowed seek medical advice immediately and show this container or label.

   The Packaging of This Product Contains Dry Natural Rubber.
3. Follow proper established laboratory procedure in handling and disposing of infectious materials.
4. QC Antigens Shigella and QC Antigen Alkalescens-Dispar Group 1 are not to be used for immunization of humans or animals.

Storage

Store QC Antigens Shigella and QC Antigen Alkalescens-Dispar Group 1 at 2-8°C. Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

QC Antigens Shigella
QC Antigen Alkalescens-Dispar Group 1

Materials Required But Not Provided

Febrile Negative Control
Agglutination slides
Applicator sticks
Sterile 0.85% NaCl solution

Reagent Preparation

QC Antigens Shigella and QC Antigen Alkalescens-Dispar Group 1 are ready to use.

Equilibrate all materials to room temperature prior to performing the tests. Ensure that all glassware and pipettes are clean and free of residues such as detergents.

Test Procedure

1. **Positive control**: Dispense 1 drop (35 µl) of the Shigella Antiserum or Alkalescens-Dispar Antiserum Poly to be tested on an agglutination slide. Add 1 drop of the appropriate QC Antigen Shigella or QC Antigen Alkalescens-Dispar Group 1 chosen as the positive control and mix thoroughly.
2. **Negative control**: Dispense 1 drop of sterile 0.85% NaCl solution or Febrile Negative Control on the agglutination slide. Add 1 drop of the appropriate QC Antigen Shigella or QC Antigen Alkalescens-Dispar Group 1 and mix thoroughly.
3. Rotate the slide for 1 minute and read for agglutination.

Results

1. Read and record results as follows:
   4+ 100% agglutination; background is clear to slightly hazy.
   3+ 75% agglutination; background is slightly cloudy.
   2+ 50% agglutination; background is moderately cloudy.
   1+ 25% agglutination; background is cloudy.
   – No agglutination.
2. **Positive control**: Should show 3+ or greater agglutination.
3. **Negative control**: Should show no agglutination. Rough reactions can occur. If so, repeat the test using Febrile Negative Control.

Limitations of the Procedure

1. Excessive heat from external sources (hot bacteriological loop, burner flame, light source, etc.) may prevent a smooth suspension of the microorganism or may cause evaporation or precipitation of the test mixture. False-positive reactions can occur.
2. Exposure to temperatures below 2°C can cause autoagglutination. Antigens must be smooth uniform suspensions. Examine antigen vials for agglutination before use. Suspensions with agglutination are not usable and should be discarded.
3. Allow the QC Antigens, the antisera and all equipment used to be at room temperature at the time of testing. The test reagents, if cold, may cause false-negative reactions.
4. Shake the antigen well before use to suspend the organisms.

References

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5. **Andrews, W. H., G. A. June, and P. S. Sherrod.** 1995. Shigella, p. 6.01-6.06. *In* FDA Bacteriological Analytical Manual, 8th ed. AOAC International, Gaithersburg, MD.
6. **Smith, J. L.** 1992. *Shigella*, p. 423-431. *In* C. Vanderzant and D. F. Splittstoesser (eds.), Compendium of methods for the microbiological examination of foods, 3rd ed. American Public Health Association, Washington, D.C.

Packaging

QC Antigen Shigella Group A	1 ml	2100-50
QC Antigen Shigella Group A_1	1 ml	2101-50
QC Antigen Shigella Group B	1 ml	2102-50
QC Antigen Shigella Group C	1 ml	2103-50
QC Antigen Shigella Group C_1	1 ml	2104-50
QC Antigen Shigella Group C_2	1 ml	2105-50
QC Antigen Shigella Group D	1 ml	2106-50
QC Antigen Alkalescens-Dispar Group 1	1 ml	2116-50
Febrile Negative Control	5 ml	3239-56

Bacto® Salmonella Antisera

Salmonella O Antisera · Salmonella H Antisera · Salmonella H Antisera Spicer-Edwards

Intended Use

Bacto Salmonella O Antisera are used in agglutination tests for the identification of *Salmonella* by somatic (O) antigens.

Bacto Salmonella H Antisera are used in tube agglutination tests for the identification of *Salmonella* by flagellar (H) antigens.

User Quality Control

Identity Specifications

Salmonella O Antisera

Lyophilized Appearance: Light gold to amber, button to powdered cake.

Rehydrated appearance: Light gold to amber, clear liquid.

Salmonella H Antisera

Lyophilized Appearance: Light gold to amber, button to powdered cake.

Rehydrated appearance: Light gold to amber, clear liquid.

continued on following page

Bacto Salmonella H Antisera Spicer-Edwards are used in tube agglutination tests for screening and identifying the most commonly encountered salmonellae by flagellar (H) antigens.

Summary and Explanation

Salmonella species cause a variety of human diseases called salmonelloses. The range of disease is from mild self-limiting gastroenteritis to more severe forms, possibly with bacteremia or typhoid fever, which can be life-threatening. Severe disease and bacteremia are associated primarily with three serovars of *S. enterica* subsp. *enterica* (Cholerasuis, Paratyphi A and Typhi) while most of the other 2,300 or more strains are associated with gastroenteritis. The severity of the diarrheal disease depends upon the virulence of the strain and the condition of the human host.

Salmonella is found in nature and occurs in the intestinal tract of many animals, both wild and domestic. The microorganism can spread to man from contact with the environment or from eating meat or vegetable food products.

User Quality Control cont.

Performance Response

Rehydrate Salmonella O, Salmonella Vi, and Salmonella H Antisera per label directions. Perform the slide agglutination test using appropriate Salmonella O and Vi Antisera and QC Antigens Salmonella O Groups A -I and Vi.

The chart below includes the QC Antigens Salmonella O recommended as homologous (positive) control antigens. (The homologous control antigen has certain identifying antigen(s) in common with the antiserum.) For a negative (heterologous) antigen control, use a QC Antigen Salmonella containing antigens unrelated to those in the homologous control.

Homologous control: Should show 3+ or greater agglutination.

Negative control: Should show no agglutination. Rarely, a +/– reaction is possible.

For Salmonella H Antisera, maintain stock cultures of known serological identification, and prepare antigen positive and negative controls by using known serotypes and following the procedure described above in Tube Test Preparation.

SALMONELLA O ANTISERUM	QC ANTIGEN SALMONELLA O HOMOLOGOUS CONTROL
Poly A-I & Vi	Groups A,B,C_1,C_2,D,E_1,E_2, E_4,F,G_1,H,I,Vi
Poly A	Groups A,B,D,E_1,E_2,E_4
Poly B	Groups C_1,C_2,F,G_1,H
Poly C	Group I
Group A Factors 1,2,12	Group A
Group B Factors 1,4,5,12	Group B
Group B Factors 1,4,12,27	Group B
Group C1 Factors 6,7	Group C_1
Group C2 Factors 6,8	Group C_2
Group D1 Factors 1,9,12	Group D
Group E Factors 1,3,10,15,19,34	Groups E_1,E_2,E_4
Group E1 Factors 3,10	Group E_1
Group E2 Factors 3,15	Group E_2
Group E4 Factors 1,3,19	Group E_4
Group F Factor 11	Group F
Group G Factors 13,22,23,(36),(37)	Group G_1
Group G1 Factors 13,22,(36),(37)	Group G_1
Group H Factors 1,6,14,24,25	Group H
Group I Factor 16	Group I
Vi	Group Vi
Factor 2	Group A
Factor 4	Group B
Factors 4,5	Group B
Factor 5	Group B
Factor 7	Group C_1
Factor 8	Group C_2
Factor 9	Group D
Factor 10	Group E_1
Factor 15	Group E_2
Factor 19	Group E_4
Factor 22	Group G_1
Factor 14	Group H

Note: Parentheses ( ) enclosing the designation for an antigen indicate that the antigen is poorly developed or agglutinates weakly agglutinates. For a complete and current explanation of the classification of *Salmonella*, consult appropriate references.[1,2,3,8,11]

Table 1. Differentiation of the genus Salmonella from other genera.[1]

Test	*Salmonella*	*Citrobacter amolonaticus*	*Citrobacter diversus*	*Citrobacter freundii*	*Edwardsiella*
Indole production	–	+	+	–	d
Citrate, Simmons	+	[+]	+	+	–
H_2S production	+	–	–	[+]	d
Urea hydrolysis	–	[+]	d	d	–
Lysine decarboxylase	+	–	–	–	+
Ornithine decarboxylase	+	+	+	[–]	[+]
D-Adonitol, acid production	–	–	+	–	–
L-Arobinose, acid production	+	+	+	+	–
L-Rhamnose, acid production	+	+	+	+	–
D-Sorbitol, acid production	+	+	+	+	–
D-Xylose, acid production	+	+	+	+	–
Acetate utilization	+	[+]	[+]	[+]	–

\+ 90-100% positive
[+] 76-89% positive
d 26-75% positive
[–] 11-25% positive
– 0-10% positive

All *Salmonella* serovars belong to two species: *S. bongori*, which contains 18 serovars, and *S. enterica*, which contains the remaining 2,300 or more serovars divided among six subspecies.[2,3]

The six subspecies of *S. enterica* are:

S. enterica subsp. *enterica* (I or 1)
S. enterica subsp. *salamae* (II or 2)
S. enterica subsp. *arizonae* (IIIa or 3a)
S. enterica subsp. *diarizonae* (IIIb or 3b)
S. enterica subsp. *houtenae* (IV or 4)
S. enterica subsp. *indica* (VI or 6)

(The legitimate species name for *S. enterica* is *S. choleraesuis*. However, this name may be confused with the serotype named "choleraesuis." At the International Congress for Microbiology in 1986, the International Subcommittee for *Enterobacteriaceae* agreed to adopt the species name, *S. enterica*.[4] LeMinor and Popoff[5] published a request to the Judicial Commission to use *S. enterica* as a species name. The Commission ruled that *S. choleraesuis* is the legitimate name.[6,7] *S. enterica* is used in many countries and is favorably accepted as the species name.[8,9] The Centers for Disease Control has adopted this designation until the problem of naming this species is resolved.[2])

Nomenclature and classification of these bacteria are constantly changing.[1] *Salmonella* and the former *Arizona* should be considered a single genus, *Salmonella*.[9] It is recommended that laboratories report the names of *Salmonella* serovars for the subspecies *enterica*. The serovar names are no longer italicized and the first letter is capitalized. For example, the strain that used to be identified as *Salmonella typhimurium* is now known as *Salmonella* Typhimurium.

Serovars of other subspecies of *S. enterica* (except some in the subspecies *salamae* and *houtenae*) and those of *S. bongori* are not named and are designated by their antigenic formula. For the most recent information on nomenclature, consult appropriate references.[1,7,10-13]

Results are for 48-hours incubation. Tests were performed at 35-37°C.

Serotypes of *Salmonella* are defined based on the antigenic structure of both somatic or cell wall (O) antigens and flagellar (H) antigens. The antigenic formula lists the O antigen(s) first, followed by the H antigen(s). The major antigens are separated by colons and the components of the antigens separated by commas. For example, the antigenic formula for *Salmonella* Typhimurium is *Salmonella* 1,4,5,12:i:1,2. This means that the strain has O antigen factors 1,4,5 and 12, the flagella phase 1 antigen i, and flagella phase 2 antigens 1 and 2.

Complete identification of *Salmonella* requires cultural isolation, biochemical characterization and serotyping. However well-defined the serology of *Salmonella*, the use of serological procedures does not supersede cultural isolation and biochemical characterization. Any serological results obtained before biochemical identification must be considered as presumptive identification only. Consult to appropriate references for complete identification of *Salmonella*.[1,2,3,8,11-14]

Characterizing the Serotypes of *Salmonella*

Salmonella O Antigens: The somatic (O) heat-stable antigens are identified first. The O antigens are numbered 1-67 using Arabic numerals. The numbers are not completely continuous because certain strains were reclassified to other genera and the antigenic Arabic numbers were deleted from the schema.

Table 2a. Differentiation of *Salmonella* species, subspecies, and some serovars.[1,2]

Test	*Salmonella enterica*					
	Salmonella bongori	subsp. *arizonae*	subsp. *enterica*	subsp. *diazonae*	subsp. *houtenae*	subsp. *indica*
Citrate, Simmons	+	+	+	+	+	[+]
H_2S production	+	+	+	+	+	+
Lysine decarboxylase	+	+	+	+	+	+
Ornithine decarboxylase	+	+	+	+	+	+
Motility	+	+	+	+	+	+
KCN, growth	+	–	–	–	+	–
Malonate utilization	–	+	–	+	–	–
D-Glucose, gas	[+]	+	+	+	+	+
L-arobinose, acid	+	+	+	+	+	+
Dulcitol, acid	+	–	+	–	–	d
Lactose, acid	–	[–]	–	[+]	–	[–]
Maltose, acid	+	+	+	+	+	+
Melibiose, acid	[+]	+	+	+	+	[+]
L-Rhamnose, acid	+	+	+	+	+	+
D-Sorbitol	+	+	+	+	+	–
Trehalose, acid	+	+	+	+	+	+
D-Xylose, acid	+	+	+	+	+	+
Mucate, acid	+	+	+	d	–	+
Tartrate, Jordans	–	–	+	[–]	d	+
ONPG	+	+	–	+	–	D

Table 2b. Differentiation of *Salmonella* species, subspecies and some serovars.[1,2]

Test	*Salmonella enterica*					
	subsp. *salamae*	subsp. *enterica* serovar Choleraesuis	serovar Gallinarum	Serovar Paratyphi A	serovar Pullorum	Serovar Typhi
Citrate, Simmons	+	[–]	–	–	–	–
H_2S production	+	d	+	–	+	+
Lysine decarboxylase	+	+	+	–	+	+
Ornithine decarboxylase	+	+	–	+	+	–
Motility	+	+	–	+	–	+
KCN, growth	–	–	–	–	–	–
Malonate utilization	+	–	–	–	–	–
D-Glucose, gas	+	+	–	+	+	–
L-arobinose, acid	+	–	[+]	+	+	–
Dulcitol, acid	+	–	+	+	–	–
Lactose, acid	–	–	–	–	–	–
Maltose, acid	+	+	+	+	–	+
Melibiose, acid	–	d	–	+	–	+
L-Rhamnose, acid	+	+	–	+	+	–
D-Sorbitol	+	[+]	–	+	[–]	+
Trehalose, acid	+	–	d	+	[+]	+
D-Xylose, acid	+	+	d	–	[+]	[+]
Mucate, acid	+	–	d	–	–	–
Tartrate, Jordans	d	[+]	+	–	–	+
ONPG	[–]	–	–	–	–	–

\+ 90-100% positive
[+] 76-89% positive
d 26-75% positive
[–] 11-25% positive
0 10% positive

Serogroups represent the organization of *Salmonella* strains based on the antigen(s) shared in common and are designated by the letters A-Z. After exhausting the alphabet, the serogroups were numbered beginning with No. 51 (the serogroup Z organism having antigen No. 50). While one somatic antigen identifies each serogroup, certain other antigens may be shared among several serogroups.

Most organisms contain antigens in common that will cause cross-reactions in an unabsorbed or "partially absorbed" antiserum. One somatic antigen identifies a serogroup and is shared in common by all members of a given serogroup. For example, serogroup A is represented by three members, *Salmonella* Paratyphi A (somatic antigens 1,2,12), *Salmonella* Kiel (somatic antigens 1,2,12), and *Salmonella* Nitra (somatic antigens 2,12). All three members of this serogroup contain antigens 2 and 12 in common. Serogroup B is represented by many organisms consisting having different combinations of somatic antigens 1,4,5,12 and 27. Serogroup D organisms contain somatic antigens 1,9,12, etc.

In the above example, all three serogroups A, B, and D contain antigens 1 and 12. An antiserum prepared from a 1,2,12 culture, if not absorbed, will react with cultures of serogroups B and D in varying degrees depending on the concentration of the commonly shared 1 and 12 factors. This must be taken into consideration when choosing an antiserum to be used in the examination of the salmonellae.

Several different antisera are available. Some represent group antigens. Others are single factor sera, which should be used when testing for an identifiable antigen in a given serogroup. Such a single factor serum is not called a "group" serum, though it contains the group identifiable agglutinin. (It has been recommended by the CDC that the term "group" be applied only to those sera possessing all the major agglutinins found in that group.)

In unabsorbed antisera, cross-reactions occur if strains sharing some "like" antigens are tested, even when they are in separate serogroups based on the major group antigen(s) they possess. Unabsorbed antisera are available as group antisera containing all factors in that group.

In absorbed antisera, cross reactions are less likely and are weaker. Absorbed antisera are available as factor specific antisera.

Flagellar *Salmonella* H Antigens: The flagellar (H) antigens are heat labile and are usually associated with motility. Cultures are ordinarily flagellated and actively motile, although flagellated cultures can be nonmotile. H antigen characterization is done after the serogroup of the strain is determined. The H antigens of *Salmonella* are designated by letters of the alphabet, a-z, followed by z, z_1, z_2, etc., and by Arabic numerals. H antigens exist in 2 phases, phase 1 and phase 2. Phase 1 antigens are expressed in letters a-z, etc., and the phase 2 antigens are most often expressed in Arabic numerals. Older cultures may express both phases of a diphasic serotype, but recent clinical isolates more often express only one phase. Phase reversal may be necessary to isolate both phases of a diphasic culture. Consult an appropriate reference for more detailed information.[8]

A pure H antiserum cannot be prepared without some somatic content. However, since H antigens are highly antigenic, the serum derived from motile cultures may be used at a dilution that reduces somatic agglutination below the detection level.

***Salmonella* Vi Antigen**: The Vi Antigen is a heat-labile envelope antigen that may surround a cell wall and mask somatic antigen activity. Microorganisms having the Vi Antigen will not agglutinate in O antisera.

Using Salmonella Antisera

Salmonella O Antisera: The recommended serological Identification scheme begins with Salmonella O Antisera Poly A through Poly G, which contain the following:

SALMONELLA POLY GROUP ANTISERA	SOMATIC GROUPS PRESENT
Bacto Salmonella O Antiserum Poly A	A,B,D,E_1,(E_2,E_3),*E_4,L
Bacto Salmonella O Antiserum Poly B	C_1,C_2,F,G,H
Bacto Salmonella O Antiserum Poly C	I,J,K,M,N,O
Bacto Salmonella O Antiserum Poly D	P,Q,R,S,T,U
Bacto Salmonella O Antiserum Poly E	V,W,X,Y,Z
Bacto Salmonella O Antiserum Poly F	51–55
Bacto Salmonella O Antiserum Poly G	56–61

*Strains of groups E_2 and E_3 are lysogenized by phage 15, then by phage 34. These strains are now classified into group E_1.[3]

If agglutination occurs, use individual Salmonella O Group Factor Antisera to determine the specific serogroup to which the isolate belongs. For efficiency, test first with individual Salmonella O Group Factor Antisera.

If agglutination does not occur with Poly A or B, test the isolate with Salmonella O Antiserum Vi. If positive, heat and retest. If agglutination does not occur with Salmonella O Antiserum Vi, the isolate is not likely to be *Salmonella*. Results should be examined. If questions exist, the isolate should be sent to a reference laboratory.

If agglutination does not occur with Poly C, D, E, F, and G, the isolate is not likely to be *Salmonella*.

Table 3. Schema for using Salmonella O Antisera Poly Groups A, B, C, D, E, F and G.

Test with	Salmonella O antisera Poly Groups A, B, C, D, E, F and G			
Test Result	+	– with Poly A or B		– with Poly C, D, E, F and G
Test with	Individual Salmonella O Antisera	Vi Antiserum		
Test Result	+ with one Salmonella O Antiserum (required)	+	–	
Test Conclusion or Next Action	Determine the *Salmonella* H Antigen	Heat and retest with individual Salmonella O Antisera	Test isolate is not a *Salmonella*	Test isolate is not a *Salmonella*

Salmonella O Antiserum Poly A-I and Vi: This antiserum detects factors 1-16, 19, 22-25, 34 and Vi. This combination of factors represents the most frequently isolated Groups A-I and the Vi antigens and is used to screen possible *Salmonella* isolates.

A positive reaction indicates that further serological testing is needed to identify the isolate using Salmonella O Group Factor Antisera. The most common serogroups are B, D and C_1. For efficiency, first use the Salmonella O Group Factor Antisera for these serogroups.

If the isolate is positive with Salmonella O Antiserum Poly A-I and Vi but negative with Poly A-Poly G, test the isolate with Salmonella Vi Antiserum. If positive with Salmonella Vi Antiserum, heat and retest using individual Salmonella O Antisera. If negative with Salmonella

Vi Antiserum, the isolate is not likely to be Salmonella. Results should be examined. If questions exist, the isolate should be sent to a reference laboratory.

A negative reaction indicates the isolate is not in serogroups A-I. If the biochemical reactions are consistent with *Salmonella*, a serogroup other than A-I is possible. Further testing with antisera for other serogroup antigens is necessary.

Table 4. Schema for using Salmonella O Antiserum Poly A-I & Vi.

Test with	Salmonella O Antisera Poly A-I and Vi			
Test Result	+			–
Test with	Individual Salmonella O Antisera			
Test Result	+	–		
Test with		Salmonella Vi Antiserum		
Test Result		+	–	
Test Conclusion or Next Action	Determine the Salmonella H Antigen	Heat and retest with individual Salmonella O Antisera	Test isolate is not a *Salmonella*	*May* be a *Salmonella* detectable by use of Salmonella O Antisera Poly C, D, E, F or G

Salmonella O Group Factor Antisera and Single Factor Antisera: Use selected Salmonella O Group Factor Antisera. Cross reactions may occur between serogroups that share O antigens. Consider this partial list of Salmonella O Group Factor Antisera as an example:

Salmonella O Antiserum Group A Factors 1, 2, 12

Salmonella O Antiserum Group B Factors 1, 4, 5, 12

Salmonella O Antiserum Group B Factors 1, 4, 12, 27

Factors 1 and 12 occur in combination with other antigens and may cause cross-reactions. The strength of the reactions will help in interpretation. Rapidly forming 3+ or greater agglutination indicates a homologous reactions.

Use selected Salmonella O Factor Antisera. Absorbed antisera specific for an identifiable antigen in a given serogroup is used to identify the isolate further. In the example above, Salmonella O Factor Antisera could be used:

Salmonella O Antiserum Factor 2

Salmonella O Antiserum Factor 4

Salmonella O Antiserum Factors 4, 5

Salmonella O antiserum Factor 5

Polyvalent Salmonella H Antisera: Further identification of a *Salmonella* isolate includes the characterization of the flagellar antigens. Agglutination with the following Polyvalent H Antisera can be done:

SALMONELLA POLY GROUP ANTISERA	FLAGELLAR ANTIGENS PRESENT
Salmonella H Antiserum Poly a-z	Groups EN,G,L,Z_4, 1 complexes and a-k,r-z,z_6,z_{10},z_{29}
Salmonella H Antiserum Poly A	Groups a,b,c,d,i,z_{10},z_{29}
Salmonella H Antiserum Poly B	Groups eh,en,enx,enz$_{15}$, G complex
Salmonella H Antiserum Poly C	Groups k,l,r,y,z,z_4
Salmonella H Antiserum Poly D	Groups z_{35},z_{36},z_{37},z_{38},z_{39},z_{41},z_{42}
Salmonella H Antiserum Poly E	1 complex z_6

Absorbed H antisera specific for single antigens or a complex of antigens can be used to identify the isolate further.

Unabsorbed and Absorbed Salmonella H Antisera: Complete identification of a *Salmonella* isolate involves analysis of phase 1 and phase 2 antigens using H antisera. For the complex pattern of analysis and procedures, consult appropriate references.[8]

Salmonella H Antisera Spicer-Edwards: Salmonella H Antisera Spicer-Edwards is used for screening and identifying the most commonly encountered *Salmonella* using a combination of polyvalent and single complex antisera.

Table 5. Identification of *Salmonella* H using Salmonella H Antisera Spicer-Edwards.

	Salmonella H Antisera Spicer-Edwards			
H Antigen(s)	**1**	**2**	**3**	**4**
a	+	+	+	–
b	+	+	–	+
c	+	+	–	–
d	+	–	+	+
e,h	+	+	+	–
G Complex*	+	–	–	+
i	+	–	–	–
k	–	+	+	+
r	–	+	–	+
y	–	+	–	–
z	–	–	+	+
Z_4 Complex**	–	–	+	–
z_{10}	–	–	–	+
z_{29}	–	+	+	–

Table 6. Identification of *Salmonella* H using Salmonella H Antisera.

H Antigen(s)	Salmonella H Antisera
e,n,x, e,n,z_{15}	EN Complex
I,v I,w I,z_{13} I,z_{28}	L Complex
1,2 1,5 1,6 1,7	1 Complex

* The G complex component of Salmonella H Antisera Spicer-Edwards 1 and 4 reacts with antigens f,g; f,g,s; f,g,t; g,m; g,m,q; g,m,s; g,m,s,t; g,m,t; g,p; g,p,s; g,p,u; g,q; g,s,t; g,t; m,p,t,u; and m,t.

** The Z_4 Complex component reacts with z_4,z_{23}; z_4,z_{24}; and z_4, z_{32}.

Note that no antigen is positive with all four Salmonella H Antisera Spicer-Edwards Any antigen that reacts with all four sera should be checked for smoothness.

Extent of Serological Identification Necessary

Complete serological characterization of *Salmonella* is not required for successful detection of the microorganism when it occurs as a pathogen. The use of adequate isolation procedures and differential biochemical tests is of primary importance. Possible *Salmonella* isolates can be presumptively identified with a minimum of serological identification. Isolates can be sent to laboratories that perform the level of testing necessary to completely identify the microorganism.

For a further discussion of the serological identification of *Salmonella*, consult appropriate references.[1,2,3,8,11]

Principles of the Procedure

Identification of *Salmonella* species includes both biochemical and serological identification. Serological confirmation involves the procedure in which the microorganism (antigen), reacts with its corresponding antibody. This *in vitro* reaction produces macroscopic clumping called agglutination. The desired homologous reaction is rapid, does not dissociate (high avidity) and bonds strongly (high affinity).

Because a microorganism (antigen) may agglutinate with an antibody produced in response to another species, heterologous reactions are possible. These are characterized as weak in strength or slow in formation. Such unexpected and perhaps unpredictable reactions may lead to some confusion in serological identification. Therefore, a positive homologous agglutination reaction should support the morphological and biochemical identification of the microorganism.

Agglutination of the somatic antigen in the slide test appears as a firm granular clumping. Homologous reactions are rapid and strong (3+). Heterologous reactions are slow and weak.

Agglutination of the flagellar antigens in the tube test appears as a loose flocculation that can easily be resuspended.

Reagents

Salmonella O, H, and Vi Antisera are lyophilized, polyclonal rabbit antisera containing approximately 0.04% Thimerosal as a preservative.

Salmonella O Poly Antisera are polyvalent antisera. Each antiserum is specific for certain serogroup antigens. When properly rehydrated and used as recommended, each vial of Salmonella O or Vi Antisera contains sufficient reagent for 60 tests. Salmonella O Antisera Poly A-I and Vi is prepared with representative strains of these serogroups and is not absorbed. It may cross-react with other antisera because of shared common O antigens.

Salmonella O Group Antisera are specific for the major factors present in the serogroup. Salmonella O Factor Antisera are specific for the factors of the individual serogroups. When using Salmonella O Group Antisera, cross-reactions are possible because serogroups may share non-major group antigens. Salmonella O Factor Antisera are absorbed as necessary to render each antiserum as specific as practical without reducing the homologous reactions to an unsatisfactory level.

Salmonella H Poly Antisera are polyvalent antisera. Each antiserum is specific for certain flagellar antigens. Each vial of Salmonella H Antiserum contains sufficient reagent to perform between 150-1500 tests, depending on the antiserum used. Salmonella H Antisera are either absorbed or unabsorbed specifically for either phase 1 or phase 2 antigens. Salmonella H Antisera Spicer-Edwards are pooled, polyvalent antisera and additional adjunctive antisera to identify the more commonly occurring H antigens.

Precautions

1. For In Vitro Diagnostic Use.
2. The Packaging of This Product Contains Dry Natural Rubber.
3. Follow proper established laboratory procedure in handling and disposing of infectious materials.

Storage

Store lyophilized and rehydrated Salmonella O, H and Vi antisera at 2-8°C.

Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products. Discard any antiserum that becomes cloudy during storage.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

Salmonella O Antisera
Salmonella H Antisera
Salmonella Vi Antiserum
(See Packaging.)

Materials Required But Not Provided

Slide Test

0.85% NaCl solution, sterile
Agglutination slides with 1 inch squares
Applicator sticks
Boiling waterbath
Centrifuge
QC Antigens Salmonella

Tube Test

0.85% NaCl solution, sterile
Culture tubes, 12 x 75 mm, and rack
Waterbath, 50 ± 2°C
Serological pipettes, 1 ml
Formaldehyde

Reagent Preparation

Equilibrate all materials to room temperature prior to performing the tests. Ensure that all glassware and pipettes are clean and free of residues such as detergents.

Salmonella O, H and Vi Antisera: To rehydrate, add 3 ml of sterile 0.85% NaCl solution and rotate gently to completely dissolve the contents. Rehydrated antisera are considered a 1:2 dilution. Subsequent Salmonella O Antisera dilutions are based on this as a starting dilution. The H antisera are further diluted for use.

Specimen Collection and Preparation

Clinical specimens: *Salmonella* can be recovered from selective differential media such as Hektoen Enteric Agar or XLD agar. For specific recommendations, consult appropriate references.[11,12] Determine that a pure culture of the microorganism has been obtained and

that biochemical test reactions are consistent with the identification of the organism as a *Salmonella* species. After these criteria are met, serological identification can be performed.

Food samples: *Salmonella* can be recovered when samples are processed to recover injured microorganisms and prevent overgrowth of competing microorganisms. Consult appropriate references for recommended procedures for isolation of Salmonella from foods.[13,14] Determine that a pure culture of the microorganism has been obtained and that biochemical test reactions are consistent with the identification of the organism as a *Salmonella* species. After these criteria have been met, serological identification can be performed.

Slide Test Procedure

Salmonella O and Vi Antisera

Use this procedure to test the isolate with each selected antiserum.

1. **Salmonella Antiserum**: Add Dispense 1 drop (3 µl) of each antiserum to be tested on an agglutination slide.
2. **Negative control**: Dispense 1 drop of 0.85% sterile NaCl solution on an agglutination slide.
3. **Test isolate**: From a solid agar medium, transfer a portion of a loopful of an isolated colony to each of the two reaction areas above and mix thoroughly.
4. **Positive control**: Dispense 1 drop of each Salmonella O Antiserum to be tested on an agglutination slide. Add 1 drop of an appropriate QC Antigen Salmonella.
5. Rotate the slides for 1 minute and read for agglutination. Results must be read within 1 minute.

Slide Test Results

1. Read and record results as follows:

   4+ 100% agglutination; background is clear to slightly hazy.
   3+ 75% agglutination; background is slightly cloudy.
   2+ 50% agglutination; background is moderately cloudy.
   1+ 25% agglutination; background is cloudy.
   – No agglutination.
2. **Positive control**: Should show a 3+ or greater agglutination.
3. **Negative control**: Should show no agglutination. If agglutination occurs, the culture is rough and cannot be tested. Subculture to a non-inhibitory medium, incubate and test the organism again.
4. **Test isolates**: 3+ or greater agglutination is a positive result.
5. A partial (less than 3+) or delayed agglutination reaction should be considered negative.
6. If a positive reaction occurs with Salmonella Vi Antiserum, follow this procedure:
   - Prepare a dense suspension of the isolate from an agar medium in 3-5 ml of sterile 0.85% NaCl solution.
   - Heat in a boiling waterbath for 30-60 minutes and cool. The suspension should not precipitate after heating. If this occurs, select another colony for testing.
   - Centrifuge at 1,000 rpm for 10-15 minutes.
   - Aspirate and discard the supernatant.
   - Resuspend the sediment in 0.5 ml sterile 0.85% NaCl solution.
   - Retest a drop of the sediment with Salmonella O Group Antisera, as outlined.
7. If the heated culture continues to react with Salmonella Vi Antiserum and not with the Salmonella O Antisera, the isolate may not be *Salmonella*. Test the isolate further to determine if it is correctly identified.
8. If an H antigen identification is required, proceed to the next section.
9. When a negative reaction is obtained with Salmonella O Antiserum Poly A-I and Vi in the above procedure, the organism is presumptively negative for *Salmonella* that belong to serogroups A-I. Biochemical tests should be performed to confirm this negative result. If biochemical tests prove the organism to be a *Salmonella*, a serogroup beyond serogroup A-I is probably involved.

   If the organism reacts with Poly A-I and Vi but does not react with the specific somatic antiseraa, it should be checked with Salmonella Vi Antiserum by the above procedure.

Tube Test Preparation

1. **0.6% formalized saline**: Prepare by adding 6 ml formaldehyde per 1,000 ml of sterile 0.85% NaCl solution.
2. **Test organism**: It is often necessary to increase the motility of the test organism. To accomplish this, make several consecutive transfers in Motility GI Medium.
   - Inoculate the tube slightly below the surface of the medium using the stab method.
   - Incubate at 35-37°C for 18-20 hours.
   - Transfer only those organisms that have migrated to the bottom of the tube.
   - When the organism successfully travels 50-60 mm through the medium in 18-20 hours, it is ready for use.
   - An infusion broth such as Veal Infusion Broth is recommended for cultivating the motile *Salmonella* prior to testing. It should be inoculated and incubated at 35°C for 24 hours. Brain Heart Infusion Broth may be used with incubation at 35°C for 4-6 hours. If Tryptic Soy Broth is used, incubate at 35°C for 24 hours.
   - Prepare the test organism suspension by using equal volumes of broth culture and 0.6% formalized saline. The final density of this test suspension should be that of a McFarland Barium Sulfate Standard No. 3.
3. **Positive control**: Commercially prepared QC Salmonella H antigens are not available. The user must maintain stock cultures of known serological identification for use in quality control. Prepare the antigen by using known serotypes and following the procedure described above. (See Test organism, above.)
4. **Salmonella H Antisera**: Rehydrated antisera is considered a 1:2 working dilution. Prepare dilutions as follows and use on the day prepared. Discard any unused portion.
   - Most **Salmonella H Antisera**: A 1:1,000 final dilution is used. Prepare by adding 0.1 ml rehydrated antiserum to 25 ml of 0.85% NaCl solution.
   - **Salmonella H Antisera x, z_{13}, z_{15} and z_{28}**: A 1:500 final dilution is used. Prepare by adding 0.1 ml rehydrated antiserum to 12.5 ml of 0.85% NaCl solution.
   - **Salmonella H Antiserum Poly a-z**: A 1:100 final dilution is used. Prepare by adding 0.1 ml rehydrated antiserum to 2.5 ml of 0.85% NaCl solution.

Tube Test Procedure

Salmonella H Antiserum:

1. Prepare a 12 x 75 ml culture tube for each organism to be tested.
2. **Diluted antiserum**: Dispense Add 0.5 ml of diluted antiserum in each tube.
3. **Test isolate**: Add 0.5 ml to the appropriate tube.
4. **Positive control**: Add 0.5 ml of antigen positive control to a tube containing 0.5 ml of antiserum.
5. **Negative control**: Add 0.5 ml of 0.85% NaCl solution to a tube containing 0.5 ml of test isolate.
6. Incubate all tubes in a waterbath at 50 ± 2°C for 1 hour.
7. Read for flocculation (agglutination).
8. Repeat the Tube Test using a phase-reversed test organism. (See the procedure for phase reversal below.)

Phase Reversal:

1. Prepare Motility GI Medium phase reversal medium according to directions.
2. Prepare the antiserum opposite to the phase desired. For example, incubating *Salmonella* Typhimurium phase 1[i] in GI Motility Medium containing i antiserum allows the growth and spread of *S.* Typhimurium phase 2 [1,2].
3. Add 1 ml of a 1:10 dilution of antiserum to 25 ml of sterile GI Motility Medium and mix well. Pour into a sterile Petri dish and allow to solidify.
4. Inoculate by punching the edge of the solidified medium.
5. Incubate at 35-37°C for 24 hours.
6. Transfer growth from the spreading edge opposite the inoculation site to a liquid medium for testing according to steps under Tube Test Procedure – Salmonella H Antisera.
7. If motility is not acceptable, pass through GI Motility Medium again.

Tube Test Procedure

Salmonella H Antiserum Spicer-Edwards

1. Prepare the test organism and the 1:2 antiserum dilution as described above in Tube Test Preparation.
2. **Final 1:1,000 dilution of antiserum**: Prepare by adding 0.1 ml of rehydrated antiserum (1:2 working dilution) to 25 ml of 0.85% NaCl solution.
3. Prepare 4 culture tubes (12 x 75 ml) for each test organism.
4. **Salmonella H Antisera Spicer-Edwards 1-4**: Add 0.5 ml of the diluted antiserum to the culture tubes.
5. **Test organism**: Add 0.5 ml to each tube.
6. Incubate tubes in waterbath at 50 ± 2°C for 1 hour.
7. Remove from the waterbath. Avoid excessive shaking when the tubes are in the waterbath or when removing them from the waterbath prior to reading the reactions.
8. Read for flocculation (agglutination).

Tube Test Results

Compare results with the flocculation (agglutination) patterns for the Spicer-Edwards schemae. (Table 5).

Limitations of the Procedure

1. Complete O and H antigen characterization of a *Salmonella* isolate is required for final identification. Due to the complexity of the laboratory procedures, identification with polyvalent antisera may be sufficient for most laboratories.
2. Possible *Salmonella* isolates having inconsistencies in biochemical reactions and O and H antigen tests should be referred to a reference laboratory for further testing.
3. Excessive heat from external sources (hot bacteriological loop, burner flame, light source, etc.) may prevent making a smooth suspension of the microorganism or cause evaporation or precipitation of the test mixture. False-positive reactions may occur.
4. Rough culture isolates do occur and will agglutinate spontaneously, causing agglutination of the negative control reaction (autoagglutination). Smooth colonies must be selected and tested in serological procedures.
5. In the slide agglutination procedure for O antigen testing, it is recommended that several colonies be tested and that unabsorbed polyvalent antisera be used followed by absorbed single factor antisera. For example, colonies of a 1,2,12 culture on an agar plate will have varying degrees of each antigen. A 1,2,12 antiserum absorbed of 1 and 12 antibodies will be highly specific but will show weak or no agglutination with colonies that have less of antigen 2 and more of antigens 1 and 12. Using unabsorbed Salmonella O Antiserum Group Factors 1,2,12 to test several suspicious colonies on a plate followed by testing with absorbed Salmonella O Antiserum Factor 2 gives the needed balance of sensitivity and specificity.
6. The slide agglutination antisera (Salmonella O Antisera) have been prepared for use in identifying cultures already defined biochemically. Such cultures are taken from an agar medium using a bacterial loop. A portion of the isolated colony is emulsified in a drop of antiserum. It is recommended that more than one colony be tested.

   The sera have been tested and absorbed using this method. They have not been tested employing an antigen suspension in NaCl solution or alcohol-treated cultures. If variations in the recommended procedures are to be used, the investigator is advised to test each lot of antiserum with known positive control cultures to ensure its proper homologous and heterologous reactions under their test conditions.
7. Agglutination reactions of 3+ or greater are interpreted as positive reactions. Cross-reactions resulting in a 1+ or 2+ agglutination are likely since there are somatic antigens shared among different groups as non-major group antigens.
8. The tube agglutination technique is recommended for H antigen testing because cross-reactions with somatic antigens may occur at the dilutions used in the slide technique.
9. No attempt has been made to absorb or test for O antibodies in H antisera.
10. In the tube test, make certain that the proper dilution is prepared for a given antiserum. Various dilutions are used for various sera. The information is given under Tube Test Preparation. Also, it is important in this test to use the recommended time and temperature of incubation. Make certain that the waterbath is in a location free of mechanical vibration.

11. There may exist common antigens between various "O" serogroups of Salmonella. As an example, Salmonella O Antiserum Poly A contains, among others, agglutinins for factor 1, since cultures possessing factor 1 were used in immunization. It may be expected that this polyvalent antiserum will react with cultures other than those contained in "O" serogroups A, B, D, E, and L due to the common 1 antigen (those organisms in Group G_1, G_2, H, R, T, etc., which contain factor 1).
12. Salmonella O Antiserum Poly A-I & Vi has been prepared with representative members of those somatic groups and has not been absorbed. It is obvious that this serum may and will react with higher O groups of Salmonella.

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Packaging

Salmonella H Antiserum a	3 ml	2820-47
Salmonella H Antiserum b	3 ml	2821-47
Salmonella H Antiserum c	3 ml	2822-47
Salmonella H Antiserum d	3 ml	2823-47
Salmonella H Antiserum eh	3 ml	2273-47
Salmonella H Antiserum f	3 ml	2544-47
Salmonella H Antiserum h	3 ml	2545-47
Salmonella H Antiserum I	3 ml	2824-47
Salmonella H Antiserum k	3 ml	2274-47
Salmonella H Antiserum m	3 ml	2546-47
Salmonella H Antiserum p	3 ml	2548-47
Salmonella H Antiserum r	3 ml	2275-47
Salmonella H Antiserum s	3 ml	2550-47
Salmonella H Antiserum t	3 ml	2551-47
Salmonella H Antiserum w	3 ml	2554-47
Salmonella H Antiserum x	3 ml	2555-47
Salmonella H Antiserum y	3 ml	2276-47
Salmonella H Antiserum z	3 ml	2277-47
Salmonella H Antiserum z_6	3 ml	2473-47
Salmonella H Antiserum z_{10}	3 ml	2279-47
Salmonella H Antiserum z_{13}	3 ml	2556-47
Salmonella H Antiserum z_{15}	3 ml	2557-47
Salmonella H Antiserum z_{23}	3 ml	2558-47
Salmonella H Antiserum z_{28}	3 ml	2561-47
Salmonella H Antiserum z_{29}	3 ml	2280-47
Salmonella H Antiserum z_{32}	3 ml	2562-47
Salmonella H Antiserum EN Complex	3 ml	2270-47
Salmonella H Antiserum G Complex	3 ml	2269-47
Salmonella H Antiserum L Complex	3 ml	2271-47
Salmonella H Antiserum Z_4 Complex	3 ml	2278-47
Salmonella H Antiserum Poly a-z	3 ml	2406-47
Salmonella H Antiserum Poly A (a,b,c,d,i,z_{10},z_{29})	3 ml	2539-47
Salmonella H Antiserum Poly B (eh,en,enx,enz$_{15}$, and G Complex)	3 ml	2540-47
Salmonella H Antiserum Poly C (k,l,r,y,z_1,z_4)	3 ml	2541-47
Salmonella H Antiserum Poly D (z_{35},z_{36},z_{37},z_{38},z_{39},z_{41},z_{42})	3 ml	2542-47
Salmonella H Antiserum Poly E (1 Complex, z_6)	3 ml	2543-47
Salmonella H Antiserum Single Factor 2	3 ml	2474-47

Salmonella H Antiserum Single Factor 5	3 ml	2475-47
Salmonella H Antiserum Single Factor 6	3 ml	2476-47
Salmonella H Antiserum Single Factor 7	3 ml	2477-47
Salmonella H Antiserum Spicer-Edwards 1	3 ml	2265-47
Salmonella H Antiserum Spicer-Edwards 2	3 ml	2266-47
Salmonella H Antiserum Spicer-Edwards 3	3 ml	2267-47
Salmonella H Antiserum Spicer-Edwards 4	3 ml	2268-47
Salmonella H Antiserum 1 Complex	3 ml	2272-47
Salmonella O Antiserum Factor 2	3 ml	2814-47
Salmonella O Antiserum Factor 4	3 ml	2659-47
Salmonella O Antiserum Factors 4,5	3 ml	2815-47
Salmonella O Antiserum Factor 5	3 ml	2660-47
Salmonella O Antiserum Factor 7	3 ml	2816-47
Salmonella O Antiserum Factor 8	3 ml	2817-47
Salmonella O Antiserum Factor 9	3 ml	2818-47
Salmonella O Antiserum Factor 10	3 ml	2257-47
Salmonella O Antiserum Factor 12	3 ml	2779-47
Salmonella O Antiserum Factor 14	3 ml	2661-47
Salmonella O Antiserum Factor 15	3 ml	2258-47
Salmonella O Antiserum Factor 19	3 ml	2259-47
Salmonella O Antiserum Factor 20	3 ml	2662-47
Salmonella O Antiserum Factor 22	3 ml	2663-47
Salmonella O Antiserum Factor 23	3 ml	2664-47
Salmonella O Antiserum Factor 25	3 ml	2666-47
Salmonella O Antiserum Factor 27	3 ml	2667-47
Salmonella O Antiserum Factor 34	3 ml	2512-47
Salmonella O Antiserum Group A Factors 1,2,12	3 ml	2947-47
Salmonella O Antiserum Group B Factors 1,4,5,12	3 ml	2948-47
Salmonella O Antiserum Group B Factors 1,4,12,27	3 ml	2973-47
Salmonella O Antiserum Group C_1 Factors 6,7	3 ml	2949-47
Salmonella O Antiserum Group C_2 Factors 6,8	3 ml	2950-47
Salmonella O Antiserum Group C_3 Factors (8), 20	3 ml	3016-47
Salmonella O Antiserum Group D_1 Factors 1,9,12	3 ml	2951-47
Salmonella O Antiserum Group D_2 Factors (9),46	3 ml	3017-47
Salmonella O Antiserum Group E Factors 1,3,10,15,19,34	3 ml	2819-47
Salmonella O Antiserum Group E_1 Factors 3,10	3 ml	2952-47
Salmonella O Antiserum Group E_2 Factors 3,15	3 ml	2954-47
Salmonella O Antiserum Group E_3 Factors (3),(15),34	3 ml	3018-47
Salmonella O Antiserum Group E_4 Factors 1,3,19	3 ml	3019-47
Salmonella O Antiserum Group F Factor 11	3 ml	2260-47
Salmonella O Antiserum Group G Factors 13,22,23,(36),(37)	3 ml	3029-47
Salmonella O Antiserum Group G_1 Factors 13,22,(36)	3 ml	2261-47
Salmonella O Antiserum Group G_2 Factors 1,13,23,(37)	3 ml	3020-47
Salmonella O Antiserum Group H Factors 1,6,14,24,25,47	3 ml	2262-47
Salmonella O Antiserum Group I Factor 16	3 ml	2263-47
Salmonella O Antiserum Group J Factor 17	3 ml	2517-47
Salmonella O Antiserum Group K Factor 18	3 ml	2518-47
Salmonella O Antiserum Group L Factor 21	3 ml	2519-47
Salmonella O Antiserum Group M Factor 28	3 ml	2520-47
Salmonella O Antiserum Group N Factor 30	3 ml	2521-47
Salmonella O Antiserum Group O Factor 35	3 ml	2522-47
Salmonella O Antiserum Poly A-I & Vi	3 ml	2264-47
Salmonella O Antiserum Poly A (A,B,D,E_1,E_2,E_3,E_4,& L)	3 ml	2534-47
Salmonella O Antiserum Poly B (C_1,C_2,F,G, & H)	3 ml	2535-47
Salmonella O Antiserum Poly C (I,J,K,M,N,& O)	3 ml	2536-47
Salmonella O Antiserum Poly D (P,Q,R,S,T,& U)	3 ml	2537-47
Salmonella O Antiserum Poly E (V,W,X,Y, & Z)	3 ml	2538-47
Salmonella O Antiserum Poly F (Groups 51-55)	3 ml	2645-47
Salmonella O Antiserum Poly G (Groups 56-61)	3 ml	2646-47
Salmonella O Antiserum Vi	3 ml	2827-47

Salmonella, Antigenic Scheme
Update of the Kauffmann-White Scheme

The Centers for Disease Control[1] has modified the Kauffmann-White[2] Antigenic Scheme originally proposed by Ewing.[3] The updated scheme is used with Difco *Salmonella* Antisera as an aid in the serological identification of *Salmonella*.

All of the *Salmonella* serovars belong to two species: *S. bongori* containing 18 serovars and *S. enterica* containing the remaining 2300+ serovars divided among 6 subspecies.[1,4]

The six subspecies of *S. enterica* are:

- *S. enterica* subsp. *enterica* (I or 1)
- *S. enterica* subsp. *salamae* (II or 2)
- *S. enterica* subsp. *arizonae* (IIIa or 3a)
- *S. enterica* subsp. *diarizonae* (IIIb or 3b)
- *S. enterica* subsp. *houtenae* (IV or 4)
- *S. enterica* subsp. *indica* (VI or 6)

The legitimate species name for the above subspecies is *S. choleraesuis*. However, this name may be confused with the serotype named "*choleraesuis*." At the International Congress for Microbiology in 1986, the International Subcommittee for *Enterobacteriaceae* agreed to adopt the species name "*S. enterica*."[5] LeMinor and Popoff[6] published a request for the use of *S. enterica* as a species name to the Judicial Commission. The Judicial Commission ruled that *S. choleraesuis* is the legitimate name.[7,8] *S. enterica* is used in many countries and is favorably accepted as the species name.[3,9] The Centers for Disease Control has adopted this designation until the problem of naming this species is resolved.[1]

Nomenclature and classification of these bacteria are ever changing.[13] *Salmonella* and the former *Arizona* should be considered a single genus - *Salmonella*.[9] It is recommended that laboratories report names of *Salmonella* serovars for the subspecies *enterica*. These serovar names are no longer italicized.[1,4] The first letter of the serovar name begins with a capital letter. For example, the strain that used to be identified as "*Salmonella typhimurium*" is now known as "*Salmonella* Typhimurium."

Serovars of other subspecies of *S. enterica* (except some in subspecies *salamae* and *houtenae*) and those of *S. bongori* are not named, and are designated by their antigenic formula. For the most recent information on nomenclature, consult appropriate references.[1,4,8,10-14]

Serotypes of *Salmonella* are defined based on the antigenic structure of both somatic or cell wall (O) antigens and flagellar (H) antigens. The O antigen groups were first designated by letters of the alphabet. Additional antigens were later delineated. Since each letter of the alphabet was already used to describe an O antigen group, numbers 51 to 67 were used to describe the next O antigen groups.

O ANTIGEN GROUP	O ANTIGEN FACTORS PRESENT
A	1,2,12
B	4,12; 1,4,5,12; or 1,4,12,27
C_1	6,7,[Vi] or 6,7,14
C_2	6,8
C_3	8; or 8,20
D_1	1,9,12
D_2	9,46
D_3	1,9,12,46,27
E_1	3,10
E_2	3,15
E_3	3,15,34
E_4	1,3,19
F	11
G	13,22 or 13,23
H	6,14; 6,14,24; or 1,6,14,25
I	16
J	17
K	18
L	21
M	28
N	30
O	35
P	38
Q	30
R	40
S	41
T	42
U	43
V	44
W	45
X	47
Y	48
Z	50
51	51
52	52
53	53
54	54
55	55
56	56
57	57
58	58
59	59
60	60
61	61
62	62
63	63
65	65
66	66
67	67

When writing an antigenic formula, list the O antigen(s) first followed by the H antigen(s). Separate the major antigens by colons and the components of the antigens by commas. For example, the antigenic formula for *Salmonella* Typhimurium is *Salmonella* 1,4,5,12:i:1,2. This means that the strain has O antigen factors 1,4,5 and 12, the flagella phase 1 antigen i, and flagellar phase 2 antigens 1 and 2.

Complete identification of *Salmonella* requires cultural isolation, biochemical characterization and serotyping. Any serological results obtained before biochemical identification must be considered as presumptive identification only. Refer to appropriate references for complete identification of *Salmonella*.[1,3,4,10,12-15]

The Kauffmann-White Scheme is presented in two forms. Appendix A contains a list of Salmonella Serotypes by O Group. Appendix B contains an alphabetical list of *Salmonella* Serotypes.

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Appendix A

Kauffmann-White Scheme

List of *Salmonella* Serotypes by O Group

(Updated 1994)

Appendix A contains a list of Salmonella Serotypes by O Group. The serotypes are sorted by O group first, then by Phase I and Phase 2 of the H antigens. The z antigens do not appear in the correct numerical order - z_4 will be listed after z_{10} because the 1 of 10 is read first, and will appear after z_{29}.

Key:

IP	Institut Pasteur. See reference #16 in Kauffmann-White Scheme monograph published by WHO Collaborating Centre for Reference and Research on Salmonella.
Ar.	"Arizona" antigenic formula
Rohde	Refer to reference #17 in Kauffmann-White Scheme monograph by R. Rohde. He incorporated all known Arizona serotypes into the Kauffmann-White Scheme.
Bergey	Refer to reference #18 in Kauffmann-White Scheme monograph by L. LeMinor for "Bergey's Manual of Systematic Bacteriology."
Underlined Numbers	Numbers that are underlined in a serotype represent somatic factors determined by phage conversion. They are present if the culture is lysogenized by the corresponding converting phage.
[ ]	O or H factors may be present or absent without relation to phage conversion.
( )	O or H factor is weakly agglutinable.
R phases	Abnormal specificities of H antigens that were described by Kauffmann. They are uncommon.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	A	Paratyphi A	1,2,12	a	[1,5]	
I	A	Nitra	2,12	g,m	-	
I	A	Kiel	1,2,12	g,p	-	
I	A	Koessen	2,12	l,v	1,5	
II	B		4,12	–	1,6	
I	B	Abortusequi	4,12	–	e,n,x	
I	B	Kisangani	1,4,[5],12	a	1,2	
I	B	Fulica	4,[5],12	a	1,5	
I	B	Hessarek	4,12,27	a	1,5	
I	B	Arechavaleta	4,[5],12	a	[1,7]	
I	B	Bispejerg	1,4,[5],12	a	e,n,x	
II	B		1,4,[5],12,27	a	e,n,x	
II	B	Makoma	1,4,[5],12,27	a	[e,n,x]	
I	B	Tinda	1,4,5,27	a	e,n,z_{15}	
I	B	Huettwilen	1,4,12	a	l,w	
II	B		1,4,12,27	a	z_{39}	
I	B	Nakuru	1,4,12,27	a	z_6	
I	B	Schleissheim	4,12,27	b	–	
I	B	Java	1,4,5,12	b	[1,2], (tartrate +)	IP calls Java, Paratyphi B var. Java. Java is often monophasic in the U.S. May possess H phase Rz_{33}.
I	B	Limete	1,4,12,27	b	1,5	
II	B		4,12	b	1,5	
I	B	Canada	4,12,27	b	1,6	
I	B	Uppsala	4,12,27	b	1,7	
I	B	Abony	1,4,5,12	b	e,n,x	IP combined Sladun (1,4,12,27:b:e,n,x) with Abony to form Abony 1,4,[5],12,27:b:e,n,x (gelatin neg.).
I	B	Abortusbovis	1,4,12,27	b	e,n,x	Gelatin pos., mucate pos.[1-4 days.] Abortusbovis was combined with Abony (1,4,5,12:b:e,n,x), gelatin neg. The name Abortusbovis was dropped.
I	B	Sladun	1,4,12,27	b	e,n,x	IP combined Sladun with Abony (1,3,4,12: b:e,n,x) to form Abony 1,4,[5],12,27:b:e,n,x. Sladun is now called Abony var. O 27+. The name Sladun has been dropped.
II	B	Sofia	1,4,12,27	b	[e,n,x]	
I	B	Wagenia	1,4,12,27	b	e,n,z_{15}	
I	B	Wien	1,4,12,27	b	l,w	
I	B	Abortuscanis	4,5,12	b	Rz_5	Abortuscanis was combined with Paratyphi B (1,4,[5],12:b:1,2) in 1938 and the name Abortuscanis was dropped.
I	B	Tripoli	1,4,12,27	b	z_6	
I	B	Paratyphi B	1,4,[5],12	[b]	[1,2]	Paratyphi B is tartrate neg.; Paratyphi B var. Java (CDC calls this *S.* ser. Java) is often monophasic (1,4,5,12:b:-) and is tartrate pos. Paratyphi B and Java may possess H phase Rz_{33}.
I	B	Legon	1,4,12,27	c	1,5	
I	B	Abortusovis	4,12	c	1,6	
I	B	Altendorf	4,12	c	1,7	IP combined Womba (4,12,27:c:1,7) with Altendorf to form Altendorf 4,12,27:c:1,7.
I	B	Womba	4,12,27	c	1,7	IP combined Womba with Altendorf (4,12:c:1,7) to form Altendorf 4,12,27:c:1,7. Womba is now called Altendorf var. 027+. The name Womba has been dropped.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	B	Bissau	4,12	c	e,n,x	
I	B	Jericho	1,4,12,27	c	e,n,z_{15}	
I	B	Hallfold	1,4,12,27	c	l,w	
I	B	Bury	4,12,27	c	z_6	
I	B	Cairo	1,4,12,27	d	1,2	IP combined Cairo with Stanley (4,5,12:d:1,2) to form Stanley 1,4,[5],12,27:d:1,2. The name Cairo has been dropped.
I	B	Stanley	4,5,12	d	1,2	IP combined Cairo (1,4,12,27:d:1,2) with Stanley to form Stanley 1,4,[5],12,27:d:1,2
I	B	Eppendorf	1,4,12,27	d	1,5	
I	B	Brezany	1,4,12,27	d	1,6	
I	B	Schwarzengrund	1,4,12,27	d	1,7	
I	B	Sarajane	1,4,[5],12,27	d	e,n,x	
II	B	Kluetjenfelde	4,12	d	e,n,x	
I	B	Duisburg	1,4,12,27	d	e,n,z_{15}	
I	B	Mons	1,4,12,27	d	l,w	
I	B	Ayinde	1,4,12,27	d	z_6	
I	B	Salinatis	4,12	d,e,h	d,e,n,z_{15}	IP states that Salinatis was combined with Duisburg (1,4,12,27:d:e,n,z_{15}). This is incorrect; IP should have stated that it was combined with Sandiego (4,[5],12:e,h:e,n,z_{15}), because Salinatis loses the d and becomes Sandiego.
I	B	Saintpaul	1,4,[5],12	e,h	1,2	
I	B	Reading	1,4,[5],12	e,h	[1,5]	
I	B	Eko	4,12	e,h	1,6	
I	B	Kaapstad	4,12	e,h	1,7	
I	B	Chester	1,4,[5],12	e,h	e,n,x	
I	B	Sandiego	4,[5],12	[e,h]	e,n,z_{15}	
II	B		4,12	e,n,x	1,2,7	
II	B	Makumira	1,4,12,27	e,n,x	1,[5],7	
II	B		4,12	(f),g	–	Not in IP book
I	B	Derby	1,4,[5],12	f,g	[1,2]	
I	B	Agona	1,4,[5],12	f,g,s	[1,2]	
II	B		4,[5],12	f,g,t	z_6,z_{42}	
I	B	Essen	4,12	g,m	–	
I	B	Hato	4,[5],12	g,m,s	–	
I	B	California	4,12	g,m,t	–	
II	B		4,12	g,m,t	–	IP calls this monophasic var. of Bechuana.
II	B		4,12	g,m,t	z_{39}	
II	B	Caledon	1,4,12,27	g,[m],[s],t	e,n,x	
II	B	Bechuana	1,4,12,27	g,[m],t	[1,5]	
I	B	Joenkoeping	4,5,12	g,s,t	–	IP combined Joenkoeping with Kingston (1,4,12,27:g,s,t:-) to form Kingston 1,4,[5],12,27:g,s,t:-. The name Joenkoeping has been dropped.
I	B	Kingston	1,4,12,27	g,s,t	[1,2]	IP combined Kingston with Joenkoeping (4,5,12:g,s,t:-) to form Kingston 1,4,[5],12,27:g,s,t:[1,2]. Kingston may possess H phase Rz_{27} or Rz_{43}.
I	B	Budapest	1,4,12,27	g,t	–	
I	B	Travis	4,[5],12	g,z_{51}	1,7	
I	B	Tennyson	4,5,12	g,z_{51}	e,n,z_{15}	
II	B		4,12	g,z_{62}	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	B	Typhimurium var. Copenhagen	1,4,12	i	1,2	
I	B	Typhimurium	1,4,5,12	i	1,2,[7]	
I	B	Lagos	1,4,[5],12	i	1,5	
I	B	Agama	4,12	i	1,6	
I	B	Farsta	4,12	i	e,n,x	
I	B	Tsevie	4,12	i	e,n,z_{15}	
I	B	Gloucester	1,4,12,27	i	l,w	
II	B		4,12,27	i	z_{35}	
I	B	Tumodi	1,4,12	i	z_6	
I	B	Massenya	1,4,12,27	k	1,5	
I	B	Neumuenster	1,4,12,27	k	1,6	
II	B		1,4,12,27	k	1,6	
I	B	Ljubljana	4,12,27	k	e,n,x	
I	B	Texas	4,[5],12	k	e,n,z_{15}	
I	B	Fyris	4,[5],12	l,v	1,2	
I	B	Azteca	4,[5],12,27	l,v	1,5	
I	B	Bredeney	1,4,12,27	l,v	1,7	Bredeney may possess H phase Rl,z_{40} instead of l,v.
I	B	Kimuenza	1,4,12,27	l,v	e,n,x	
II	B		1,4,12,27	l,v	e,n,x	
I	B	Brandenburg	1,4,[5],12,27	l,v	e,n,z_{15}	
II	B		1,4,12,27	l,v	z_{39}	
I	B	Clackamas	4,12	l,v,[z13]	1,6	IP does not get z_{13}
I	B	Mono	4,12	l,w	1,5	
I	B	Togo	4,12	l,w	1,6	
II	B	Kilwa	4,12	l,w	e,n,x	
I	B	Ayton	1,4,12,27	l,w	z_6	
I	B	Haduna	4,12	l,z13,[z28]	1,6	
I	B	Kubacha	1,4,12,27	l,z13,z28	1,7	
I	B	Kano	1,4,12,27	l,z13,z28	e,n,x	
I	B	Vom	1,4,12,27	l,[z13],[z28]	e,n,z_{15}	
I	B	Tyresoe	4,12	l,[z13],z28	1,5	
I	B	Kunduchi	1,4,[5],12,27	l,[z13],[z28]	[1,2]	
II	B		4,12	l,z28	–	
I	B	Reinickendorf	4,12	l,z28	e,n,x	
I	B	Banana	1,4,[5],12	m,t	[1,5]	Banana may possess H phase Rz_{45}.
I	B	Madras	4,[5],12	m,t	e,n,z_{15}	
I	B	Heidelberg	1,4,[5],12	r	1,2	
I	B	Bradford	4,12,27	r	1,5	
I	B	Winneba	4,12	r	1,6	
I	B	Remo	1,4,12,27	r	1,7	
I	B	Bochum	4,[5],12	r	l,w	
I	B	Southampton	1,4,12,27	r	z_6	
I	B	Africana	4,12	r,i	l,w	
I	B	Drogana	1,4,12,27	r,(i)	e,n,z_{15}	IP calls Drogana r,i.
I	B	Coeln	4,[5],12	y	1,2	
I	B	Trachau	4,12,27	y	1,5	
I	B	Finaghy	4,12	y	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	B	Teddington	1,4,12,27	y	1,7	
I	B	Ball	1,4,12,27	y	e,n,x	IP combined Ball with Ruki (4,5,12:y:e,n,x) and Dalat (4,5,27:y:e,n,x) to form Ball 1,4,[5],12,27:y:e,n,x.
I	B	Ruki	4,5,12	y	e,n,x	IP combined Ruki with Ball (1,4,12,27:y:e,n,x) and Dalat (4,5,27:y:e,n,x) to form Ball 1,4,[5], 12,27:y:e,n,x. The name Ruki has been dropped.
I	B	Dalat	4,5,27	y	e,n,x	Dalat was combined with Ball. The name Dalat has been dropped.
I	B	Jos	1,4,12,27	y	e,n,z_{15}	
I	B	Kamoru	4,12,27	y	z_6	
I	B	Shubra	4,[5],12	z	1,2	
I	B	Kiambu	4,12	z	1,5	
II	B		1,4,12,27	z	1,5	
I	B	Loubomo	4,12	z	1,6	
I	B	Indiana	1,4,12	z	1,7	
II	B		4,12	z	1,7	
I	B	Neftenbach	4,12	z	e,n,x	
II	B	Nordenham	1,4,12,27	z	e,n,x	
I	B	Koenigstuhl	1,4,[5],12	z	e,n,z_{15}	
I	B	Preston	1,4,12	z	l,w	
II	B		4,12	z	z_{39}	
I	B	Entebbe	1,4,12,27	z	z_6	
I	B	Haifa	1,4,[5],12	z_{10}	1,2	
I	B	Ituri	1,4,12	z_{10}	1,5	
I	B	Tudu	4,12	z_{10}	1,6	
I	B	Albert	4,12	z_{10}	e,n,x	
I	B	Tokoin	4,12	z_{10}	e,n,z_{15}	
I	B	Mura	1,4,12	z_{10}	l,w	
I	B	Vellore	1,4,12,27	z_{10}	z_{35}	
I	B	Fortune	1,4,12,27	z_{10}	z_6	
I	B	Brancaster	1,4,12,27	z_{29}	–	
II	B	Helsinki	1,4,12	z_{29}	[e,n,x]	
I	B	Pasing	4,12	z_{35}	1,5	
I	B	Tafo	1,4,12,27	z_{35}	1,7	
I	B	Yaounde	1,4,12,27	z_{35}	e,n,z_{15}	
I	B	Sloterdijk	1,4,12,27	z_{35}	z_6	
I	B	Tejas	4,12	z_{36}	–	
I	B	Wilhelmsburg	1,4,[5],12,27	z_{38}	[e,n,z15]	
II	B	Durbanville	1,4,12,27	[z_{39}]	1,[5],7	
I	B	Jaja	4,12,27	z_4,z_{23}	–	IP combined Jaja with Stanleyville (1,4,[5],12:z_4,z_{23}:[1,5]) to form Stanleyville 1,4,[5],12,27:z4,z23:[1,5]. Jaja is now called Stanleyville var. O 27+. The name Jaja has been dropped.
I	B	Stanleyville	1,4,[5],12	z_4,z_{23}	[1,2]	IP combined Jaja (4,12,27:z_4,z_{23}:-) with Stanleyville to form Stanleyville 1,4,[5],12,27:z_4,z_{23}:[1,2].
I	B	Vuadens	4,12,27	z_4,z_{23}	z_6	
I	B	Kalamu	4,[5],12	z_4,z_{24}	[1,5]	
I	B	Thayngen	1,4,12,27	z_{41}	1,(2),5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	B	Maska	1,4,12,27	z_{41}	e,n,z_{15}	
II	C_1		6,7	–	1,6	
I	C_1	Sanjuan	6,7	a	1,5	
II	C_1		6,7,14	a	1,5	
I	C_1	Umhlali	6,7	a	1,6	
I	C_1	Austin	6,7	a	1,7	
I	C_1	Oslo	6,7,14	a	e,n,x	
I	C_1	Denver	6,7	a	e,n,z_{15}	
I	C_1	Coleypark	6,7,14	a	l,w	
II	C_1	Calvinia	6,7	a	z_{42}	
I	C_1	Damman	6,7	a	z_6	
II	C_1		6,7	a	z_6	
I	C_1	Nissii	6,7,14	b	–	Nissii was combined with Nienstedten (6,7,14:b:l,w) as a monophasic variant of Nienstedten. Nienstedten is now called a variant of Ohio by IP. The name Nissii has been dropped.
I	C_1	Brazzaville	6,7	b	1,2	
I	C_1	Edinburg	6,7	b	1,5	
I	C_1	Adime	6,7	b	1,6	
I	C_1	Koumra	6,7	b	1,7	
I	C_1	Lockleaze	6,7,14	b	e,n,x	
II	C_1	Bloemfontein	6,7	b	[e,n,x]:z_{42}	
I	C_1	Georgia	6,7	b	e,n,z_{15}	
I	C_1	Ohio	6,7	b	l,w	IP combined Nienstedten (6,7,14:b:[l,w]) with Ohio to form Ohio 6,7,14:b:[l,w}. Ohio may possess H phase Rz_{59}.
I	C_1	Nienstedten	6,7,14	b	[l,w]	Nienstedten was combined with Nissii (6,7,14:b:-) and called Nienstedten; then IP combined Nienstedten with Ohio (6,7:b:l,w) to form Ohio (6,7,14:b:[l,w]). Nienstedten is now called Ohio var. O 14+ by IP.
I	C_1	Kotte	6,7	b	z_{35}	
II	C_1		6,7	b	z_{39}	
I	C_1	Leopoldville	6,7,14	b	z_6	
I	C_1	Hissar	6,7,14	c	1,2	
I	C_1	Choleraesuis	6,7	c	1,5	H_2S negative
I	C_1	Decatur	6,7	c	1,5	IP has dropped Decatur and calls it dulcitol positive, mucate positive variant of Choleraesuis.
I	C_1	Paratyphi C	6,7,[Vi]	c	1,5	
I	C_1	Typhisuis	6,7	c	1,5	Typhisuis is a bioserotype found in pigs. It is like Choleraesuis except tartrate negative.
I	C_1	Choleraesuis var. Kunzendorf		6,7	c	[1,5] H_2S positive
I	C_1	Birkenhead	6,7	c	1,6	
I	C_1	Schwabach	6,7	c	1,7	
I	C_1	Namibia	6,7	c	e,n,x	
I	C_1	Kaduna	6,7,14	c	e,n,z_{15}	
I	C_1	Kisii	6,7	d	1,2	
I	C_1	Kambole	6,7	d	1,[2],7	
I	C_1	Isangi	6,7,14	d	1,5	
I	C_1	Mission	6,7	d	1,5	Mission was combined with Isangi 6,7,14:d:1,5. The name Mission has been dropped.
I	C_1	Kivu	6,7	d	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_1	Amersfoort	6,7	d	e,n,x	IP combined Omderman (6,7,14:d:e,n,x) with Amersfoort to form Amersfoort 6,7,14:d:e,n,x.
I	C_1	Omderman	6,7,14	d	e,n,x	IP combined Omderman with Amersfoort (6,7:d:e,n,x) to form Amersfoort 6,7,14:d:e,n,x. Omderman is now called Amersfoort var. O 14+ by IP.
I	C_1	Gombe	6,7,14	d	e,n,z_{15}	
I	C_1	Eimsbuettel	6,7,14	d	l,w	IP combined Eimsbuettel with Livingstone (6,7:d:l,w) to form Livingstone 6,7,14:d:l,w. Eimbuettel is now called Livingstone var. O 14+ by IP.
I	C_1	Livingstone	6,7	d	l,w	IP combined Eimsbuettel (6,7,14:d:l,w) with Livingstone to form Livingstone 6,7,14:d:l,w.
I	C_1	Wil	6,7	d	l,z_{13},z_{28}	
II	C_1		6,7	d	z_{42}	
I	C_1	Nieukerk	6,7,14	d	z_6	
I	C_1	Larochelle	6,7	e,h	1,2	
I	C_1	Lomita	6,7	e,h	1,5	
I	C_1	Norwich	6,7	e,h	1,6	
I	C_1	Nola	6,7	e,h	1,7	
I	C_1	Braenderup	6,7,14	e,h	e,n,z_{15}	
I	C_1	Ardwick	6,7,14	f,g	–	IP combined Ardwick with Rissen (6,7:f,g:-) to form Rissen 6,7,14:f,g:-. Ardwick is now called Rissen var. O 14+ by IP.
I	C_1	Rissen	6,7	f,g	–	IP combined Ardwick (6,7,14:f,g:-) with Rissen for form Rissen 6,7,14:f,g:-.
I	C_1	Eingedi	6,7	f,g,t	1,2,7	
I	C_1	Afula	6,7	f,g,t	e,n,x	
II	C_1		6,7	(g),m,[s],t	[1,5]	
I	C_1	Montevideo	6,7,14	g,m,[p],s	[1,2,7]	
II	C_1		6,7	g,m,[s],t	e,n,x	
I	C_1	Othmarschen	6,7,14	g,m,[t]	–	
II	C_1		6,7	g,[m],s,t	[z_{42}]	
I	C_1	Menston	6,7	g,s,[t]	[1,6]	
I	C_1	Riggil	6,7	g,t	–	
II	C_1		6,7	g,t	e,n,x:z_{42}	
IV	C_1		6,7	g,z51	–	
I	C_1	Alamo	6,7	g,z_{51}	1,5	
I	C_1	Augustenborg	6,7,14	i	1,2	
I	C_1	Oritamerin	6,7	i	1,5	
I	C_1	Garoli	6,7	i	1,6	
I	C_1	Lika	6,7	i	1,7	
I	C_1	Athinai	6,7	i	e,n,z_{15}	
I	C_1	Norton	6,7	i	l,w	
I	C_1	Stuttgart	6,7,14	i	z_6	
I	C_1	Galiema	6,7,14	k	1,2	
I	C_1	Daytona	6,7	k	1,6	
I	C_1	Baiboukoum	6,7	k	1,7	
I	C_1	Singapore	6,7	k	e,n,x	
I	C_1	Escanaba	6,7	k	e,n,z_{15}	
I	C_1	Cardiff	6,7	k	R1,10	IP combined Cardiff that contains H phase R1,10 with Thompson (6,7,14:k:1,5).

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	C_1		6,7	k	[z_6]	
IIIa	C_1		6,7	(k)	z:[z_{55}]	(Ar. 27:22:31:[37])
I	C_1	Thompson	6,7,14	[k]	[1,5]	IP combined Cardiff that contains H phase R1,10 (6,7:k:R1,10) with Thompson.
I	C_1	Concord	6,7	l,v	1,2	
I	C_1	Irumu	6,7	l,v	1,5	
I	C_1	Mkamba	6,7	l,v	1,6	
I	C_1	Kortrijk	6,7	l,v	1,7	
I	C_1	Bonn	6,7	l,v	e,n,x	
I	C_1	Potsdam	6,7,14	l,v	e,n,z_{15}	
I	C_1	Coromandel	6,7	l,v	z_{35}	
IIIb	C_1		6,7	l,v	z_{53}	(Ar. 27:23:25)
I	C_1	Gdansk	6,7	l,v	z_6	IP combined Gelsenkirchen (6,7,14:l,v:z_6) with Gdansk to form Gdansk 6,7,14:l,v:z_6.
I	C_1	Gelsenkirchen	6,7,14	l,v	z_6	IP combined Gelsenkirchen with Gdansk (6,7:l,v:z_6) to form Gdansk 6,7,14:l,v:z_6. Gelsenkirchen is now called Gdansk var. O 14+ by IP.
I	C_1	Gabon	6,7	l,w	1,2	
I	C_1	Colorado	6,7	l,w	1,5	
II	C_1		6,7	l,w	1,5,7	
II	C_1		6,7	l,w	z_{42}	
I	C_1	Nessziona	6,7	l,z13	1,5	
I	C_1	Kenya	6,7	l,z13	e,n,x	
I	C_1	Strathcona	6,7	l,z13,z28	1,7	
I	C_1	Makiso	6,7	l,z13,z28	z_6	
I	C_1	Neukoelin	6,7	l,z13,[z28]	e,n,z_{15}	
II	C_1	Heilbron	6,7	l,z28	1,5:[z_{42}]	
II	C_1		6,7	l,z28	e,n,x	
II	C_1		6,7	l,z28	z_6	
I	C_1	Haelsingborg	6,7	m,p,t,[u]	–	
I	C_1	Oranienburg	6,7	m,t	–	IP combined Theilallee (6,7,14:m,t:-) with Oranienburg to form Oranienburg 6,7,14:m,t:-. Oranienburg may possess H phase Rz$_{57}$.
I	C_1	Thielallee	6,7,14	m,t	–	IP combined Thielallee with Oranienburg (6,7:m,t:-) to form Oranienburg 6,7,14:m,t:-. Theilallee is now called Oranienburg var. O 14+ by IP.
II	C_1		6,7	m,t	–	
I	C_1	Winston	6,7	m,t	1,6	
I	C_1	Oakey	6,7	m,t	z_{64}	
I	C_1	Virchow	6,7	r	1,2	
I	C_1	Infantis	6,7,14	r	1,5	Infantis may possess H phase Rz$_{49}$.
I	C_1	Nigeria	6,7	r	1,6	
I	C_1	Colindale	6,7	r	1,7	
I	C_1	Papuana	6,7	r	e,n,z_{15}	
I	C_1	Grampian	6,7	r	l,w	
I	C_1	Richmond	6,7	y	1,2	
I	C_1	Bareilly	6,7,14	y	1,5	
I	C_1	Oyonnax	6,7	y	1,6	
I	C_1	Gatow	6,7	y	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_1	Hartford	6,7	y	e,n,x	Hartford may possess H phase Rz_{50} or Rz_{67}.
I	C_1	Mikawasima	6,7,14	y	e,n,z_{15}	Mikawasima may possess H phase Rz_{47} or Rz_{50}.
I	C_1	Chile	6,7	z	1,2	
I	C_1	Poitiers	6,7	z	1,5	
II	C_1	Tosamanga	6,7	z	1,5	
I	C_1	Oakland	6,7	z	1,6,[7]	
I	C_1	Cayar	6,7	z	e,n,x	
I	C_1	Businga	6,7	z	e,n,z_{15}	
I	C_1	Bruck	6,7	z	l,w	
II	C_1		6,7	z	z_{39}	
II	C_1	Oysterbeds	6,7	z	z_{42}	
II	C_1		6,7	z	z_6	
I	C_1	Menden	6,7	z_{10}	1,2	
I	C_1	Inganda	6,7	z_{10}	1,5	
I	C_1	Eschweiler	6,7	z_{10}	1,6	
I	C_1	Ngili	6,7	z_{10}	1,7	
I	C_1	Djugu	6,7	z_{10}	e,n,x	
I	C_1	Mbandaka	6,7,14	z_{10}	e,n,z_{15}	
I	C_1	Jerusalem	6,7,14	z_{10}	l,w	
I	C_1	Omuna	6,7	z_{10}	z_{35}	
II	C_1		6,7	z_{10}	z_{35}	
I	C_1	Redba	6,7	z_{10}	z_6	
II	C_1		6,7	z_{29}	–	
I	C_1	Tennessee	6,7,14	z_{29}	[1,2,7]	
I	C_1	Tienba	6,7	z_{35}	1,6	
I	C_1	Palime	6,7	z_{35}	e,n,z_{15}	
IV	C_1	Argentina	6,7	z_{36}	–	
I	C_1	Tampico	6,7	z_{36}	e,n,z_{15}	
II	C_1	Bacongo	6,7	z_{36}	z_{42}	
I	C_1	Bornum	6,7,14	z_{38}	–	IP combined Bornum with Lille (6,7:z_{38}:-) to form Lille 6,7,14:z_{38}:-. Bornum is now called Lille var. O 14+ by IP.
I	C_1	Lille	6,7	z_{38}	–	IP combined Lille with Bornum (6,7,14:z_{38}:-) to form Lille 6,7,14:z_{38}:-.
I	C_1	Rumford	6,7	z_{38}	1,2	
II	C_1	Gilbert	6,7	z_{39}	1,5,7	
IV	C_1	Roterberg	6,7	z_4,z_{23}	-	
I	C_1	Obogu	6,7	z_4,z_{23}	1,5	
I	C_1	Planckendael	6,7	z_4,z_{23}	1,6	
I	C_1	Goma	6,7	z_4,z_{23}	z_6	
I	C_1	Aequatoria	6,7	z_4,z_{23}	[e,n,z_{15}]	
I	C_1	Somone	6,7	z_4,z_{24}	–	
IV	C_1	Kralendyk	6,7	z_4,z_{24}	–	
II	C_1		6,7	z_4,z_{24}	z_{42}	
VI	C_1		6,7	z41	1,7	
I	C_1	Hillsborough	6,7	z41	l,w	
I	C_1	Tamilnadu	6,7	z_{41}	z_{35}	
II	C_1	Sullivan	6,7	z_{42}	1,7	
II	C_1		6,7	z_{42}	e,n,x:1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_1	Bulovka	6,7	z_{44}	–	
II	C_1	Cape	6,7	z_6	1,7	
I	C_2	Newport var. Puerto Rico	6,8	–	1,2	
II	C_2		6,8	–	1,5,7	
I	C_2	Valdosta	6,8	a	1,2	
I	C_2	Doncaster	6,8	a	1,5	
I	C_2	Curacao	6,8	a	1,6	
I	C_2	Nordufer	6,8	a	1,7	
I	C_2	Narashino	6,8	a	e,n,x	
II	C_2		6,8	a	e,n,x	
I	C_2	Leith	6,8	a	e,n,z_{15}	
II	C_2		6,8	a	z_{39}	
II	C_2	Tulear	6,8	a	z_{52}	
I	C_2	Be	8,20	a	[z_6]	
I	C_2	Djelfa	8	b	1,2	
I	C_2	Skansen	6,8	b	1,2	
I	C_2	Korbol	8,20	b	1,5	
I	C_2	Nagoya	6,8	b	1,5	
II	C_2		6,8	b	1,5	
I	C_2	Stourbridge	6,8	b	1,6	
I	C_2	Eboko	6,8	b	1,7	
I	C_2	Sanga	8	b	1,7	
I	C_2	Gatuni	6,8	b	e,n,x	
I	C_2	Konstanz	8	b	e,n,x	
I	C_2	Presov	6,8	b	e,n,z_{15}	
I	C_2	Shipley	8,20	b	e,n,z_{15}	
I	C_2	Bukuru	6,8	b	l,w	
I	C_2	Banalia	6,8	b	z_6	
I	C_2	Tounouma	8,20	b	z_6	
I	C_2	Wingrove	6,8	c	1,2	
I	C_2	Utah	6,8	c	1,5	
I	C_2	Bronx	6,8	c	1,6	
I	C_2	Belfast	6,8	c	1,7	
I	C_2	Belem	6,8	c	e,n,x	
I	C_2	Santiago	8,20	c	e,n,x	
I	C_2	Quiniela	6,8	c	e,n,z_{15}	
I	C_2	Alexanderpolder	8	c	l,w	
I	C_2	Tado	8,20	c	z_6	
I	C_2	Mexicana	6,8	d	1,2	Mexicana was combined with Muenchen. The name Mexicana has been dropped.
I	C_2	Muenchen	6,8	d	1,2	
I	C_2	Virginia	8	d	[1,2]	
I	C_2	Manhattan	6,8	d	1,5	
I	C_2	Yovokome	8,20	d	1,5	
I	C_2	Dunkwa	6,8	d	1,7	
I	C_2	Portanigra	8,20	d	1,7	
I	C_2	Sterrenbos	6,8	d	e,n,x	
I	C_2	Herston	6,8	d	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_2	Labadi	8,20	d	z_6	
II	C_2		6,8	d	z_6:z_{42}	
I	C_2	Bardo	8	e,h	1,2	
I	C_2	Newport	6,8,20	e,h	1,2	Newport may possess H phase Rz_{50} or Rz_{58} or Rz_{78} or R1,12
I	C_2	Ferruch	8	e,h	1,5	
I	C_2	Kottbus	6,8	e,h	1,5	
I	C_2	Cremieu	6,8	e,h	1,[6]	
I	C_2	Atakpame	8,20	e,h	1,7	
I	C_2	Tshiongwe	6,8	e,h	e,n,z_{15}	
I	C_2	Rechovot	8,20	e,h	z_6	
I	C_2	Sandow	6,8	f,g	e,n,z_{15}	
II	C_2		6,8	f,g,m,t	[e,n,x]	
I	C_2	Emek	8,20	g,m,s	–	
I	C_2	Chincol	6,8	g,m,[s]	[e,n,x]	
I	C_2	Reubeuss	8,20	g,m,t	–	
II	C_2		6,8	g,m,t	1,7	
I	C_2	Alminko	8,20	g,s,t	–	
I	C_2	Nanergou	6,8	g,s,t	–	
I	C_2	Lindenburg	6,8	i	1,2	
I	C_2	Bargny	8,20	i	1,5	
I	C_2	Takoradi	6,8	i	1,5	
I	C_2	Warnow	6,8	i	1,6	
I	C_2	Malmoe	6,8	i	1,7	
I	C_2	Bonariensis	6,8	i	e,n,x	
I	C_2	Aba	6,8	i	e,n,z_{15}	
I	C_2	Cyprus	6,8	i	l,w	
I	C_2	Magherafelt	8,20	i	l,w	
I	C_2	Kentucky	8,20	i	z_6	
I	C_2	Kallo	6,8	k	1,2	
I	C_2	Blockley	6,8	k	1,5	Blockley may possess H phase Rz_{58}
I	C_2	Haardt	8	k	1,5	
I	C_2	Schwerin	6,8	k	e,n,x	
I	C_2	Charlottenburg	6,8	k	e,n,z_{15}	
I	C_2	Litchfield	6,8	l,v	1,2	
I	C_2	Pakistan	8	l,v	1,2	
I	C_2	Loanda	6,8	l,v	1,5	
I	C_2	Manchester	6,8	l,v	1,7	
I	C_2	Holcomb	6,8	l,v	e,n,x	
II	C_2		6,8	l,v	e,n,x	
I	C_2	Edmonton	6,8	l,v	e,n,z_{15}	
I	C_2	Amherstiana	8	l,(v)	1,6	
I	C_2	Fayed	6,8	l,w	1,2	
II	C_2		6,8	l,w	z_6:z_{42}	
I	C_2	Hiduddify	6,8	l,z_{13},z_{28}	1,5	
II	C_2		6,8	l,z_{28}	e,n,x	
I	C_2	Breukelen	6,8	l,z_{13},[z_{28}]	e,n,z_{15}	
I	C_2	Bassa	6,8	m,t	-	
I	C_2	Yokoe	8,20	m,t	-	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	C_2	Baragwanath	6,8	m,t	1,5	
II	C_2	Germiston	6,8	m,t	e,n,x	
I	C_2	Bsilla	6,8	r	1,2	
I	C_2	Hindmarsh	8,20	r	1,5	
I	C_2	Akanji	6,8	r	1,7	
I	C_2	Noya	8	r	1,7	
I	C_2	Goldcoast	6,8	r	l,w	
I	C_2	Pikine	8,20	r	z_6	Pikine was combined with Altona (8,20:r,[i]:z_6). The name Pikine has been dropped.
I	C_2	Cocody	8,20	r,i	e,n,z_{15}	
I	C_2	Hidalgo	6,8	r,i	e,n,z_{15}	
I	C_2	Bovismorbificans	6,8	r,[i]	1,5	
I	C_2	Brikama	8,20	r,[i]	l,w	
I	C_2	Altona	8,20	r,[i]	z_6	Pikine (8,20:r:z_6) was combined with Altona and called Altona.
I	C_2	Giza	8,20	y	1,2	
I	C_2	Brunei	8,20	y	1,5	
I	C_2	Tananarive	6,8	y	1,5	
I	C_2	Bulgaria	6,8	y	1,6	
II	C_2		6,8	y	1,6:z_{42}	
I	C_2	Alagbon	8	y	1,7	
I	C_2	Inchpark	6,8	y	1,7	
I	C_2	Daarle	6,8	y	e,n,x	
I	C_2	Sunnycove	8	y	e,n,x	
I	C_2	Praha	6,8	y	e,n,z_{15}	
I	C_2	Benue	6,8	y	l,w	
I	C_2	Sindelfingen	8,20	y	l,w	
I	C_2	Kralingen	8,20	y	z_6	
I	C_2	Mowanjum	6,8	z	1,5	
II	C_2		6,8	z	1,5	
I	C_2	Kalumburu	6,8	z	e,n,z_{15}	
I	C_2	Phaliron	8	z	e,n,z_{15}	
I	C_2	Kuru	6,8	z	l,w	
I	C_2	Daula	8,20	z	z_6	
I	C_2	Bazenheid	8,20	z_{10}	1,2	
I	C_2	Zerifin	6,8	z_{10}	1,2	
I	C_2	Mapo	6,8	z_{10}	1,5	
I	C_2	Paris	8,20	z_{10}	1,5	
I	C_2	Cleveland	6,8	z_{10}	1,7	
I	C_2	Hadar	6,8	z_{10}	e,n,x	
I	C_2	Istanbul	8	z_{10}	e,n,x	
I	C_2	Chomedey	8,20	z_{10}	e,n,z_{15}	
I	C_2	Glostrup	6,8	z_{10}	e,n,z_{15}	
I	C_2	Remiremont	8,20	z_{10}	l,w	
I	C_2	Molade	8,20	z_{10}	z_6	
I	C_2	Wippra	6,8	z_{10}	z_6	
II	C_2		6,8	z_{29}	1,5	
II	C_2		6,8	z_{29}	e,n,x	
II	C_2		8	z_{29}	e,n,x:z_{42}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_2	Tamale	8,20	z_{29}	[e,n,z_{15}]	
I	C_2	Uno	6,8	z_{29}	[e,n,z_{15}]	
I	C_2	Kolda	8,20	z_{35}	1,2	
I	C_2	Yarm	6,8	z_{35}	1,2	
I	C_2	Angers	8,20	z_{35}	z_6	
I	C_2	Apeyeme	8,20	z_{38}	–	
I	C_2	Bellevue	8	z_4,z_{23}	1,7	
I	C_2	Lezennes	6,8	z_4,z_{23}	1,7	
I	C_2	Breda	6,8	z_4,z_{23}	e,n,x	
I	C_2	Chailey	6,8	z_4,z_{23}	[e,n,z_{15}]	
I	C_2	Dabou	8,20	z_4,z_{23}	l,w	
I	C_2	Corvallis	8,20	z_4,z_{23}	[z_6]	
I	C_2	Albany	8,20	z_4,z_{24}	–	Albany may possess H phase Rz_{45}.
I	C_2	Duesseldorf	6,8	z_4,z_{24}	–	
I	C_2	Tallahassee	6,8	z_4,z_{32}	–	
I	C_2	Diogoye	8,20	z_{41}	z_6	
I	C_2	Aesch	6,8	z_{60}	1,2	
I	D_1	Gallinarum	1,9,12	–	–	Gallinarum must be identified biochemically.
I	D_1	Pullorum	1,9,12	–	–	IP combined Pullorum with Gallinarum (1,9,12:-:-). They must be identified biochemically.
I	D_1	Miami	1,9,12	a	1,5	Miami must be differentiated from Sendai with biochemical tests. Miami is pos. for H_2S, citrate, and tartrate; Sendai is neg.
I	D_1	Sendai	1,9,12	a	1,5	Sendai must be differentiated from Miami with biochemical tests. Sendai is neg. for H_2S, citrate, and tartrate; Miami is pos.
II	D_1		9,12	a	1,5	
I	D_1	Os	9,12	a	1,6	
I	D_1	Saarbruecken	1,9,12	a	1,7	
I	D_1	Lomalinda	1,9,12	a	e,n,x	
II	D_1		1,9,12	a	e,n,x	
I	D_1	Durban	9,12	a	e,n,z_{15}	
II	D_1		9,12	a	z_{39}	
II	D_1		1,9,12	a	z_{42}	
I	D_1	Onarimon	1,9,12	b	1,2	
I	D_1	Frintrop	1,9,12	b	1,5	
II	D_1	Mjimwema	1,9,12	b	e,n,x	
II	D_1	Suederelbe	1,9,12	b	z_{39}	
II	D_1	Blankenese	1,9,12	b	z_6	
I	D_1	Goeteborg	9,12	c	1,5	
I	D_1	Ipeko	9,12	c	1,6	
I	D_1	Elokate	9,12	c	1,7	
I	D_1	Alabama	9,12	c	e,n,z_{15}	
I	D_1	Ridge	9,12	c	z_6	
I	D_1	Typhi	9,12,[Vi]	d	–	Typhi may possess H phase Rj or Rz_{66}.
I	D_1	Ndolo	1,9,12	d	1,5	
I	D_1	Tarshyne	9,12	d	1,6	
I	D_1	Eschberg	9,12	d	1,7	
II	D_1	Rhodesiense	9,12	d	e,n,x	
I	D_1	Bangui	9,12	d	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	D_1	Jaffna	1,9,12	d	z_{35}	
II	D_1		9,12	d	z_{39}	
I	D_1	Zega	9,12	d	z_6	
I	D_1	Bournemouth	9,12	e,h	1,2	
I	D_1	Eastbourne	1,9,12	e,h	1,5	
I	D_1	Westafrica	9,12	e,h	1,7	
I	D_1	Israel	9,12	e,h	e,n,z_{15}	
II	D_1	Lindrick	9,12	e,n,x	1,[5],7	
II	D_1		9,12	e,n,x	1,6	
I	D_1	Enteritidis	1,9,12	[f],g,m,[p],[t]	[1,7]	
I	D_1	Berta	1,9,12	[f],g,t	–	
I	D_1	Blegdam	9,12	g,m,q	–	
II	D_1	Muizenberg	9,12	g,m,s,t	1,5	IP combined Muizenberg with Hamburg (1,9,12:g,t:-) and Manica (1,9,12:g,m,s,t:z_{42}) to form *S.* II 1,9,12:g,[m],[s],t:[1,5,7]:[z_{42}].
II	D_1	Kuilsrivier	1,9,12	g,m,s,t	e,n,x	
II	D_1	Manica	1,9,12	g,m,s,t	z_{42}	IP combined Manica with Hamburg (1,9,12:g,t:-) and Muizenberg (9,12:g,m,s,t:1,5) to form *S.* II 1,9,12:g,[m],[s],t:[1,5,7]:[z_{42}].
II	D_1		1,9,12	g,m,[s],t	[1,5,7]:[z_{42}]	
I	D_1	Dublin	1,9,12,[Vi]	g,p	–	
I	D_1	Naestved	1,9,12	g,p,s	–	
I	D_1	Rostock	1,9,12	g,p,u	–	
I	D_1	Moscow	9,12	g,q	–	
II	D_1	Neasden	9,12	g,s,t	e,n,x	
II	D_1	Hamburg	1,9,12	g,t	–	IP combined Hamburg with Manica (1,9,12:g,m,s,t:z_{42}) and Muizenberg (9,12:g,m,s,t:1,5) to form *S.* II 1,9,12:g,m,[s],t:[1,5,7]:[z_{42}].
I	D_1	Newmexico	9,12	g,z_{51}	1,5	
II	D_1		1,9,12	g,z_{62}	–	
I	D_1	Antarctica	9,12	g,z_{63}	–	
I	D_1	Seremban	9,12	i	1,5	
I	D_1	Claibornei	1,9,12	k	1,5	
I	D_1	Goverdhan	9,12	k	1,6	
I	D_1	Mendoza	9,12	l,v	1,2	
I	D_1	Panama	1,9,12	l,v	1,5	Panama may possess H phase R1,11
I	D_1	Kapemba	9,12	l,v	1,7	
I	D_1	Zaiman	9,12	l,v	e,n,x	
II	D_1		9,12	l,v	e,n,x	
I	D_1	Goettingen	9,12	l,v	e,n,z_{15}	
I	D_1	Italiana	9,12	l,v	R1,11	IP combined Italiana that contains H phase R1,11 with Panama (1,9,12:l,v:1,5). The name Italiana has been dropped.
II	D_1		9,12	l,v	z_{39}	
I	D_1	Victoria	1,9,12	l,w	1,5	
II	D_1	Daressalaam	1,9,12	l,w	e,n,x	
I	D_1	Itami	9,12	l,z_{13}	1,5	
I	D_1	Miyazaki	9,12	l,z_{13}	1,7	
I	D_1	Napoli	1,9,12	l,z_{13}	e,n,x	
I	D_1	Javiana	1,9,12	l,z_{28}	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	D_1		9,12	l,z_{28}	1,5:[z_{42}]	
I	D_1	Kotu	9,12	l,z_{28}	1,6	
II	D_1		9,12	l,z_{28}	e,n,x	
II	D_1		9,12	m,t	–	
I	D_1	Pensacola	1,9,12	m,t	[1,2]	
II	D_1		1,9,12	m,t	1,5	
II	D_1		1,9,12	m,t	z_{39}	
I	D_1	Jamaica	9,12	r	1,5	
I	D_1	Camberwell	9,12	r	1,7	
I	D_1	Campinense	9,12	r	e,n,z_{15}	
I	D_1	Lome	9,12	r	z_6	
I	D_1	Powell	9,12	y	1,7	
I	D_1	Lawndale	1,9,12	z	1,5	
I	D_1	Kimpese	9,12	z	1,6	
II	D_1	Stellenbosch	1,9,12	z	1,7	
II	D_1	Hueningen	9,12	z	z_{39}	
II	D_1	Angola	1,9,12	z	z_6	
I	D_1	Portland	9,12	z_{10}	1,5	
I	D_1	Ruanda	9,12	z_{10}	e,n,z_{15}	
I	D_1	Treguier	1,9,12	z_{10}	z_6	
II	D_1	Canastel	9,12	z_{29}	[1,5]	
II	D_1		1,9,12	z_{29}	e,n,x	
I	D_1	Penarth	9,12	z_{35}	z_6	
I	D_1	Elomrane	1,9,12	z_{38}	–	
II	D_1	Wynberg	1,9,12	z_{39}	1,7	
I	D_1	Wangata	1,9,12	z_4,z_{23}	[1,7]	
I	D_1	Natal	9,12	z_4,z_{24}	–	
I	D_1	Ottawa	1,9,12	z_{41}	1,5	
II	D_1		1,9,12	z_{42}	1,[5],7	
I	D_1	Franken	1,9,12	z_{60}	z_{67}	
I	D_2	Baildon	9,46	a	e,n,x	
I	D_2	Doba	9,46	a	e,n,z_{15}	
I	D_2	Cheltenham	9,46	b	1,5	
I	D_2	Zadar	9,46	b	1,6	
I	D_2	Worb	9,46	b	e,n,x	
II	D_2	Lundby	9,46	b	e,n,x	
I	D_2	Bamboye	9,46	b	l,w	
I	D_2	Kolar	9,46	b	z_{35}	
I	D_2	Linguere	9,46	b	z_6	
I	D_2	Itutaba	9,46	c	z_6	
I	D_2	Ontario	9,46	d	1,5	
I	D_2	Quentin	9,46	d	1,6	
I	D_2	Strasbourg	9,46	d	1,7	
I	D_2	Olten	9,46	d	e,n,z_{15}	
I	D_2	Plymouth	9,46	d	z_6	
I	D_2	Bergedorf	9,46	e,h	1,2	
I	D_2	Waedenswil	9,46	e,h	1,5	
I	D_2	Guerin	9,46	e,h	z_6	
II	D_2		9,46	e,n,x	1,5,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	D_2	Wernigerode	9,46	f,g	–	
I	D_2	Hillingdon	9,46	g,m	–	
I	D_2	Macclesfield	9,46	g,m,s,t	1,(2),7	
II	D_2	Duivenhoks	9,46	g,[m],[s],t	[e,n,x]	
I	D_2	Gateshead	9,46	g,s,t	–	
II	D_2		9,46	g,z_{62}	–	
I	D_2	Mathura	9,46	i	e,n,z_{15}	
I	D_2	Potto	9,46	i	z_6	
I	D_2	Marylebone	9,46	k	1,2	
I	D_2	Cochin	9,46	k	1,5	
I	D_2	Ceyco	9,46	k	z_{35}	
I	D_2	India	9,46	l,v	1,5	
I	D_2	Geraldton	9,46	l,v	1,6	
I	D_2	Toronto	9,46	l,v	e,n,x;[z_{44}]	
I	D_2	Ackwepe	9,46	l,w	–	
I	D_2	Sangalkam	9,46	m,t	–	
II	D_2		9,46	m,t	e,n,x	
I	D_2	Deckstein	9,46	r	1,7	
I	D_2	Shoreditch	9,46	r	e,n,z_{15}	
I	D_2	Sokode	9,46	r	z_6	
I	D_2	Benin	9,46	y	1,7	
I	D_2	Irchel	9,46	y	e,n,x	
I	D_2	Nantes	9,46	y	l,w	
I	D_2	Mayday	9,46	y	z_6	
II	D_2		9,46	z	1,5	
II	D_2	Haarlem	9,46	z	e,n,x	
I	D_2	Bambylor	9,46	z	e,n,z_{15}	
I	D_2	Lishabi	9,46	z_{10}	1,7	
I	D_2	Inglis	9,46	z_{10}	e,n,x	
I	D_2	Mahina	9,46	z_{10}	e,n,z_{15}	
II	D_2		9,46	z_{10}	z_{39}	
I	D_2	Louisiana	9,46	z_{10}	z_6	
II	D_2		9,46	z_{10}	z_6	
I	D_2	Ouakam	9,46	z_{29}	-	
I	D_2	Hillegersberg	9,46	z_{35}	1,5	
I	D_2	Basingstoke	9,46	z_{35}	e,n,z_{15}	
I	D_2	Trimdon	9,46	z_{35}	z_6	
I	D_2	Fresno	9,46	z_{38}	–	
II	D_2		9,46	z_{39}	1,7	
I	D_2	Ekotedo	9,46	z_4,z_{23}	–	
I	D_2	Ngaparou	9,46	z_4,z_{24}	–	
II	D_2	Maarssen	9,46	z_4,z_{24}	z_{39}:z_{42}	
I	D_2	Wuppertal	9,46	z_{41}	–	
II	D_3	Zuerich	1,9,12,46,27	c	z_{39}	
II	D_3		9,12,46,27	g,t	e,n,x	
II	D_3		1,9,12,46,27	l,z_{13},z_{28}	z_{39}	
II	D_3		1,9,12,46,27	y	z_{39}	
II	D_3		1,9,12,46,27	z_{10}	1,5	
II	D_3		1,9,12,46,27	z_{10}	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	D_3		1,9,12,46,27	z_{10}	z_{39}	
II	D_3		1,9,12,46,27	z_4,z_{24}	[1,5]	
I	E_1	Aminatu	3,10	a	1,2	
I	E_1	Goelzau	3,10	a	1,5	IP combined Clichy (3,15:a:1,5) with Goelzau to form Goelzau 3,10,[15]:a:1,5.
I	E_1	Oxford	3,10	a	1,7	IP combined Khartoum (3,15,34:a:1,7) with Oxford to form Oxford 3,10,[15],[15,34]:a:1,7.
I	E_1	Masembe	3,10	a	e,n,x	Masembe may possess H phase Rz_5.
II	E_1	Matroosfontein	3,10	a	e,n,x	
I	E_1	Galil	3,10	a	e,n,z_{15}	
II	E_1		3,10	a	z_{39}	
I	E_1	Kalina	3,10	b	1,2	
I	E_1	Butantan	3,10	b	1,5	IP combined Rosenthal (3,15:b:1,5) and unnamed 3,15,34:b:1,5 with Butantan to form Butantan 3,10,[15],[15,34]:b:1,5.
I	E_1	Allerton	3,10	b	1,6	
I	E_1	Huvudsta	3,10	b	1,7	
I	E_1	Benfica	3,10	b	e,n,x	
II	E_1		3,10	b	e,n,x	
I	E_1	Yaba	3,10,[15]	b	e,n,z_{15}	
I	E_1	Epicrates	3,10	b	l,w	
I	E_1	Westminster	3,10,[15]	b	z_{35}	CDC has no 3,10:b:z_{35}.
II	E_1		3,10	b	z_{39}	
I	E_1	Wilmington	3,10	b	z_6	
I	E_1	Asylanta	3,10	c	1,2	
I	E_1	Gbadago	3,10,[15]	c	1,5	
I	E_1	Ikayi	3,10,[15]	c	1,6	Ikayi Var. O 15+ was described after E_1 and E_2 were combined.
I	E_1	Pramiso	3,10	c	1,7	
I	E_1	Agege	3,10	c	e,n,z_{15}	
I	E_1	Anderlecht	3,10	c	l,w	
I	E_1	Okefoko	3,10	c	z_6	
I	E_1	Stormont	3,10	d	1,2	
I	E_1	Shangani	3,10	d	1,5	IP combined Pankow (3,15:d:1,5) with Shangani to form Shangani 3,10,[15]:d:1,5.
I	E_1	Lekke	3,10	d	1,6	
I	E_1	Onireke	3,10	d	1,7	
I	E_1	Souza	3,10	d	e,n,x	IP combined Eschersheim (3,15:d:e,n,x) with Souza to form Souza 3,10,[15]:d:e,n,x.
II	E_1		3,10	d	e,n,x	
I	E_1	Madjorio	3,10	d	e,n,z_{15}	
I	E_1	Birmingham	3,10	d	l,w	
I	E_1	Maron	3,10	d	z_{35}	
I	E_1	Weybridge	3,10	d	z_6	
I	E_1	Vejle	3,10	e,h	1,2	IP combined Goerlitz (3,15:e,h:1,2) with Vejle to form Vejle 3,10,[15]:e,h:1,2.
I	E_1	Muenster	3,10	e,h	1,5	IP combined Muenster with Newhaw (3,15:e,h:1,5) and Arkansas (3,15,34:e,h:1,5) to form Muenster 3,10,[15],[15,34]:e,h:1,5.
I	E_1	Anatum	3,10	e,h	1,6	IP combined Newington (3,15:e,h:1,6) and Minneapolis (3,15,34:e,h:1,6) with Anatum to form Anatum 3,10,[15],[15,34]:e,h:1,6.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_1	Nyborg	3,10	e,h	1,7	IP combined Selandia (3,15:e,h:1,5) with Nyborg to form Nyborg 3,10,[15]:e,h:1,7.
I	E_1	Newlands	3,10,[15,34]	e,h	e,n,x	
I	E_1	Lamberhurst	3,10	e,h	e,n,z_{15}	
I	E_1	Meleagridis	3,10	e,h	l,w	IP combined Meleagridis with Cambridge (3,15:e,h:l,w) and Wildwood (3,15,34:e,h:l,w) to form Meleagridis 3,10,[15],[15,34]:e,h:l,w.
I	E_1	Sekondi	3,10	e,h	z_6	
II	E_1	Chudleigh	3,10	e,n,x	1,7	
I	E_1	Alfort	3,10	f,g	e,n,x	
I	E_1	Regent	3,10	f,g,[s]	[1,6]	
I	E_1	Suberu	3,10	g,m	–	
I	E_1	Amsterdam	3,10	g,m,s	–	IP combined Drypool (3,15:g,m,s) and Drypool var. O 34+ with Amsterdam to form Amsterdam 3,10,[15],[15,34]:g,m,s:-.
II	E_1	Parow	3,10,[15]	g,m,s,t	–	
I	E_1	Westhampton	3,10	g,s,t	–	IP combined Halmstad (3,15:g,s,t:-) and Canoga (3,15,34:g,s,t:-) with Westhampton to form Westhampton 3,10,[15],[15,34]:g,s,t:-. Westhampton may possess H phase Rz_{37} or Rz_{43} or Rz_{45}.
II	E_1	Islington	3,10	g,t	–	
I	E_1	Bloomsbury	3,10	g,t	1,5	
I	E_1	Cuckmere	3,10	i	1,2	
I	E_1	Amounderness	3,10	i	1,5	
I	E_1	Truro	3,10	i	1,7	
I	E_1	Bessi	3,10	i	e,n,x	
I	E_1	Falkensee	3,10	i	e,n,z_{15}	
I	E_1	Hoboken	3,10	i	l,w	
I	E_1	Yeerongpilly	3,10	i	z_6	
I	E_1	Wimborne	3,10	k	1,2	
I	E_1	Zanzibar	3,10,[15]	k	1,5	
I	E_1	Serrekunda	3,10	k	1,7	
I	E_1	Yundum	3,10	k	e,n,x	
I	E_1	Marienthal	3,10	k	e,n,z_{15}	
I	E_1	Newrochelle	3,10	k	l,w	
I	E_1	Nchanga	3,10	l,v	1,2	IP combined Nchanga with Nancy (3,15:l,v:1,2) to form Nchanga 3,10,[15]:l,v:1,2.
I	E_1	Sinstorf	3,10	l,v	1,5	
I	E_1	London	3,10	l,v	1,6	IP combined London with Portsmouth (3,15:l,v:1,6) to form London 3,10,[15]:l,v:1,6.
I	E_1	Give	3,10	l,v	1,7	IP combined Newbrunswick (3,15:l,v:1,7) and Menhaden (3,15,34:l,v:1,7) with Give to form Give 3,10,[15],[15,34]:[d],l,v:[d],1,7. Give may possess H phase d; Rl,z_{40}; or Rz_{77}.
II	E_1		3,10	l,v	e,n,x	
I	E_1	Ruzizi	3,10	l,v	e,n,z_{15}	
I	E_1	Sinchew	3,10	l,v	z_{35}	
II	E_1	Fuhlsbuettel	3,10	l,v	z_6	
I	E_1	Assinie	3,10	l,w	z_6	Assinie may possess H phase Rz_{45}.
I	E_1	Freiburg	3,10	l,z_{13}	1,2	
I	E_1	Uganda	3,10,15	l,z_{13}	1,5	
I	E_1	Fallowfield	3,10	l,z_{13},z_{28}	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_1	Hoghton	3,10	l,z_{13},z_{28}	z_6	
II	E_1		3,10	l,z_{28}	1,5	
I	E_1	Joal	3,10	l,z_{28}	1,7	
I	E_1	Lamin	3,10	l,z_{28}	e,n,x	
II	E_1	Westpark	3,10	l,z_{28}	e,n,x	
II	E_1		3,10	l,z_{28}	z_{39}	
II	E_1		3,10	m,t	1,5	
I	E_1	Southbank	3,10,15,34	m,t	[1,6]	
II	E_1	Stikland	3,10	m,t	e,n,x	
I	E_1	Ughelli	3,10	r	1,5	
I	E_1	Elisabethville	3,10	r	1,7	
I	E_1	Simi	3,10	r	e,n,z_{15}	
I	E_1	Weltevreden	3,10	r	z_6	IP combined Lanka 3,15:r:z_6 with Weltevreden to form Weltevreden 3,10,[15]:r:z_6.
I	E_1	Seegefeld	3,10	r,[i]	1,2	
I	E_1	Dumfries	3,10	r,[i]	1,6	
I	E_1	Rutgers	3,10	Rl,z_{40}	1,7	Rutgers has been dropped from the scheme and the H phase Rl,z_{40} is now considered an R phase of Give.
I	E_1	Amager	3,10	y	1,2	IP combined Tuebingen (3,15:y:1,2) with Amager to form Amager 3,10,[15]:y:1,2. Amager may possess H phase Rz_{45}.
I	E_1	Orion	3,10	y	1,5	IP combined Binza (3,15:y:1,5) and Thomasville (3,15,34:y:1,5) with Orion to form Orion 3,10,[15],[15,34]:y:1,5.
I	E_1	Mokola	3,10	y	1,7	
I	E_1	Ohlstedt	3,10	y	e,n,x	
I	E_1	Bolton	3,10	y	e,n,z_{15}	
I	E_1	Langensalza	3,10	y	l,w	
I	E_1	Stockholm	3,10	y	z_6	IP combined Tournai (3,15:y:z_6) with Stockholm to form Stockholm 3,10,[15]:y:z_6.
I	E_1	Fufu	3,10	z	1,5	
II	E_1	Alexander	3,10	z	1,5	
I	E_1	Harleystreet	3,10	z	1,6	
I	E_1	Huddinge	3,10	z	1,7	
II	E_1	Finchley	3,10	z	e,n,x	
I	E_1	Clerkenwell	3,10	z	l,w	
II	E_1	Tafelbaai	3,10	z	z_{39}	
I	E_1	Landwasser	3,10	z	z_6	
I	E_1	Okerara	3,10	z_{10}	1,2	
I	E_1	Lexington	3,10	z_{10}	1,5	IP combined Lexington with Manila (3,15:z_{10}:1,5) and Illinois (3,15,34:z_{10}:1,5) to form Lexington 3,10,[15],[15,34]:z_{10},1,5. Lexington may possess H phase Rz_{49}.
I	E_1	Harrisonburg	3,10,[15],[15,34]	z_{10}	1,6	
I	E_1	Coquilhatville	3,10	z_{10}	1,7	
I	E_1	Kristianstad	3,10	z_{10}	e,n,z_{15}	
I	E_1	Biafra	3,10	z_{10}	z_6	
I	E_1	Jedburgh	3,10,[15]	z_{29}	–	
II	E_1		3,10	z_{29}	–	
I	E_1	Everleigh	3,10	z_{29}	e,n,x	
II	E_1		3,10	z_{29}	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_1	Zongo	3,10	z_{35}	1,7	
I	E_1	Shannon	3,10	z_{35}	l,w	
I	E_1	Cairina	3,10	z_{35}	z_6	
I	E_1	Macallen	3,10	z_{36}	–	
II	E_1	Mpila	3,10	z_{38}	z_{42}	
I	E_1	Bolombo	3,10	z_{38}	[z_6]	
II	E_1	Winchester	3,10	z_{39}	1,[5],7	
I	E_1	Adabraka	3,10	z_4,z_{23}	[1,7]	
I	E_1	Wagadugu	3,10	z_4,z_{23}	z_6	
I	E_1	Florian	3,10,[15]	z_4,z_{24}	–	
II	E_1		3,10	z_4,z_{24}	–	
I	E_1	Pietersburg	3,10,[15,34]	z_{69}	1,7	
I	E_2	Clichy	3,15	a	1,5	IP combined Clichy with Goelzau (3,10:a:1,5) to form Goelzau 3,10,[15]:a:1,5. Clichy is now called Goelzau var. O 15+ by IP.
I	E_2	Rosenthal	3,15	b	1,5	IP combined Rosenthal and unnamed 3,15,34:b:1,5 with Butantan (3,10:b:1,5) to form Butantan 3,10,[15],[15,34]:b:1,5. Rosenthal is now called Butantan var. O 15+ by IP.
I	E_2	Pankow	3,15	d	1,5	IP combined Pankow with Shangani (3,10:d:1,5) to form Shangani 3,10,15:d:1,5. Pankow is now called Shangani var. O 15+ by IP.
I	E_2	Eschersheim	3,15	d	e,n,x	IP combined Eschersheim with Souza (3,10:d:e,n,x) to form Souza 3,10,[15]:d:e,n,x. Eschersheim is now called Souza var. O 15+ by IP.
I	E_2	Goerlitz	3,15	e,h	1,2	IP combined Goerlitz with Vejle (3,10:e,h:1,2) to form Vejle 3,10,15:e,h:1,2. Goerlitz is now called Vejle var. O 15+ by IP.
I	E_2	Newhaw	3,15	e,h	1,5	IP combined Newhaw and Arkansas (3,15,34:e,h:1,5) with Muenster (3,10:e,h:1,5) to form Muenster 3,10,[15],[15,34]:e,h:1,5. Newhaw is now called Muenster var. O 15+ by IP.
I	E_2	Newington	3,15	e,h	1,6	IP combined Newington and Minneapolis (3,15,34:e,h:1,6) with Anatum (3,10:e,h:1,6) to form Anatum 3,10,[15],[15,34]:e,h:1,6. Newington is now called Anatum var. O 15+ by IP.
I	E_2	Selandia	3,15	e,h	1,7	IP combined Selandia with Nyborg (3,10:e,h:1,7) to form Nyborg 3,10,[15]:e,h:1,7. Selandia is now called Nyborg var. O 15+ by IP.
I	E_2	Cambridge	3,15	e,h	l,w	IP combined Cambridge and Wildwood (3,15,34:e,h:l,w) with Meleagridis (3,10:e,h:l,w) to form Meleagridis 3,10,[15],[15,34]:e,h:l,w. Cambridge is now called Meleagridis var. O 15+ by IP.
I	E_2	Drypool	3,[15],[15,34]	g,m,s	–	IP combined Drypool 3,15:g,m,s:- and Drypool var. O34+ with Amsterdam (3,10:g,m,s:-) to form Amsterdam 3,10,[15],[15,34]:g,m,s:-. Drypool is now called Amsterdam var. O 15+ or O 15+, 34+ by IP.
I	E_2	Halmstad	3,15	g,s,t	–	IP combined Halmstad and Canoga (3,15,34:g,s,t:-) with Westhampton (3,10:g,s,t:-) to form Westhampton 3,10,[15],[15,34]:g,s,t:-. Halmstad is now called Westhampton var. O 15+ by IP.
I	E_2	Nancy	3,15	l,v	1,2	IP combined Nancy with Nchanga (3,10:l,v:1,2) to form Nchanga 3,10,[15]:l,v:1,2. Nancy is now called Nchanga var. O 15+ by IP.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_2	Portsmouth	3,15	l,v	1,6	IP combined Portsmouth with London (3,10:l,v:1,6) to form London 3,10,[15]:l,v:1,6. Portsmouth is now called London var. O 15+ by IP.
I	E_2	Newbrunswick	3,15	l,v	1,7	IP combined Newbrunswick and Menhaden (3,15,34:l,v:1,7) with Give (3,10:l,v:1,7) to form Give 3,10,[15],[15,34]:[d],l,v:[d],1,7. Newbrunswick is now called Give var. O 15+ by IP.
I	E_2	Kinshasa	3,15	l,z_{13}	1,5	IP combined Kinshasa with Uganda (3,10:l,z13:1,5) to form Uganda 3,10,[15]:l,z13:1,5. Kinshasa is now called Uganda var. O 15+ by IP.
I	E_2	Lanka	3,15	r	z_6	IP combined Lanka with Weltevreden (3,10:r:z6) to form Weltevreden 3,10,[15]:r:z6. Lanka is now called Weltevreden var. O 15+ by IP.
I	E_2	Hamilton	3,15	Rz_{27}	–	IP combined Hamilton with Goerlitz (3,15:e,h:1,2) and Vejle (3,10:e,h:1,2) to form Vejle 3,10,15:e,h:1,2:Rz_{27}. Hamilton is now called Vejle var. Rz_{27}+. The name Hamilton has been dropped.
I	E_2	Tuebingen	3,15	y	1,2	IP combined Tuebingen with Amager (e,10:y:1,2) to form Amager 3,10,[15]:y:1,2. Tuebingen is now called Amager var. O 15+ by IP.
I	E_2	Binza	3,15	y	1,5	IP combined Binza and Thomasville (3,15,34:y:1,5) with Orion (3,10:y:1,5) to form Orion 3,10,[15],[15,34]:y:1,5. Binza is now called Orion var. O 15+ by IP.
I	E_2	Tournai	3,15	y	z_6	IP combined Tournai with Stockholm (3,10:y:z6) to form Stockholm 3,10,[15]:y:z6. Tournai is now called Stockholm var. O 15+ by IP.
I	E_2	Manila	3,15	z_{10}	1,5	IP combined Manila and Illinois (3,15,34:z10:1,5) with Lexington (3,10:z10:1,5) to form Lexington 3,10,[15],[15,34]:z10:1,5. Manila is now called Lexington var. O 15+ by IP.
I	E_3	Khartoum	3,15,34	a	1,7	IP combined Khartoum with Oxford (3,10:a:1,7) to form Oxford 3,10,[15],[15,34]:a:1,7. Khartoum is now called Oxford var. O 15+ by IP. CDC has no 3,15:a:1,7. Khartoum was found by IP with colonies containing O 3,15.
I	E_3	Arkansas	3,15,34	e,h	1,5	IP combined Arkansas and Newhaw (3,15:e,h:1,5) with Muenster (3,10:e,h:1,5) to form Muenster 3,10,[15],[15,34]:e,h:1,5. Arkansas is now callled Muenster var. O 15+, 34+ by IP.
I	E_3	Minneapolis	3,15,34	e,h	1,6	IP combined Minneapolis and Newington (3,15:e,h:1,6) with Anatum (3,10:e,h:1,6) to form Anatum 3,10,[15],[15,34]:e,h:1,6. Minneapolis is now called Anatum var. O 15+ by IP.
I	E_3	Wildwood	3,15,34	e,h	l,w	IP combined Wildwood and Cambridge (3,15:e,h:l,w) with Meleagridis (3,10:e,h:l,w) to form Meleagridis 3,10,[15],[15,34]:e,h:l,w. Wildwood is now called Meleagridis var. O 15+, 34+ by IP.
I	E_3	Drypool	3,15,34	g,m,s	–	IP combined Drypool (3,15:g,m,s:-) and Drypool var. O 34+ with Amsterdam (3,10:g,m,s:-) to form Amsterdam 3,10,[15],[15,34]:g,m,s:-. Drypool is now called Amsterdam var. O 15+ or var. O 15+,34+ by IP.
I	E_3	Canoga	3,15,34	g,s,t	-	IP combined Canoga and Halmstad (3,15:g,s,t:-) with Westhampton (3,10:g,s,t:-) to form Westhampton 3,10,[15],[15,34]:g,s,t:-. Canoga is now called Westhampton var. O 15+, 34+ by IP.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_3	Menhaden	3,15,34	l,v	1,7	IP combined Menhaden with Give (3,10:l,v:1,7) and Newbrunswick (3,15:l,v:1,7) to form Give 3,10,[15],[15,34]:[d],l,v:1,7. Menhaden is now called Give var. O 15+, 34+ by IP.
I	E_3	Thomasville	3,15,34	y	1,5	IP combined Thomasville and Binza (3,15:y:1,5) with Orion (3,10:y:1,5) to form Orion 3,10,[15],[15,34]:y:1,5. Thomasville is now called Orion var. O 15+ by IP.
I	E_3	Illinois	3,15,34	z_{10}	1,5	IP combined Illinois and Manila (3,15:z_{10}:1,5) with Lexington (3,10:z10:1,5) to form Lexington 3,10,[15],[15,34]:z10:1,5. Illinois is now called Lexington var. O 15+, 34+ by IP.
I	E_4	Niumi	1,3,19	a	1,5	
I	E_4	Juba	1,3,19	a	1,7	
I	E_4	Gwoza	1,3,19	a	e,n,z_{15}	
I	E_4	Alkmaar	1,3,19	a	l,w	
I	E_4	Gnesta	1,3,19	b	1,5	
I	E_4	Visby	1,3,19	b	1,6	
I	E_4	Tambacounda	1,3,19	b	e,n,x	
I	E_4	Kande	1,3,19	b	e,n,z_{15}	
I	E_4	Broughton	1,3,19	b	l,w	
I	E_4	Chittagong	1,3,10,19	b	z_{35}	
I	E_4	Accra	1,3,19	b	z_6	
I	E_4	Eastglam	1,3,19	c	1,5	
I	E_4	Bida	1,3,19	c	1,6	
I	E_4	Madiago	1,3,19	c	1,7	
I	E_4	Ahmadi	1,3,19	d	1,5	
I	E_4	Liverpool	1,3,19	d	e,n,z_{15}	
I	E_4	Tilburg	1,3,19	d	l,w	Tilburg may possess H phase Rz_{49}.
I	E_4	Niloese	1,3,19	d	z_6	
I	E_4	Vilvoorde	1,3,19	e,h	1,5	
I	E_4	Hayindogo	1,3,19	e,h	1,6	
I	E_4	Sanktmarx	1,3,19	e,h	1,7	
I	E_4	Sao	1,3,19	e,h	e,n,z_{15}	
I	E_4	Calabar	1,3,19	e,h	l,w	
I	E_4	Rideau	1,3,19	f,g	-	
I	E_4	Bilu	(1),3,10,(19)	f,g,t	1,(2),7	
I	E_4	Petahtikva	1,3,19	f,g,t	1,7	
I	E_4	Maiduguri	1,3,19	f,g,t	e,n,z_{15}	
I	E_4	Kouka	1,3,19	g,m,[t]	–	
I	E_4	Dessau	1,3,15,19	g,s,t	–	
I	E_4	Senftenberg	1,3,19	g,[s],t		Senftenberg may possess H phase Rz_{37} or Rz_{43} or Rz_{45} or Rz_{46}. Simsbury (1,3,19:Rz_{27}:-) is now considered an H phase Rz_{27} of Senftenberg.
I	E_4	Stratford	1,3,19	i	1,2	
I	E_4	Chichester	1,3,19	i	1,6	
I	E_4	Machaga	1,3,19	i	e,n,x	
I	E_4	Avonmouth	1,3,19	i	e,n,z_{15}	
I	E_4	Zuilen	1,3,19	i	l,w	
I	E_4	Taksony	1,3,19	[i]	z_6	
I	E_4	Bethune	1,3,19	k	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_4	Ngor	1,3,19	l,v	1,5	
I	E_4	Parkroyal	1,3,19	l,v	1,7	
I	E_4	Svedvi	1,3,19	l,v	e,n,z_{15}	
I	E_4	Fulda	1,3,19	l,w	1,5	
I	E_4	Westerstede	1,3,19	l,z_{13}	[1,2]	
I	E_4	Winterthur	1,3,19	l,z_{13}	1,6	
I	E_4	Lokstedt	1,3,19	l,z_{13},z_{28}	1,2	
I	E_4	Stuivenberg	1,3,19	l,z_{13},z_{28}	1,5	
I	E_4	Bedford	1,3,19	l,z_{13},z_{28}	e,n,z_{15}	
I	E_4	Tomelilla	1,3,19	l,z_{28}	1,7	
I	E_4	Kindia	1,3,19	l,z_{28}	e,n,x	
I	E_4	Cannstatt	1,3,19	m,t	–	
I	E_4	Yalding	1,3,19	r	e,n,z_{15}	
I	E_4	Fareham	1,3,19	r,i	l,w	
I	E_4	Simsbury	1,3,19	Rz_{27}	–	IP combined Simsbury with Senftenberg 1,3,19:g,[s],t:-. Simsbury is now considered an R phase of Senftenberg. The name Simsbury has been dropped.
I	E_4	Gatineau	1,3,19	y	1,5	
I	E_4	Thies	1,3,19	y	1,7	
I	E_4	Cannonhill	1,3,15,19	y	e,n,x	
I	E_4	Kinson	1,3,19	y	e,n,x	
I	E_4	Slade	1,3,19	y	e,n,z_{15}	
I	E_4	Krefeld	1,3,19	y	l,w	
I	E_4	Korlebu	1,3,19	z	1,5	
I	E_4	Kainji	1,3,19	z	1,6	
I	E_4	Lerum	1,3,19	z	1,7	
I	E_4	Schoeneberg	1,3,19	z	e,n,z_{15}	
I	E_4	Carno	1,3,19	z	l,w	
I	E_4	Hongkong	1,3,19	z	z_6	
I	E_4	Dallgow	1,3,19	z_{10}	e,n,z_{15}	
I	E_4	Llandoff	1,3,19	z_{29}	[z_6]	
I	E_4	Ochiogu	1,3,19	z_{38}	[e,n,z_{15}]	
I	E_4	Ilugun	1,3,10,19	z_4,z_{23}	z_6	
I	E_4	Sambre	1,3,19	z_4,z_{24}	–	
II	F		11	–	1,5	
I	F	Gallen	11	a	1,2	
I	F	Marseille	11	a	1,5	
VI	F		11	a	1,5	
I	F	Toowong	11	a	1,7	
II	F	Montgomery	11	a,[d]	[d]:e,n,z15	
I	F	Luciana	11	a	e,n,z_{15}	
I	F	Epinay	11	a	l,z_{13},z_{28}	
II	F	Glencairn	11	a	z_6:z_{42}	
I	F	Atento	11	b	1,2	
I	F	Leeuwarden	11	b	1,5	
I	F	Wohlen	11	b	1,6	
VI	F		11	b	1,7	
VI	F	Srinagar	11	b	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	F	Pharr	11	b	e,n,z_{15}	
I	F	Chiredzi	11	c	1,5	
I	F	Woodinville	11	c	e,n,x	
II	F		11	c	e,n,z_{15}	
I	F	Ati	11	d	1,2	
I	F	Gustavia	11	d	1,5	
I	F	Chandans	11	d	e,n,x:[r]	
I	F	Pennsylvania	11	d	e,n,z_{15}	
I	F	Findorff	11	d	z_6	
I	F	Chingola	11	e,h	1,2	
I	F	Adamstua	11	e,h	1,6	
I	F	Redhill	11	e,h	l,z_{13},z_{28}	
II	F	Grabouw	11	g,[m],s,t	[z_{39}]	
I	F	Missouri	11	g,s,t	–	
IV	F	Mundsburg	11	g,z51	–	
I	F	Aberdeen	11	i	1,2	
I	F	Brijbhumi	11	i	1,5	
I	F	Heerlen	11	i	1,6	
I	F	Veneziana	11	i	e,n,x	
I	F	Pretoria	11	k	1,2	
I	F	Abaetetuba	11	k	1,5	
I	F	Sharon	11	k	1,6	
I	F	Colobane	11	k	1,7	
I	F	Kisarawe	11	k	e,n,x,[z_{15}]	
I	F	Mannheim	11	k	l,w	
I	F	Amba	11	k	l,z_{13},z_{28}	
IIIb	F		11	k	z_{53}	(Ar. 17:29:25)
I	F	Stendal	11	l,v	1,2	
I	F	Maracaibo	11	l,v	1,5	
I	F	Fann	11	l,v	e,n,x	
I	F	Bullbay	11	l,v	e,n,z_{15}	
IIIb	F		11	l,v	z_{53}	(Ar. 17:23:25)
IIIb	F		11	l,v	z	(Ar. 17:23:31). May possess H phase Rz$_{56}$ (Ar. 38).
I	F	Glidji	11	l,w	1,5	
I	F	Connecticut	11	l,z_{13},z_{28}	1,5	
I	F	Osnabrueck	11	l,z_{13},z_{28}	e,n,x	
II	F	Huila	11	l,z_{28}	e,n,x	
I	F	Moers	11	m,t	–	
II	F	Lincoln	11	m,t	e,n,x	
I	F	Senegal	11	r	1,5	
I	F	Rubislaw	11	r	[e,n,x]	
I	F	Volta	11	r	l,z_{13},z_{28}	
I	F	Euston	11	r,i	e,n,x,z_{15}	
I	F	Solt	11	y	1,5	
I	F	Jalisco	11	y	1,7	
I	F	Herzliya	11	y	e,n,x	
I	F	Crewe	11	z	1,5	
I	F	Maroua	11	z	1,7	
II	F		11	z	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	F	Soutpan	11	z	z_{39}	
I	F	Nyanza	11	z	z_6	
I	F	Wentworth	11	z_{10}	1,2	
I	F	Straengnaes	11	z_{10}	1,5	
I	F	Telhashomer	11	z_{10}	e,n,x	
I	F	Lene	11	z_{38}	–	
IIIa	F		11	z_4,z_{23}	–	(Ar. 17:1,2,5:-)
IV	F	Parera	11	z_4,z_{23}	–	
I	F	Remete	11	z_4,z_{23}	1,6	
I	F	Etterbeek	11	z_4,z_{23}	e,n,z_{15}	
I	F	Yehuda	11	z_4,z_{24}	–	
IV	F		11	z_4,z_{32}	–	
I	F	Maastricht	11	z_{41}	1,2	
II	G		13,23	–	1,6	
I	G	Chagoua	1,13,23	a	1,5	
II	G		1,13,23	a	1,5	
I	G	Mim	13,22	a	1,6	
II	G		13,22	a	e,n,x	
I	G	Wyldegreen	1,13,23	a	l,w	
I	G	Marshall	13,22	a	l,z_{13},z_{28}	
II	G	Tygerberg	1,13,23	a	z_{42}	
I	G	Atlanta	13,23	b	–	Atlanta was combined with Mississippi (1,13,23:b:1,5). The name Atlanta has been dropped.
I	G	Ibadan	13,22	b	1,5	
I	G	Mississippi	1,13,23	b	[1,5]	
II	G	Acres	1,13,23	b	$[1,5]:z_{42}$	
I	G	Bracknell	13,23	b	1,6	
I	G	Oudwijk	13,22	b	1,6	
I	G	Rottnest	1,13,22	b	1,7	
I	G	Ullevi	1,13,23	b	e,n,x	
I	G	Vaertan	13,22	b	e,n,x	
I	G	Bahati	13,22	b	e,n,z_{15}	
I	G	Durham	13,23	b	e,n,z_{15}	
II	G		1,13,22	b	z_{42}	
I	G	Haouaria	13,22	c	e,n,x,z_{15}	
I	G	Handen	1,13,23	d	1,2	
I	G	Mishmarhaemek	1,13,23	d	1,5	
I	G	Friedenau	13,22	d	1,6	
I	G	Wichita	1,13,23	d	1,6	Wichita may possess H phase Rz_{37}.
I	G	Grumpensis	1,13,23	d	1,7	
II	G		13,23	d	e,n,x	
I	G	Diguel	1,13,22	d	e,n,z_{15}	
I	G	Telelkebir	13,23	d	e,n,z_{15}	
II	G		1,13,23	d	e,n,z_{15}	
I	G	Putten	13,23	d	l,w	
I	G	Isuge	13,23	d	z_6	
I	G	Tschangu	1,13,23	e,h	1,5	
I	G	Willemstad	1,13,22	e,h	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	G	Vridi	1,13,23	e,h	l,w	
II	G	Epping	1,13,23	e,n,x	1,[5],7	
I	G	Raus	13,22	f,g	e,n,x	
I	G	Havana	1,13,23	f,g,[s]	–	Havana may possess H phase Rz_{45} or Rz_{79}.
IIIa	G		1,13,23	g,51	–	(Ar. 18:13,14:-)
I	G	Bron	13,22	g,m	[e,n,z15]	
II	G		1,13,23	g,m,s,t	1,5	
II	G	Luanshya	1,13,23	g,m,s,t	[e,n,x]	IP combined Luanshya with Kraaifontein (1,13,23:g,m,t:[e,n,x]) to form Luanshya 1,13,23:g,m,[s],t:[e,n,x].
II	G		1,13,23	g,[s],t	z_{42}	
II	G	Limbe	1,13,22	g,m,t	[1,5]	
II	G	Kraaifontein	1,13,23	g,m,t	[e,n,x]	IP combined Kraaifontein with Luanshya (1,13,23:g,m,s,t:[e,n,x]) to form Luanshya 1,13,23:g,m,[s],t:[e,n,x]. The name Kraaifontein has been dropped.
I	G	Agbeni	1,13,23	g,m,[t]	–	
I	G	Congo	13,23	g,[m],[s],t	–	IP calls Congo 13,23:g,m,s,t:-.
I	G	Newyork	13,22	g,s,t	–	
I	G	Okatie	13,23	g,[s],t	–	
II	G		1,13,23	g,m,s,t	z_{42}	
II	G	Gojenberg	1,13,23	g,t	1,5	
II	G	Rotterdam	1,13,22	g,t	1,5	
V	G		1,13,22	i	–	
I	G	Idikan	1,13,23	i	1,5	
I	G	Jukestown	13,23	i	e,n,z_{15}	
I	G	Kedougou	1,13,23	i	l,w	
I	G	Marburg	13,23	k	–	
II	G		13,22	k	$1,5:z_{42}$	
II	G		13,23	k	z_{41}	
I	G	Lovelace	13,22	l,v	1,5	
IIIb	G		13,22	l,v	1,5,7	(Ar. 18:23:30)
I	G	Borbeck	13,22	l,v	1,6	
I	G	Nanga	1,13,23	l,v	e,n,z_{15}	
II	G		13,23	l,w	e,n,x	
II	G		13,22	l,z_{28}	1,5	
II	G		13,23	l,z_{28}	1,5	
II	G	Vredelust	1,13,23	l,z_{28}	z_{42}	
II	G		13,23	l,z_{28}	z_6	
I	G	Kintambo	1,13,23	m,t	–	
I	G	Washington	13,22	m,t	–	
II	G	Katesgrove	1,13,23	m,t	1,5	
II	G	Worcester	1,13,23	m,t	e,n,x	
II	G	Boulders	1,13,23	m,t	z_{42}	
II	G		13,22	m,t	$z_{42}:z_{39}$	
V	G		13,22	r	–	
I	G	Adjame	13,23	r	1,6	
I	G	Linton	13,23	r	e,n,z_{15}	
I	G	Tanger	1,13,22	y	1,6	
I	G	Yarrabah	13,23	y	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	G	Ordonez	1,13,23	y	l,w	
I	G	Tunis	1,13,23	y	z_6	
II	G		13,22	z	–	
II	G	Nachshonim	1,13,23	z	1,5	
I	G	Farmsen	13,23	z	1,6	
I	G	Poona	1,13,22	z	1,6	Poona may possess H phase Rz_{59}.
I	G	Bristol	13,22	z	1,7	
I	G	Tanzania	1,13,22	z	e,n,z_{15}	
I	G	Worthington	1,13,23	z	l,w	Worthington may possess H phase Rz_{45}.
II	G		1,13,23	z	z_{42}	
I	G	Roodepoort	1,13,22	z_{10}	1,5	
I	G	Demerara	13,23	z_{10}	l,w	
II	G		1,13,22	z_{10}	z_6	
I	G	Agoueve	13,22	z_{29}	–	
I	G	Cubana	1,13,23	z_{29}	–	Cubana may possess H phase Rz_{37} or Rz_{43}.
II	G	Clifton	13,22	z_{29}	1,5	
II	G		1,13,23	z_{29}	1,5	
II	G	Goodwood	13,22	z_{29}	e,n,x	
II	G		1,13,23	z_{29}	e,n,x	
I	G	Mampong	13,22	z_{35}	1,6	
I	G	Anna	13,23	z_{35}	e,n,z_{15}	
I	G	Nimes	13,22	z_{35}	e,n,z_{15}	
I	G	Fanti	13,23	z_{38}	–	
I	G	Leiden	13,22	z_{38}	-	
II	G		1,13,23	z_{39}	1,5,7	
II	G		13,22	z_{39}	1,7	
I	G	Ajiobo	13,23	z_4,z_{23}	–	
IIIa	G		13,22	z_4,z_{23}	–	(Ar. 18:1,2,5:-)
I	G	Ried	1,13,22	z_4,z_{23}	[e,n,z_{15}]	
IIIa	G		13,23	z_4,z_{23},z_{32}	–	(Ar. 18:1,6,7:-). CDC would call this 1,6,7,9.
I	G	Romanby	1,13,23	z_4,z_{24}	–	
IIIa	G		1,13,23	z_4,z_{24}	–	(Ar. 18:1,3,11:-)
II	G	Stevenage	1,13,23	[z_{42}]	1,[5],7	
I	H	Garba	1,6,14,25	a	1,5	
VI	H		[1],6,14	a	1,5	
VI	H	Ferlac	1,6,14,25	a	e,n,x	
I	H	Banjul	1,6,14,25	a	e,n,z_{15}	
I	H	Ndjamena	1,6,14,25	b	1,2	
I	H	Kuntair	1,6,14,25	b	1,5	
I	H	Tucson	[1],6,14,[25]	b	[1,7]	
IIIb	H		(6),14	b	e,n,x,z_{15}	(Ar. 7a,7c:43:28)
I	H	Blijdorp	1,6,14,25	c	1,5	
I	H	Kassberg	1,6,14,25	c	1,6	
I	H	Runby	1,6,14,25	c	e,n,x	
I	H	Minna	1,6,14,25	c	l,w	
I	H	Finkenwerder	[1],6,14,[25]	d	1,5	
I	H	Heves	6,14,[24]	d	1,5	
I	H	Woodhull	1,6,14,25	d	1,6	
I	H	Florida	[1],6,14,[25]	d	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	H	Midway	6,14,24	d	1,7	
I	H	Charity	[1],6,14,[25]	d	e,n,x	
I	H	Lindern	6,14,[24]	d	e,n,x	
I	H	Teko	1,6,14,25	d	e,n,z_{15}	
I	H	Encino	1,6,14,25	d	l,z13,z_{28}	
I	H	Albuquerque	1,6,14,24	d	z_6	
I	H	Bahrenfeld	6,14,24	e,h	1,5	
I	H	Onderstepoort	1,6,14,[25]	e,h	1,5	
I	H	Magumeri	1,6,14,25	e,h	1,6	
I	H	Beaudesert	[1],6,14,[25]	e,h	1,7	
I	H	Warragul	[1],6,14,[25]	g,m	–	
I	H	Caracas	[1],6,14,[25]	g,m,s	–	
I	H	Sylvania	[1],6,14,[25]	g,p	–	
I	H	Catanzaro	6,14	g,s,t	–	
I	H	Mampeza	1,6,14,25	i	1,5	
I	H	Buzu	[1],6,14,[25]	i	1,7	
I	H	Schalkwijk	6,14,[24]	i	e,n,..	
I	H	Moussoro	1,6,14,25	i	e,n,z_{15}	
I	H	Harburg	[1],6,14,[25]	k	1,5	
II	H		6,14,[24]	k	1,6	
II	H		6,14	k	[e,n,x]	
IIIb	H		(6),14	k	z	(Ar. 7a,7c:29:31)
IIIb	H		(6),14	k	z_{53}	(Ar. 7a,7c:29:25)
II	H		1,6,14	k	z_6:z_{42}	
I	H	Boecker	[1],6,14,[25]	l,v	1,7	
I	H	Horsham	1,6,14,[25]	l,v	e,n,x	
IIIb	H		(6),14	l,v	z	(Ar. 7a,7c:23:31)
IIIb	H		(6),14	l,v	z_{35}	(Ar. 7a,7c:23:21)
IIIb	H		(6),14	l,v	z_{53}	(Ar. 7a,7c:23:25)
I	H	Aflao	1,6,14,25	l,z_{28}	e,n,x	
I	H	Kaitaan	1,6,14,25	m,t	–	
II	H	Rooikrantz	1,6,14	m,t	1,5	
II	H	Emmerich	6,14	[m,t]	e,n,x	
IIIb	H		(6),14	r	z	(Ar. 7a,7c:24:31)
I	H	Istoria	1,6,14,25	r,i	1,5	
I	H	Surat	[1],6,14,[25]	[r],[i]	e,n,z_{15}	
I	H	Carrau	6,14,[24]	y	1,7	
I	H	Madelia	1,6,14,25	y	1,7	
I	H	Fischerkietz	1,6,14,25	y	e,n,x	
I	H	Mornington	1,6,14,25	y	e,n,z_{15}	
I	H	Homosassa	1,6,14,25	z	1,5	
I	H	Kanifing	1,6,14,25	z	1,6	
I	H	Soahanina	6,14,24	z	e,n,x	
I	H	Sundsvall	[1],6,14,[25]	z	e,n,x	
I	H	Royan	1,6,14,25	z	e,n,z_{15}	
I	H	Poano	1,6,14,25	z	l,z_{13},z_{28}	
I	H	Nessa	1,6,14,25	z_{10}	1,2	
VI	H	Bornheim	1,6,14,25	z_{10}	1,(2),7	Bornheim was formerly in Subspecies II.
II	H	Simonstown	1,6,14	z_{10}	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	H		(6),14	z_{10}	e,n,x,z_{15}	(Ar. 7a,7c:27:28)
IIIb	H		(6),14	z_{10}	z_{53}	(Ar. 7a,7c:27:25)
II	H	Slangkop	1,6,14	z_{10}	z_6:z_{42}	
IIIb	H		(6),14	z_{10}	z:[z_{53}]	(Ar. 7a,7c:27:31:[25])
I	H	Potosi	6,14	z_{36}	1,5	
I	H	Sara	1,6,14,25	z_{38}	[e,n,x]	
IV	H		6,14	z_4,z_{23}	–	
I	H	Arapahoe	1,6,14	z_4,z_{23}	1,5	
I	H	Bousso	1,6,14,25	z_4,z_{23}	[e,n,z_{15}]	
I	H	Chichiri	6,14,24	z_4,z_{24}	–	
I	H	Uzaramo	1,6,14,25	z_4,z_{24}	–	
II	H		1,6,14	z_{42}	1,6	
IIIb	H		(6),14	z_{52}	e,n,x,z_{15}	(Ar. 7a,7c:26:28)
IIIb	H		(6),14	z_{52}	z_{35}	(Ar. 7a,7c:26:21)
I	I	Hannover	16	a	1,2	
I	I	Brazil	16	a	1,5	
I	I	Amunigun	16	a	1,6	
I	I	Nyeko	16	a	1,7	
I	I	Togba	16	a	e,n,x	
I	I	Fischerhuette	16	a	e,n,z_{15}	
I	I	Heron	16	a	z_6	
I	I	Hull	16	b	1,2	
I	I	Wa	16	b	1,5	
I	I	Glasgow	16	b	1,6	
I	I	Hvittingfoss	16	b	e,n,x	
II	I		16	b	e,n,x	
I	I	Sangera	16	b	e,n,z_{15}	
I	I	Vegesack	16	b	l,w	
II	I		16	b	z_{39}	
II	I		16	b	z_{42}	
I	I	Malstatt	16	b	z_6	
I	I	Vancouver	16	c	1,5	
I	I	Gafsa	16	c	1,6	
I	I	Shamba	16	c	e,n,x	
I	I	Hithergreen	16	c	e,n,z_{15}	
I	I	Yoruba	16	c	l,w	
I	I	Oldenburg	16	d	1,2	
I	I	Sculcoates	16	d	1,5	
II	I		16	d	1,5	
I	I	Sherbrooke	16	d	1,6	
I	I	Gaminara	16	d	1,7	
I	I	Barranquilla	16	d	e,n,x	
I	I	Nottingham	16	d	e,n,z_{15}	
I	I	Caen	16	d	l,w	
I	I	Barmbek	16	d	z6	
I	I	Malakal	16	e,h	1,2	
I	I	Saboya	16	e,h	1,5	
I	I	Rhydyfelin	16	e,h	e,n,x	
I	I	Weston	16	e,h	z_6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	I	Bellville	16	e,n,x	1,(5),7	
II	I	Elsiesrivier	16	[e,n,x]	1,6:z_{42}	
I	I	Tees	16	f,g	–	
I	I	Nikolaifleet	16	g,m,s	–	
I	I	Adeoyo	16	g,m,[t]	–	
II	I	Mobeni	16	g,[m],[s],t	[e,n,x]	
II	I		16	g,[m],[s],t	z_{42}	
I	I	Cardoner	16	g,s,t	–	
II	I	Merseyside	16	g,t	[1,5]	
I	I	Amina	16	i	1,5	
I	I	Agbara	16	i	1,6	
I	I	Wisbech	16	i	1,7	
I	I	Frankfurt	16	i	e,n,z_{15}	
I	I	Pisa	16	i	l,w	
IIIb	I		16	i	z_{35}	(Ar. 25:33:21)
I	I	Abobo	16	i	z_6	
I	I	Szentes	16	k	1,2	
I	I	Nuatja	16	k	e,n,x	
I	I	Orientalis	16	k	e,n,z_{15}	
IIIb	I		16	k	z	(Ar. 25:29:31)
IIIb	I		16	k	z_{53}	(Ar. 25:29:25)
IIIb	I		16	(k)	z_{35}	(Ar. 25:22:21)
IIIb	I		16	l,v	1,5,7	(Ar. 25:23:30)
I	I	Shanghai	16	l,v	1,6	
I	I	Welikade	16	l,v	1,7	
I	I	Salford	16	l,v	e,n,x	
I	I	Burgas	16	l,v	e,n,z_{15}	
IIIb	I		16	l,v	z_{35}	(Ar. 25:23:21)
IIIb	I		16	l,v	z_{53}	(Ar. 25:23:25)
I	I	Losangeles	16	l,v	z_6	
IIIb	I		16	l,v	z:[z_{61}]	(Ar. 25:23:31:[41])
I	I	Zigong	16	l,w	1,5	
I	I	Westeinde	16	l,w	1,6	
I	I	Brooklyn	16	l,w	e,n,x	
I	I	Lomnava	16	l,w	e,n,z_{15}	
II	I	Noordhoek	16	l,w	z_6	
I	I	Mandera	16	l,z13	e,n,z_{15}	
I	I	Battle	16	l,z_{13},z_{28}	1,6	
I	I	Ablogame	16	l,z_{13},z_{28}	z_6	
I	I	Enugu	16	l,[z_{13}],z_{28}	[1,5]	
II	I	Sarepta	16	l,z_{28}	z_{42}	
I	I	Mpouto	16	m,t	–	
II	I		16	m,t	e,n,x	
II	I	Rowburton	16	m,t	[z_{42}]	
I	I	Ivory	16	r	1,6	
I	I	Brunflo	16	r	1,7	
I	I	Annedal	16	r,i	e,n,x	
I	I	Zwickau	16	r,i	e,n,z_{15}	
I	I	Rovaniemi	16	r,[i]	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	I	Saphra	16	y	1,5	
I	I	Akuafo	16	y	1,6	
I	I	Kikoma	16	y	e,n,x	
I	I	Avignon	16	y	e,n,z_{15}	
I	I	Fortlamy	16	z	1,6	
I	I	Lingwala	16	z	1,7	
II	I	Louwbester	16	z	[e,n,x]	
I	I	Brevik	16	z	e,n,[x],z_{15}	
II	I		16	z	z_{42}	
I	I	Bouake	16	z	z_6	
I	I	Badagry	16	z_{10}	1,5	
IIIb	I		16	z_{10}	1,5,7	(Ar. 25:27:30)
I	I	Lisboa	16	z_{10}	1,6	
IIIb	I		16	z_{10}	e,n,x,z_{15}	(Ar. 25:27:28)
I	I	Redlands	16	z_{10}	e,n,z_{15}	
I	I	Angouleme	16	z_{10}	z_6	
I	I	Saloniki	16	z_{29}	–	
II	I		16	z_{29}	1,5	
II	I	Jacksonville	16	z_{29}	[e,n,x]	
I	I	Trier	16	z_{35}	1,6	
I	I	Dakota	16	z_{35}	e,n,z15	
IV	I		16	z_{36}	–	
I	I	Naware	16	z_{38}	–	
I	I	Grancanaria	16	z_{39}	[1,6]	Grancanaria can be d-tartrate neg., dulcitol neg., ONPG pos., and anaerogenic.
II	I	Haddon	16	z_4,z_{23}	–	
IV	I	Ochsenzoll	16	z_4,z_{23}	–	
I	I	Kibi	16	z_4,z_{23}	[1,6]	
II	I		16	z_4,z_{24}	–	
IV	I	Chameleon	16	z_4,z_{32}	–	
II	I	Woodstock	16	z_{42}	1,[5],7	
IIIb	I		16	z_{52}	z_{35}	(Ar. 25:26:21)
II	I		16	z_6	1,6	
I	J	Bonames	17	a	1,2	
I	J	Jangwani	17	a	1,5	
I	J	Kinondoni	17	a	e,n,x	
I	J	Kirkee	17	b	1,2	
I	J	Dahra	17	b	1,5	
II	J	Hillbrow	17	b	e,n,x,z_{15}	
I	J	Bignona	17	b	e,n,z_{15}	
II	J		17	b	z6	
I	J	Victoriaborg	17	c	1,6	
II	J	Woerden	17	c	z_{39}	
I	J	Berlin	17	d	1,5	
I	J	Niamey	17	d	l,w	
I	J	Jubilee	17	e,h	1,2	
II	J		17	e,n,x,z_{15}	1,[5],7	
II	J	Verity	17	e,n,x,z_{15}	1,6	
II	J	Bleadon	17	(f),g,t	[e,n,x,z_{15}]	IP has dropped f.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	J		17	g,m,s,t	–	
I	J	Lowestoft	17	g,s,t	–	
II	J		17	g,t	z_{39}	
I	J	Ahanou	17	i	1,7	
IIIb	J		17	i	z_{35}	(Ar. 12:33:21)
II	J		17	k	–	
I	J	Irenea	17	k	1,5	
I	J	Warri	17	k	1,7	
I	J	Matadi	17	k	e,n,x	
I	J	Zaria	17	k	e,n,z_{15}	
IIIb	J		17	k	z	(Ar. 12:29:32)
I	J	Morotai	17	l,v	1,2	
I	J	Michigan	17	l,v	1,5	
I	J	Lancaster	17	l,v	1,7	
I	J	Carmel	17	l,v	e,n,x	
IIIb	J		17	l,v	e,n,x,z_{15}	(Ar. 12:23:28)
IIIb	J		17	l,v	z_{35}	(Ar. 12:23:21)
I	J	Granlo	17	l,z_{28}	e,n,x	
I	J	Bama	17	m,t	–	
II	J		17	m,t	–	
I	J	Lode	17	r	1,2	
IIIb	J		17	r	z	(Ar. 12:24:31)
II	J		17	y	–	
I	J	Hadejia	17	y	e,n,z_{15}	
I	J	Gori	17	z	1,2	
I	J	Warengo	17	z	1,5	
I	J	Tchamba	17	z	e,n,z_{15}	
II	J	Constantia	17	z	l,w:z_{42}	
I	J	Djibouti	17	z_{10}	e,n,x	
IIIb	J		17	z_{10}	e,n,x,z_{15}	(Ar.12:27:28). May possess H phase Rz$_{56}$ (Ar. 38).
IIIb	J		17	z_{10}	z	(Ar. 12:27:31)
I	J	Kandla	17	z_{29}	–	
IIIa	J		17	z_{29}	–	(Ar. 12:16,17,18:-)
IV	J		17	z_{29}	–	
IIIa	J		17	z_{36}	–	(Ar. 12:17,20:-)
IV	J		17	z_{36}	–	
IIIa	J		17	z_4,z_{23}	–	(Ar. 12:1,2,5:- and 12:1,2,6:-)
IIIa	J		17	z_4,z_{23},z_{32}	–	(Ar. 12:1,6,7,9:-)
IIIa	J		17	z_4,z_{24}	–	(Ar. 12:1,3,11:-)
IIIa	J		17	z_4,z_{32}	–	(Ar. 12:1,6,7:- and 12:1,7,8:-)
I	K	Cotia	18	–	1,6	
I	K	Brazos	6,14,18	a	e,n,z_{15}	
I	K	Fluntern	6,14,18	b	1,5	
I	K	Rawash	6,14,18	c	e,n,x	
I	K	Groenekan	18	d	1,5	
I	K	Usumbura	6,14,18	d	1,7	
I	K	Pontypridd	18	g,m	–	
IIIa	K		18	g,z_{51}	–	(Ar. 7a,7b:13,14:-)
I	K	Memphis	18	k	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	K		18	(k)	z_{53}	(Ar. 7a,7b:22:25)
IIIb	K		18	(k)	z_{54}	(Ar. 7a,7b:22:34)
IIIb	K		18	l,v	e,n,x,z_{15}	(Ar. 7a,7b:23:28)
I	K	Orlando	18	l,v	e,n,z_{15}	
IIIb	K		18	l,v	z	(Ar. 7a,7b:23:31)
IIIb	K		18	l,v	z_{53}	(Ar. 7a,7b:23:25)
I	K	Toulon	18	l,w	e,n,z_{15}	
I	K	Langenhorn	18	m,t	–	
II	K		18	m,t	1,5	
IIIb	K		18	r	z	(Ar. 7a,7b:24,31)
II	K		18	y	e,n,x,z_{15}	
I	K	Potengi	18	z	–	
I	K	Leer	18	z_{10}	1,5	
IIIb	K		18	z_{10}	e,n,x,z_{15}	(Ar. 7a,7b:27:28)
I	K	Carnac	18	z_{10}	z_6	
II	K	Zeist	18	z_{10}	z_6	
II	K	Beloha	18	z_{36}	–	
IV	K		18	z_{36},z_{38}	–	
I	K	Sinthia	18	z_{38}	–	
II	K		18	z_4,z_{23}	–	
IIIa	K		18	z_4,z_{23}	–	(Ar. 7a,7b:1,2,5:- and 7a,7b:1,2,6:-)
I	K	Cerro	18	z_4,z_{23}	[1,5]	Cerro was combined with Siegburg (6,14,18:z_4,z_{23}:[1,5]) and called Cerro. Cerro may possess H phase Rz_{45}.
I	K	Siegburg	6,14,18	z_4,z_{23}	[1,5]	IP combined Siegburg with Cerro (18:z_4,z_{23}:[1,5]) to form Cerro 6,14,18:z_4,z_{23}:[1,5]. Siegburg is now called Cerro var. O 14+. The name Siegburg has been dropped.
I	K	Aarhus	18	z_4,z_{23}	z_{64}	
I	K	Blukwa	18	z_4,z_{24}	–	
II	K		18	z_4,z_{24}	–	
IIIa	K	Shomron	18	z_4,z_{32}	–	Shomron was formerly in Subspecies II, but is now combined with *Arizona* 7a,7b:1,7,8:-. The name Shomron has been dropped.
IIIa	K		18	z_4,z_{32}	–	(Ar. 7a,7b:1,6,7:- and 7a,7b:1,7,8:-)
I	K	Delmenhorst	18	z_{71}	–	
I	L	Assen	21	a	[1,5]	
II	L		21	b	1,5	
I	L	Ghana	21	b	1,6	
I	L	Minnesota	21	b	e,n,x	Minnesota may possess H phase Rz_{33} or Rz_{49}.
I	L	Hydra	21	c	1,6	
I	L	Rhone	21	c	e,n,x	
II	L		21	c	e,n,x	
IIIb	L		21	c	e,n,x,z_{15}	(Ar. 22:32:28)
I	L	Spartel	21	d	1,5	
I	L	Magwa	21	d	e,n,x	
I	L	Madison	21	d	z_6	
I	L	Good	21	f,g	e,n,x	
II	L		21	g,[m],[s],t	–	
IIIa	L		21	g,z_{51}	–	(Ar. 22:13,14:-)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IV	L		21	g,z_{51}	–	
I	L	Diourbel	21	i	1,2	
IIIb	L		21	i	1,5,7	(Ar. 22:33:30)
IIIb	L		21	i	e,n,x,z_{15}	(Ar. 22:33:28)
IIIb	L		21	k	e,n,x,z_{15}	(Ar. 22:29:28)
IIIb	L		21	k	z	(Ar. 22:29:31)
IIIb	L		21	l,v	z	(Ar. 22:23:31)
IIIb	L		21	l,v	z_{57}	(Ar. 22:23:40)
I	L	Keve	21	l,w	–	
I	L	Jambur	21	l,z_{28}	e,n,z_{15}	
II	L		21	m,t	–	
I	L	Mountmagnet	21	r	–	
IIIb	L		21	r	z	(Ar. 22:24:31)
I	L	Ibaragi	21	y	1,2	
I	L	Ruiru	21	y	e,n,x	
II	L		21	z	–	CDC does not have this.
IIIb	L		21	z_{10}	e,n,x,z_{15}	(Ar. 22:27:28)
IIIb	L		21	z_{10}	z	(Ar. 22:27:31)
IIIb	L		21	z_{10}	z_{53}	(Ar. 22:27:25)
II	L	Wandsbek	21	z_{10}	[z_6]	
IIIa	L		21	z_{29}	–	(Ar. 22:16,17,18:-)
I	L	Gambaga	21	z_{35}	e,n,z_{15}	
IV	L		21	z_{36}	–	
I	L	Baguida	21	z_4,z_{23}	–	
IIIa	L		21	z_4,z_{23}	–	(Ar. 22:1,2,5:- and 22:1,2,6:-)
IV	L	Soesterberg	21	z_4,z_{23}	–	
II	L	Gwaai	21	z_4,z_{24}	–	
IIIa	L		21	z_4,z_{24}	–	(Ar. 22:1,3,11:-)
IV	L		21	z_4,z_{32}	–	
IIIb	L		21	z_{65}	e,n,x,z_{15}	(Ar. 22:32:28)
I	M	Solna	28	a	1,5	
I	M	Dakar	28	a	1,6	
I	M	Bakau	28	a	1,7	
I	M	Seattle	28	a	e,n,x	
II	M		28	a	e,n,x	
I	M	Honelis	28	a	e,n,z_{15}	
I	M	Dibra	28	a	z_6	
I	M	Moero	28	b	1,5	
I	M	Ashanti	28	b	1,6	
I	M	Bokanjac	28	b	1,7	
I	M	Soumbedioune	28	b	e,n,x	
II	M		28	b	e,n,x	
I	M	Langford	28	b	e,n,z_{15}	
II	M	Kaltenhausen	28	b	z_6	
I	M	Hermannswerder	28	c	1,5	
I	M	Eberswalde	28	c	1,6	
I	M	Halle	28	c	1,7	
I	M	Dresden	28	c	e,n,x	
I	M	Wedding	28	c	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	M	Techimani	28	c	z_6	
I	M	Amoutive	28	d	1,5	
I	M	Hatfield	28	d	1,6	
I	M	Mundonobo	28	d	1,7	
I	M	Mocamedes	28	d	e,n,x	
I	M	Patience	28	d	e,n,z_{15}	
I	M	Cullingworth	28	d	l,w	
I	M	Kpeme	28	e,h	1,7	
I	M	Gozo	28	e,h	e,n,z_{15}	
II	M		28	e,n,x	1,7	
I	M	Friedrichsfelde	28	f,g	–	
I	M	Yardley	28	g,m	1,6	
I	M	Abadina	28	g,m	[e,n,z_{15}]	
I	M	Croft	28	g,m,s	[e,n,z_{15}]	
II	M		28	g,m,t	e,n,x	
II	M		28	g,m,t	z_{39}	
II	M	Llandudno	28	g,[m],[s],t	1,5	
I	M	Ona	28	g,s,t	-	
II	M		28	g,s,t	e,n,x	
I	M	Doorn	28	i	1,2	
I	M	Cotham	28	i	1,5	
I	M	Volksmarsdorf	28	i	1,6	
I	M	Dieuppeul	28	i	1,7	
I	M	Warnemuende	28	i	e,n,x	
I	M	Kuessel	28	i	e,n,z_{15}	
I	M	Douala	28	i	l,w	
I	M	Guildford	28	k	1,2	
I	M	Ilala	28	k	1,5	
I	M	Adamstown	28	k	1,6	
I	M	Ikeja	28	k	1,7	
I	M	Taunton	28	k	e,n,x	
I	M	Ank	28	k	e,n,z_{15}	
I	M	Leoben	28	l,v	1,5	
I	M	Vitkin	28	l,v	e,n,x	
I	M	Nashua	28	l,v	e,n,z_{15}	
I	M	Ramsey	28	l,w	1,6	
I	M	Catalunia	28	l,z_{13},z_{28}	1,5	
I	M	Penilla	28	l,z_{13},z_{28}	e,n,z_{15}	
II	M		28	l,z_{28}	1,5	
I	M	Fajara	28	l,z_{28}	e,n,x	
I	M	Morillons	28	m,t	1,6	
II	M		28	m,t	[e,n,x]	
I	M	Vinohrady	28	m,t	[e,n,z_{15}]	
I	M	Bassadji	28	r	1,6	
I	M	Kibusi	28	r	e,n,x	
II	M	Oevelgoenne	28	r	e,n,z_{15}	
I	M	Fairfield	28	r	l,w	
I	M	Banco	28	r,i	1,7	
I	M	Chicago	28	r,[i]	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	M	Sanktgeorg	28	r,[i]	e,n,z_{15}	
I	M	Oskarshamn	28	y	1,2	
I	M	Nima	28	y	1,5	
I	M	Pomona	28	y	1,7	Pomona may possess H phases Rz_{60}, Rz_{70} or Rz_{80}.
I	M	Kitenge	28	y	e,n,x	
I	M	Telaviv	28	y	e,n,z_{15}	
I	M	Shomolu	28	y	l,w	
I	M	Selby	28	y	z_6	
I	M	Vanier	28	z	1,5	
II	M		28	z	1,5	
I	M	Doel	28	z	1,6	
I	M	Ezra	28	z	1,7	
I	M	Brisbane	28	z	e,n,z_{15}	
II	M	Ceres	28	z	z_{39}	
I	M	Rogy	28	z_{10}	1,2	
I	M	Farakan	28	z_{10}	1,5	
I	M	Libreville	28	z_{10}	1,6	
I	M	Malaysia	28	z_{10}	1,7	
I	M	Umbilo	28	z_{10}	e,n,x	
I	M	Luckenwalde	28	z_{10}	e,n,z_{15}	
I	M	Moroto	28	z_{10}	l,w	
IIIb	M		28	z_{10}	z	(Ar. 35:27:31)
IIIb	M		28	z_{10}	z:[z_{57}]	(Ar. 35:27:31:[40])
I	M	Djermaia	28	z_{29}	–	
II	M		28	z_{29}	1,5	
II	M		28	z_{29}	e,n,x	
I	M	Konolfingen	28	z_{35}	1,6	
I	M	Babili	28	z_{35}	1,7	
I	M	Santander	28	z_{35}	e,n,z_{15}	
I	M	Aderike	28	z_{38}	[e,n,z_{15}]	
I	M	Cannobio	28	z_4,z_{23}	1,5	
I	M	Teltow	28	z_4,z_{23}	1,6	
I	M	Babelsberg	28	z_4,z_{23}	[e,n,z_{15}]	
I	N	Overvecht	30	a	1,2	
I	N	Zehlendorf	30	a	1,5	
I	N	Guarapiranga	30	a	e,n,x	
I	N	Doulassame	30	a	e,n,z_{15}	
II	N	Odijk	30	a	z_{39}	
I	N	Louga	30	b	1,2	
I	N	Aschersleben	30	b	1,5	
I	N	Urbana	30	b	e,n,x	
I	N	Neudorf	30	b	e,n,z_{15}	
II	N		30	b	z_6	
I	N	Zaire	30	c	1,7	
I	N	Morningside	30	c	e,n,z_{15}	
II	N		30	c	z_{39}	
I	N	Messina	30	d	1,5	
I	N	Livulu	30	e,h	1,2	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	N	Torhout	30	e,h	1,5	
I	N	Giessen	30	g,m,s	–	
II	N		30	g,m,s	e,n,x	
I	N	Godesberg	30	g,m,[t]	–	
I	N	Sternschanze	30	g,s,t	–	Sternschanze may possess H phase Rz_{59}.
II	N	Slatograd	30	g,t	–	
I	N	Wayne	30	g,z_{51}	–	
I	N	Landau	30	i	1,2	
I	N	Morehead	30	i	1,5	
I	N	Mjordan	30	i	e,n,z_{15}	
I	N	Soerenga	30	i	l,w	
I	N	Hilversum	30	k	1,2	
I	N	Ramatgan	30	k	1,5	
I	N	Aqua	30	k	1,6	
I	N	Angoda	30	k	e,n,x	
II	N		30	k	e,n,x,z_{15}	
I	N	Odozi	30	k	e,n,[x],z_{15}	
I	N	Ligeo	30	l,v	1,2	
I	N	Donna	30	l,v	1,5	
I	N	Ockenheim	30	l,z_{13},z_{28}	1,6	
I	N	Morocco	30	l,z_{13},z_{28}	e,n,z_{15}	
II	N		30	l,z_{28}	z_6	
II	N		30	m,t	–	
I	N	Grandhaven	30	r	1,2	
I	N	Gege	30	r	1,5	
I	N	Matopeni	30	y	1,2	
I	N	Bietri	30	y	1,5	
I	N	Steinplatz	30	y	1,6	
I	N	Baguirmi	30	y	e,n,x	
I	N	Nijmegen	30	y	e,n,z_{15}	
I	N	Sada	30	z_{10}	1,2	
I	N	Senneville	30	z_{10}	1,5	
I	N	Kumasi	30	z_{10}	e,n,z_{15}	
I	N	Aragua	30	z_{29}	–	
I	N	Kokoli	30	z_{35}	1,6	
I	N	Wuiti	30	z_{35}	e,n,z_{15}	
I	N	Ago	30	z_{38}	–	
II	N		30	z_{39}	1,7	
I	N	Stoneferry	30	z_4,z_{23}	–	
I	N	Bodjonegoro	30	z_4,z_{24}	–	
II	N		30	z_6	1,6	
I	O	Umhlatazana	35	a	e,n,z_{15}	
I	O	Tchad	35	b	–	
I	O	Gouloumbo	35	c	1,5	
I	O	Yolo	35	c	[e,n,z_{15}]	
II	O		35	d	1,5	
I	O	Dembe	35	d	l,w	
I	O	Gassi	35	e,h	z_6	
I	O	Adelaide	35	f,g	–	Adelaide may possess H phase Rz_{27}.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	O	Ealing	35	g,m,s	–	
II	O		35	g,m,s,t	–	
I	O	Ebrie	35	g,m,t	–	
I	O	Anecho	35	g,s,t	–	
I	O	Agodi	35	g,t	–	
II	O		35	g,t	1,5	
II	O		35	g,t	z_{42}	
IIIa	O		35	g,z_{51}	–	(Ar. 20:13,14:-)
IIIb	O		35	i	e,n,x,z_{15}	(Ar. 20:33:28)
I	O	Gambia	35	i	e,n,z_{15}	
I	O	Bandia	35	i	l,w	
IIIb	O		35	i	z	(Ar. 20:33:31)
IIIb	O		35	i	z_{35}	(Ar. 20:33:21)
IIIb	O		35	i	z_{53}	(Ar. 20:33:25)
IIIb	O		35	k	e,n,x,z_{15}	(Ar. 20:29:28)
IIIb	O		35	k	z	(Ar. 20:29:31)
IIIb	O		35	k	z_{53}	(Ar. 20:29:25). May possess H phase Rz_{50} (Ar.42).
IIIb	O		35	(k)	z	(Ar. 20:22:31)
IIIb	O		35	(k)	z_{35}	(Ar. 20:22:21)
IIIb	O		35	l,v	1,5,7	(Ar. 20:23:30)
IIIb	O		35	l,v	e,n,x,z_{15}	(Ar. 20:23:28)
IIIb	O		35	l,v	z_{35}	(Ar. 20:23:21)
II	O		35	l,z_{28}	–	
I	O	Monschaui	35	m,t	-	
II	O		35	m,t	-	
IIIb	O		35	r	e,n,x,z_{15}	(Ar. 20:24:28)
I	O	Massakory	35	r	l,w	
IIIb	O		35	r	z	(Ar. 20:24:31)
IIIb	O		35	r	z_{35}	(Ar. 20:24:21)
IIIb	O		35	r	z_{61}	(Ar. 20:24:41)
I	O	Camberene	35	z_{10}	1,5	
I	O	Enschede	35	z_{10}	l,w	
IIIb	O		35	z_{10}	z_{35}	(Ar. 20:27:21)
I	O	Ligna	35	z_{10}	z_6	
I	O	Widemarsh	35	z_{29}	–	
IIIa	O		35	z_{29}	–	(Ar. 20:16,17,18:-)
II	O	Utbremen	35	z_{29}	e,n,x	
IIIa	O		35	z_{36}	–	(Ar. 20:17,20:-)
I	O	Haga	35	z_{38}	–	
I	O	Alachua	35	z_4,z_{23}	–	Alachua may possess H phase Rz_{37} or Rz_{45}.
IIIa	O		35	z_4,z_{23}	–	(Ar. 20:1,2,6:-)
I	O	Westphalia	35	z_4,z_{24}	–	
IIIa	O		35	z_4,z_{32}	–	(Ar. 20:1,7,8:-)
IIIb	O		35	z_{52}	1,5,7	(Ar. 20:26:30)
IIIb	O		35	z_{52}	e,n,x,z_{15}	(Ar. 20:26:28)
IIIb	O		35	z_{52}	z	(Ar. 20:26:31)
IIIb	O		35	z_{52}	z_{35}	(Ar. 20:26:21)
II	P		38	b	1,2	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	P	Rittersbach	38	b	e,n,z_{15}	
I	P	Sheffield	38	c	1,5	
I	P	Kidderminster	38	c	1,6	
II	P	Carletonville	38	d	[1,5]	
I	P	Thiaroye	38	e,h	1,2	
I	P	Kasenyi	38	e,h	1,5	
I	P	Korovi	38	g,m,[s]	–	
II	P	Foulpointe	38	g,t	–	
IIIa	P		38	g,z_{51}	–	(Ar. 16:13,14:-)
IV	P		38	g,z_{51}	–	
I	P	Mgulani	38	i	1,2	
I	P	Lansing	38	i	1,5	
IIIb	P		38	i	z	(Ar. 16:33:31)
IIIb	P		38	i	z_{53}	(Ar. 16:33:25)
I	P	Echa	38	k	1,2	
I	P	Mango	38	k	1,5	
I	P	Inverness	38	k	1,6	
I	P	Njala	38	k	e,n,x	
IIIb	P		38	k	e,n,x,z_{15}	(Ar. 16:29:28)
IIIb	P		38	k	z	(Ar. 16:29:31)
IIIb	P		38	k	z_{53}	(Ar. 16:29:25)
IIIb	P		38	(k)	1,5,7	(Ar. 16:22:30)
IIIb	P		38	(k)	z	(Ar. 16:22:31)
IIIb	P		38	(k)	z_{35}	(Ar. 16:22:21). May possess H phase Rz_{56} (Ar. 38).
IIIb	P		38	(k)	z_{54}	(Ar. 16:22:34)
IIIb	P		38	(k)	z_{55}	(Ar. 16:22:37)
I	P	Alger	38	l,v	1,2	
I	P	Kimberley	38	l,v	1,5	
I	P	Roan	38	l,v	e,n,x	
IIIb	P		38	l,v	z	(Ar. 16:23:31)
IIIb	P		38	l,v	z_{35}	(Ar. 16:23:21)
IIIb	P		38	l,v	z_{53}:[z_{54}]	(Ar. 16:23:25:[34])
I	P	Rothenburgsort	38	m,t	–	
I	P	Lindi	38	r	1,5	
IIIb	P		38	r	1,5,7	(Ar. 16:24:30)
I	P	Emmastad	38	r	1,6	
IIIb	P		38	r	e,n,x,z_{15}	(Ar. 16:24:28)
IIIb	P		38	r	z:[z57]	(Ar. 16:24:31:[40])
IIIb	P		38	r	z_{35}	(Ar. 16:24:21)
I	P	Freetown	38	y	1,5	
I	P	Colombo	38	y	1,6	
I	P	Perth	38	y	e,n,x	
I	P	Stachus	38	z	–	
I	P	Neunkirchen	38	z_{10}	–	
IIIb	P		38	z_{10}	z	(Ar. 16:27:31)
IIIb	P		38	z_{10}	z_{53}	(Ar. 16:27:25)
I	P	Klouto	38	z_{38}	–	
IIIa	P		38	z_4,z_{23}	–	(Ar. 16:1,2,6:-)
IV	P		38	z_4,z_{23}	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	P	Yoff	38	z_4,z_{23}	1,2	
I	P	Bangkok	38	z_4,z_{24}	–	
IIIb	P		38	z_{47}	z_{53}	(Ar. 16:39:25)
IIIb	P		38	z_{52}	z_{35}	(Ar. 16:26:21)
IIIb	P		38	z_{52}	z_{53}	(Ar. 16:26:25)
IIIb	P		38	z_{53}	–	(Ar. 16:25:-). May possess H phase Rz_{50} (Ar. 42) or Rz_{76} (Ar. Rz_{76}). CDC does not have monophasic.
IIIa	P		38	z_{61}	–	(Ar. 16:41:-)
IIIb	P		38	z_{61}	z_{53}	(Ar. 16:41:25)
II	Q		39	–	1,7	
II	Q		39	a	z_{39}	
I	Q	Wandsworth	39	b	1,2	
I	Q	Abidjan	39	b	l,w	
II	Q		39	c	e,n,x	
I	Q	Logone	39	d	1,5	
I	Q	Mara	39	e,h	[1,5]	
II	Q		39	e,n,x	1,7	
II	Q		39	g,m,t	–	
I	Q	Hofit	39	i	1,5	
I	Q	Cumberland	39	i	e,n,x	
I	Q	Champaign	39	k	1,5	Champaign may possess H phase Rz_{48}
II	Q		39	l,v	1,5	
I	Q	Kokomlemle	39	l,v	e,n,x	
I	Q	Oerlikon	39	l,v	e,n,z_{15}	
II	Q	Mondeor	39	l,z_{28}	e,n,x	
II	Q		39	l,z_{28}	z_{39}	
II	Q		39	m,t	e,n,x	
I	Q	Cook	39	Rz_{48}	1,5	IP combined Cook with Champaign (39:k:1,5). The name Cook has been dropped.
I	Q	Anfo	39	y	1,2	
I	Q	Windermere	39	y	1,5	
I	Q	Hegau	39	z_{10}	–	
I	R	Shikmonah	40	a	1,5	
II	R		1,40	a	1,5	
II	R	Springs	40	a	z_{39}	
I	R	Greiz	40	a	z_6	
II	R		1,40	a	z_6	
II	R		40	b	–	
I	R	Riogrande	40	b	1,5	
I	R	Saugus	40	b	1,7	
I	R	Johannesburg	1,40	b	e,n,x	
I	R	Duval	1,40	b	e,n,z_{15}	
I	R	Benguella	40	b	z_6	
II	R	Suarez	1,40	c	e,n,x,z_{15}	
II	R		1,40	c	z_{39}	
II	R	Ottershaw	40	d	–	
I	R	Driffield	1,40	d	1,5	
I	R	Tilene	1,40	e,h	1,2	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	R		1,40	e,n,x	1,[5],7	
II	R		1,40	e,n,x,z_{15}	1,6	
I	R	Bijlmer	1,40	g,m	–	
II	R	Alsterdorf	1,40	g,m,[s],t	[1,5]	
II	R	Boksburg	40	g,[m],s,[t]	e,n,x	
II	R		1,40	g,[m],[s],t	z_{42}	
II	R		1,40	g,t	[e,n,x]	
II	R		1,40	g,t	1,5	
II	R		1,40	g,t	e,n,x,z_{15}	
II	R		40	g,t	z_{39}	
IV	R	Seminole	1,40	g,z_{51}	–	
IIIb	R		40	g,z_{51}	[e,n,x,z15]	(Ar. 10a,10b:13,14:[28])
IIIb	R		40	i	1,5,7	(Ar. 10a,10b:33:30)
I	R	Goulfey	1,40	k	1,5	
I	R	Allandale	1,40	k	1,6	
I	R	Hann	40	k	e,n,x	
II	R	Sunnydale	1,40	k	e,n,x,z_{15}	
IIIb	R		40	k	z_{53}	(Ar. 10a,10b:29:25)
II	R		40	k	z_6	
IIIb	R		40	k	z:z_{57}	(Ar. 10a,10b:29:31:40)
I	R	Millesi	1,40	l,v	1,2	
I	R	Canary	40	l,v	1,6	
IIIb	R		40	l,v	z	(Ar. 10a,10b,(10c):23:31)
IIIb	R		40	l,v	z_{53}	(Ar. 10a,10b:23:25)
I	R	Overchurch	1,40	l,w	[1,2]	
I	R	Tiko	40	l,z_{13},z_{28}	1,2	
I	R	Bukavu	1,40	l,z_{28}	1,5	
II	R		1,40	l,z_{28}	1,5:z_{42}	
I	R	Santhiaba	40	l,z_{28}	1,6	
II	R		1,40	l,z_{28}	z_{39}	
IV	R		40	m,t	–	
II	R		40	m,t	z_{39}	
II	R		1,40	m,t	z_{42}	
I	R	Odienne	40	y	1,5	
II	R	Bulawayo	1,40	z	1,5	
I	R	Casamance	40	z	e,n,x	
II	R		1,40	z	z_{39}	
II	R		40	z	z_{42}	
I	R	Nowawes	40	z	z_6	
II	R		1,40	z	z_6	
IIIb	R		40	z_{10}	z_{35}	(Ar. 10a,10b:27:21)
I	R	Trotha	40	z_{10}	z_6	
I	R	Omifisan	40	z_{29}	–	
IIIa	R		40	z_{29}	–	(Ar. 10a,10b:16,18:-)
V	R		1,40	z_{35}	–	
II	R	Fandran	1,40	z_{35}	e,n,x,z_{15}	
I	R	Yekepa	1,40	z_{35}	e,n,z_{15}	
IIIa	R		40	z_{35}	–	(Ar. 10a,10b:17,20:-)
II	R		40	z_{39}	1,5:z_{42}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	R	Grunty	1,40	z_{39}	1,6	
II	R		40	z_{39}	1,7	
IIIa	R		40	z_4,z_{23}	–	(Ar. 10a,10b:1,2,5:-; 10a,10b:1,2,5,6:-; and 10a,10b:1,2,6:-)
IV	R	Sachsenwald	1,40	z_4,z_{23}	–	
IIIa	R		40	z_4,z_{24}	–	(Ar. 10a,10b:1,3,11:-)
IV	R	Degania var. subsp. IV	40	z_4,z_{24}	–	
II	R	Degania	40	z_4,z_{24}	[z_{39}]	
IIIa	R		40	z_4,z_{32}	–	(Ar. 10a,10b:1,2,10:-; 10a,10c:1,2,10:-; and 10a,10b:1,7,8:-)
IIIa	R		40	z_4,z_{32}	–	
IV	R	Bern	1,40	z_4,z_{32}	–	
I	R	Karamoja	40	z_{41}	1,2	
II	R		1,40	z_{42}	1,6	
II	R		1,40	[z_{42}]	1,(5),7	
II	R		1,40	z_6	1,5	
V	R		40	z_{81}	–	H z_{81} was formerly H a in *S. bongori*.
II	S		41	–	1,6	
I	S	Burundi	41	a	–	
II	S	Vietnam var. subsp. II	41	b	–	
II	S		41	b	[1,5]	
I	S	Vaugirard	41	b	1,6	
VI	S		41	b	1,7	
I	S	Sica	41	b	e,n,z_{15}	
I	S	Vietnam	41	b	z_6	
IIIb	S		41	c	e,n,x,z_{15}	(Ar. 13:32:28)
II	S		41	c	[z_6]	
I	S	Egusi	41	d	[1,5]	
II	S	Hennepin	41	d	z_6	
II	S		41	g,m,s,t	z_6	
II	S	Lethe	41	g,t	–	
IIIa	S		41	g,z_{51}	–	(Ar. 13:13,14:-)
I	S	Samaru	41	i	1,5	
I	S	Verona	41	i	1,6	
I	S	Ferlo	41	k	1,6	
II	S		41	k	1,6	
II	S		41	k	[z_6]	
IIIb	S		41	(k)	[z_{35}]	(Ar. 13:22:[21])
II	S		41	l,z_{13},z_{28}	e,n,x,z_{15}	
I	S	Leatherhead	41	m,t	1,6	
I	S	Lubumbashi	41	r	1,5	
II	S	Dubrovnik	41	z	1,5	
II	S	Negev	41	z_{10}	1,2	
I	S	Leipzig	41	z_{10}	1,5	
I	S	Landala	41	z_{10}	1,6	
I	S	Inpraw	41	z_{10}	e,n,x	
II	S	Lurup	41	z_{10}	e,n,x,z_{15}	
II	S	Lichtenberg	41	z_{10}	[z_6]	
I	S	Lodz	41	z_{29}	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIa	S		41	z_{29}	–	(Ar. 13:16,17,18:-)
IV	S		41	z_{29}	–	
I	S	Ahoutoue	41	z_{35}	1,6	
IIIa	S		41	z_{36}	–	(Ar. 13:17,20:-)
I	S	Offa	41	z_{38}	–	
IIIa	S		41	z_4,z_{23}	–	(Ar. 13:1,2,5:- and 13:1,2,6:-)
IV	S	Waycross var. subsp. IV	41	z_4,z_{23}	–	
I	S	Waycross	41	z_4,z_{23}	[e,n,z_{15}]	
IIIa	S		41	z_4,z_{23},z_{32}	–	(Ar. 13:1,6,7,9:-)
IIIa	S		41	z_4,z_{24}	–	(Ar. 13:1,3,11:-)
I	S	Ipswich	41	z_4,z_{24}	[1,5]	
IIIa	S		41	z_4,z_{32}	–	(Ar. 13:1,6,7:- and 13:1,7,8:-)
IV	S		41	z_{52}	–	
I	T	Faji	1,42	a	e,n,z_{15}	
II	T	Chinovum	42	b	1,5	
I	T	Orbe	42	b	1,6	
II	T	Uphill	42	b	e,n,x,z_{15}	
I	T	Tomegbe	1,42	b	e,n,z_{15}	
I	T	Egusitoo	1,42	b	z_6	
II	T		42	b	z_6	
I	T	Antwerpen	1,42	c	e,n,z_{15}	
I	T	Kampala	1,42	c	z_6	
II	T		42	d	z_6	
II	T		42	[e,n,x]	1,6	
II	T	Fremantle	42	(f),g,t	–	
IIIa	T		42	g,z_{51}	–	(Ar. 15:13,14:-)
IV	T		1,42	g,z_{51}	–	
I	T	Maricopa	1,42	g,z_{51}	1,5	
I	T	Borromea	42	i	1,6	
I	T	Kaneshie	1,42	i	l,w	
I	T	Middlesbrough	1,42	i	z_6	
IIIb	T		42	k	–	(Ar. 15:29:-)
I	T	Haferbreite	42	k	[1,6]	
IIIb	T		42	k	e,n,x,z15	(Ar. 15:29:28)
IIIb	T		42	k	z	(Ar. 15:29:31)
IIIb	T		42	k	z_{35}	(Ar. 15:29:21)
I	T	Gwale	1,42	k	z_6	
IIIb	T		42	(k)	z_{35}	(Ar. 15:22:21)
IIIb	T		42	l,v	1,5,7	(Ar. 15:23:30)
II	T	Portbech	42	l,v	e,n,x,z_{15}	
IIIb	T		42	l,v	e,n,x,z_{15}	(Ar. 15:23:28)
I	T	Coogee	42	l,v	e,n,z_{15}	
IIIb	T		42	l,v	z	(Ar. 15:23:31)
IIIb	T		42	l,v	z_{53}	(Ar. 15:23:25)
II	T		1,42	l,w	e,n,x	
II	T		42	l,[z_{13}],z_{28}	[z_6]	
I	T	Waral	1,42	m,t	–	
II	T		42	m,t	[e,n,x,z_{15}]	
II	T	Nairobi	42	r	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	T		42	r	–	(Ar. 15:24:-). May possess H phase Rz_{50} (Ar. 42).
I	T	Sipane	1,42	r	e,n,z_{15}	
I	T	Brive	1,42	r	l,w	
IIIb	T		42	r	z	(Ar. 15:24:31)
IIIb	T		42	r	z_{53}	(Ar. 15:24:25)
I	T	Spalentor	1,42	y	e,n,z_{15}	
I	T	Harvestehude	1,42	y	z_6	
II	T	Detroit	42	z	1,5	
I	T	Ursenbach	1,42	z	1,6	
II	T	Rand	42	z	e,n,x,z_{15}	
I	T	Melbourne	42	z	e,n,z_{15}	
II	T	Nuernberg	42	z	z_6	
IIIb	T		42	z_{10}	–	(Ar. 15:27:-). May possess H phase Rz_{56} (Ar. 38) and Rz_{50} (Ar. 42).
II	T		42	z_{10}	1,2	
II	T		42	z_{10}	e,n,x,z_{15}	
IIIb	T		42	z_{10}	e,n,x,z_{15}	(Ar. 15:27:28)
IIIb	T		42	z_{10}	z	(Ar. 15:27:31)
IIIb	T		42	z_{10}	z_{35}	(Ar. 15:27:21)
I	T	Loenga	1,42	z_{10}	z_6	
II	T		42	z_{10}	z_6	
IIIb	T		42	z_{10}	z_{67}	(Ar. 15:27:46)
I	T	Djama	1,42	z_{29}	[1,5]	
I	T	Kahla	1,42	z_{35}	1,6	
I	T	Tema	1,42	z_{35}	z_6	
I	T	Weslaco	42	z_{36}	–	
IV	T		42	z_{36}	–	
I	T	Vogan	1,42	z_{38}	z_6	
IIIa	T		42	z_4,z_{23}	–	(Ar. 15:1,2,5:- and 15:1,2,6:-)
I	T	Gera	1,42	z_4,z_{23}	[1,6]	
I	T	Broc	42	z_4,z_{23}	e,n,z_{15}	
I	T	Toricada	1,42	z_4,z_{24}	–	
IIIa	T		42	z_4,z_{24}	–	(Ar. 15:1,3,11:-)
IV	T		1,42	z_4,z_{24}	–	
I	T	Taset	1,42	z_{41}	–	
IIIb	T		42	z_{52}	z	(Ar. 15:26:31)
II	T		42	z_6	1,6	
I	U	Graz	43	a	1,2	
I	U	Berkeley	43	a	1,5	
II	U		43	a	1,5	
II	U		43	a	z_6	
II	U	Kommetje	43	b	z_{42}	
I	U	Montreal	43	c	1,5	
I	U	Orleans	43	d	1,5	
II	U		43	d	e,n,x,z_{15}	
II	U		43	d	z_{39}	
II	U		43	d	z_{42}	
II	U		43	e,n,x,z_{15}	1,(5),7	
II	U		43	e,n,x,z_{15}	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	U	Milwaukee	43	f,g,[t]	–	
II	U	Mosselbay	43	g,m,[s],t	[z_{42}]	
II	U	Veddel	43	g,t	–	
II	U		43	g,t	1,5	
IIIa	U		43	g,z_{51}	–	(Ar. 21:13,14:-)
IV	U		43	g,z_{51}	–	
II	U		43	g,z_{62}	e,n,x	
I	U	Mbao	43	i	1,2	
I	U	Voulte	43	i	e,n,x	
I	U	Thetford	43	k	1,2	
I	U	Ahuza	43	k	1,5	
IIIb	U		43	k	z	(Ar. 21:29:31)
IIIb	U		43	l,v	z_{53}:[Rz_{56}]	(Ar. 21:23:25:[38])
I	U	Sudan	43	l,z_{13}	–	
II	U		43	l,z_{13},z_{28}	1,5	
IIIb	U		43	r	e,n,x,z_{15}	(Ar. 21:24:28)
IIIb	U		43	r	z	(Ar. 21:24:31)
IIIb	U		43	r	z_{53}	(Ar. 21:24:25)
I	U	Farcha	43	y	1,2	
I	U	Kingabwa	43	y	1,5	
I	U	Ogbete	43	z	1,5	
II	U		43	z	1,5	
I	U	Arusha	43	z	e,n,z_{15}	
I	U	Adana	43	z_{10}	1,5	
I	U	Makiling	43	z_{29}	–	
IV	U		43	z_{29}	–	
II	U		43	z_{29}	e,n,x	
II	U		43	z_{29}	z_{42}	
I	U	Ahepe	43	z_{35}	1,6	
IIIa	U		43	z_{36}	–	(Ar. 21:17,20:-)
IV	U	Volksdorf	43	z_{36},z_{38}	–	
I	U	Irigny	43	z_{38}	–	
IIIa	U		43	z_4,z_{23}	–	(Ar. 21:1,2,5:- and 21:1,2,6:-)
IV	U	Houten	43	z_4,z_{23}	–	
IV	U		43	z_4,z_{23}	–	
IIIa	U		43	z_4,z_{24}	–	(Ar. 21:1,3,11:-)
IV	U		43	z_4,z_{24}	–	
IV	U	Tuindorp	43	z_4,z_{32}	–	
II	U	Bunnik	43	z_{42}	[1,5,7]	
IIIb	U		43	z_{52}	z_{53}	(Ar. 21:26:25)
I	V	Niakhar	44	a	1,5	
I	V	Tiergarten	44	a	e,n,x	
I	V	Niarembe	44	a	l,w	
I	V	Sedgwick	44	b	e,n,z_{15}	
I	V	Madigan	44	c	1,5	
I	V	Quebec	44	c	e,n,z_{15}	
I	V	Bobo	44	d	1,5	
I	V	Kermel	44	d	e,n,x	
I	V	Fischerstrasse	44	d	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	V	Palamaner	1,44	d	z_{35}	
II	V		1,44	e,n,x	1,6	
I	V	Vleuten	44	f,g	–	
I	V	Gamaba	1,44	g,m,[s]	–	
I	V	Splott	44	g,s,t	–	
II	V		44	g,t	z_{42}	
I	V	Carswell	44	g,z_{51}	–	
IV	V		44	g,z_{51}	–	
I	V	Maritzburg	1,44	i	e,n,z_{15}	
I	V	Lawra	44	k	e,n,z_{15}	
I	V	Malika	44	l,z_{28}	1,5	
I	V	Muguga	44	m,t	–	
V	V	Camdeni	44	r	–	
I	V	Brefet	44	r	e,n,z_{15}	
I	V	Bolama	44	z	e,n,x	
I	V	Uhlenhorst	44	z	l,w	
I	V	Guinea	1,44	z_{10}	[1,7]	
I	V	Llobregat	1,44	z_{10}	e,n,x	
I	V	Zinder	44	z_{29}	–	
IV	V		44	z_{29}	–	
II	V		44	z_{29}	e,n,x:z_{42}	
IV	V		44	z_{36},[z_{38}]	–	
I	V	Koketime	44	z_{38}	–	
V	V		44	z_{39}	–	
II	V	Clovelly	1,44	z_{39}	[e,n,x,z_{15}]	
I	V	Kua	44	z_4,z_{23}	–	
II	V		44	z_4,z_{23}	–	
IIIa	V		44	z_4,z_{23}	–	(Ar. 1,3:1,2,5:- and 1,3:1,2,6:-)
IV	V		44	z_4,z_{23}	–	
I	V	Ploufragan	1,44	z_4,z_{23}	e,n,z_{15}	
IIIa	V		44	z_4,z_{23},z_{32}	–	(Ar. 1,3:1,6,7,9:-)
I	V	Christiansborg	44	z_4,z_{24}	–	
IIIa	V		44	z_4,z_{24}	–	(Ar. 1,3:1,3,11:-)
IV	V		44	z_4,z_{24}	–	
IIIa	V		44	z_4,z_{32}	–	(Ar. 1,3:1,2,10:- and 1,3:1,7,8:-). IP calls z_4,z_{23},z_{32}, Ar. 1,2,10.
IV	V	Lohbruegge	44	z_4,z_{32}	–	
VI	W	Vrindaban	45	a	e,n,x	
I	W	Meekatharra	45	a	e,n,z_{15}	
II	W	Ejeda	45	a	z_{10}	
I	W	Riverside	45	b	1,5	
I	W	Fomeco	45	b	e,n,z_{15}	
I	W	Deversoir	45	c	e,n,x	
I	W	Dugbe	45	d	1,6	
I	W	Karachi	45	d	e,n,x	
I	W	Warmsen	45	d	e,n,z_{15}	
I	W	Suelldorf	45	f,g	–	
II	W	Windhoek	45	g,m,s,t	1,5	
II	W	Bremen	45	g,m,s,t	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	W	Tornow	45	g,m,[s],[t]	–	
II	W	Perinet	45	g,m,t	e,n,x,z_{15}	
I	W	Binningen	45	g,s,t	–	
IIIa	W		45	g,z_{51}	–	(Ar. 11:13,14:-)
IV	W		45	g,z_{51}	–	
I	W	Verviers	45	k	1,5	
I	W	Casablanca	45	k	1,7	
I	W	Cairns	45	k	e,n,z_{15}	
I	W	Imo	45	l,v	[e,n,z_{15}]	
I	W	Apapa	45	m,t	–	
II	W		45	m,t	1,5	
I	W	Kofandoka	45	r	e,n,z_{15}	
II	W		45	z	1,5	
I	W	Yopougon	45	z	e,n,z_{15}	
II	W	Klapmuts	45	z	z_{39}	
I	W	Jodhpur	45	z_{29}	–	
IIIa	W		45	z_{29}	–	(Ar. 11:16,18:-)
II	W		45	z_{29}	1,5	
II	W		45	z_{29}	e,n,x	
II	W		45	z_{29}	z_{42}	
I	W	Lattenkamp	45	z_{35}	1,5	
I	W	Balcones	45	z_{36}	–	
IV	W		45	z_{36},z_{38}	–	
IIIa	W		45	z_4,z_{23}	–	(Ar. 11:1,2,5:-)
IV	W		45	z_4,z_{23}	–	
I	W	Transvaal	45	z_4,z_{24}	–	
IIIa	W		45	z_4,z_{24}	–	(Ar. 11:1,3,11:-)
IIIa	W		45	z_4,z_{32}	–	(Ar. 11:1,7,8:-)
II	X	Bilthoven	47	a	[1,5]	
II	X		47	a	e,n,x,z_{15}	
I	X	Saka	47	b	–	IP combined Saka with Sya (47:b:z_6) and called it Sya.
I	X	Wenatchee	47	b	1,2	
II	X	Phoenix	47	b	1,5	
II	X	Khami	47	b	[e,n,x,z_{15}]	
I	X	Sya	47	b	z_6	
II	X		47	b	z_6	
IIIb	X		47	c	1,5,7	(Ar. 28:32:30)
I	X	Kodjovi	47	c	[1,6]	Kodjovi may possess H phase Rz_{78}.
IIIb	X		47	c	e,n,x,z_{15}:[z_{57}]	(Ar. 23:32:28 and 28:32:28:[40])
IIIb	X		47	c	z	(Ar. 28:32:31)
IIIb	X		47	c	z_{35}	(Ar. 28:32:21)
II	X		47	d	e,n,x,z_{15}	
I	X	Stellingen	47	d	[e,n,x]	
II	X	Quimbamba	47	d	z_{39}	
II	X		47	e,n,x,z_{15}	1,6	
I	X	Sljeme	1,47	f,g	–	
I	X	Anie	47	(g),m,t	–	IP combined Anie with Mesbit (47:m,t:[e,n,z_{15}]) and called it Mesbit.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	X	Luke	1,47	g,m	–	
II	X		47	g,t	e,n,x	
IIIa	X		47	g,z_{51}	–	(Ar. 28:13,14)
IIIb	X		47	i	e,n,x,z_{15}	(Ar. 23:33:28). May possess H phase Rz_{50} (Ar. 42).
I	X	Bergen	47	i	e,n,z_{15}	
IIIb	X		47	i	z	(Ar. 28:33:31)
IIIb	X		47	i	z_{35}	(Ar. 23:33:21 and 28:33:21)
IIIb	X		47	i	z_{53}:[z_{57}]	(Ar. 23:33:25 and 28:33:25:[40])
I	X	Staoueli	47	k	1,2	
I	X	Bootle	47	k	1,5	
IIIb	X		47	k	1,5,7	(Ar. 28:29:30)
I	X	Dahomey	47	k	1,6	Dahomey may possess H phase Rz_{58}.
IIIb	X		47	k	e,n,x,z_{15}	(Ar. 28:29:28)
I	X	Lyon	47	k	e,n,z_{15}	
IIIb	X		47	k	z	(Ar. 28:29:31)
IIIb	X		47	k	z_{35}	(Ar. 23:29:21)
IIIb	X		47	k	z_{53}	(Ar. 23:29:25)
IV	X		47	l,v	–	
IIIb	X		47	l,v	1,5,(7)	(Ar. 23:23:30). May possess H phase Rz_{50} (Ar. 42).
IIIa	X		47	l,v	e,n,x,z_{15}	(Ar. 28:23:28)
IIIb	X		47	l,v	z	(Ar. 23:23:31)
IIIb	X		47	l,v	z_{35}	(Ar. 28:23:21)
IIIb	X		47	l,v	z_{53}	(Ar. 28:23:25)
IIIb	X		47	l,v	z_{57}	(Ar. 28:23:40)
I	X	Teshie	1,47	l,z_{13},z_{28}	e,n,z_{15}	
I	X	Mesbit	47	m,t	[e,n,z_{15}]	
IIIa	X		47	r	–	(Ar. 23:24:-). CDC does not have this.
I	X	Dapango	47	r	1,2	
IIIb	X		47	r	1,5,7	(Ar. 23:24:30)
IIIb	X		47	r	z	(Ar. 23:24:31)
IIIb	X		47	r	z_{35}	(Ar. 23:24:21 and 28:24:21)
IIIb	X		47	r	z_{53}	(Ar. 23:24:25). May possess H phase Rz_{74} (Ar. Rz_{74})
IIIb	X		47	r	z_{53}:Rz_{50}:z_{60}	(Ar. 28:24:25:42:44). Not in IP book.
IIIb	X		47	r	z_{53}:[z_{60}]	(Ar. 23:24:25:[44]). May possess H phase Rz_{70} and Rz_{72} (Ar. Rz_{70} or Rz_{72}).
I	X	Moualine	47	y	1,6	
I	X	Blitta	47	y	e,n,x	
I	X	Mountpleasant	47	z	1,5	
I	X	Kaolack	47	z	1,6	
II	X		47	z	e,n,x,z_{15}	
II	X	Chersina	47	z	z_6	
IIIb	X		47	z_{10}	1,5,7	(Ar. 28:27:30)
IIIb	X		47	z_{10}	z	(Ar. 28:27:31)
IIIb	X		47	z_{10}	z_{35}	(Ar. 28:27:21)
I	X	Ekpoui	47	z_{29}	–	
IIIa	X		47	z_{29}	–	(Ar. 28:16,18:-)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	X		47	z_{29}	e,n,x,z_{15}	
I	X	Bingerville	47	z_{35}	e,n,z_{15}	
IV	X		47	z_{36}	–	
I	X	Alexanderplatz	47	z_{38}	–	
IIIa	X		47	z_4,z_{23}	–	(Ar. 28:1,2,5:-)
I	X	Tabligbo	47	z_4,z_{23}	[e,n,z_{15}]	
I	X	Binche	47	z_4,z_{23}	l,w	
I	X	Bere	47	z_4,z_{23}	[z_6]	Bere may possess H phase Rz45.
I	X	Tamberma	47	z_4,z_{24}	–	
I	X	Quinhon	47	z_{44}	–	
IIIb	X		47	z_{52}	1,5,7	(Ar. 28:26:30)
IIIb	X		47	z_{52}	e,n,x,z_{15}	(Ar. 28:26:28)
IIIb	X		47	z_{52}	z	(Ar. 28:26:31)
IIIb	X		47	z_{52}	z_{35}	(Ar. 28:26:21)
II	X		47	z_6	1,6	
I	Y	Hisingen	48	a	1,5,7	
IIIb	Y		48	a	z_{35}	(Ar. 5:35:21). Not in 1992 IP, but is in Bergey.
II	Y		48	a	z_{39}	
II	Y		48	a	z_6	
V	Y		48	b	–	
II	Y		48	b	[z_6]	
IIIb	Y		48	c	z	(Ar. 29:32:31)
II	Y	Etosha	48	d	1,11	Etosha was not considered a new serotype by Kauffmann and is not used.
II	Y		48	d	1,2	
II	Y	Hagenbeck	48	d	z_6	
I	Y	Fitzroy	48	e,h	1,5	
II	Y	Hammonia	48	e,n,x,z_{15}	z_6	
II	Y	Erlangen	48	g,m,t	–	
IIIa	Y		48	g,z_{51}	–	(Ar. 5:13,14:-)
IV	Y	Marina	48	g,z_{51}	–	
IIIb	Y	Sydney	48	i	z	Sydney was formerly in subspecies II, but it it now combined with *Arizona* 5:33:31. The name Sydney has been dropped.
IIIb	Y		48	i	z_{35}:[z_{57}]	(Ar. 29:33:21:[40])
IIIb	Y		48	i	z_{53}	(Ar. 5:33:25)
IIIb	Y		48	i	z_{61}	(Ar. 5,29:33:41)
IIIb	Y		48	i	z:[z_{72}]	(Ar. 5,29:33:31:[z_{72}]). CDC does not have z_{72} strain.
IIIb	Y		48	k	1,5,(7)	(Ar. 5:29:30)
II	Y		48	k	e,n,x,z_{15}	
IIIb	Y		48	k	e,n,x,z_{15}	(Ar. 5:29:28)
I	Y	Dahlem	48	k	e,n,z_{15}	
IIIb	Y		48	k	z	(Ar. 5,29:29:31)
IIIb	Y		48	k	z_{35}:[Rz_{75}]	(Ar. [5:29:21:Rz_{75}]). CDC does not have Rz_{75}.
IIIb	Y		48	k	z_{53}	(Ar. 5,29:29:25)
IIIb	Y		48	(k)	z_{53}	(Ar. 5:22:25 and Ar. 5,29:22:25). Called 5:22:25 by IP.
II	Y	Sakaraha	48	[k]	z_{39}	
I	Y	Australia	48	l,v	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	Y		48	l,v	1,5,(7)	(Ar. 5:23:30). May possess H phase Rz_{47} or Rz_{50} (Ar. 39 or 42).
IIIb	Y		48	l,v	z	(Ar. 5,29:23:31)
IIIb	Y		48	r	e,n,x,z_{15}	(Ar. 5:24:28)
IIIb	Y		48	r	z	(Ar. 5,29:24:31)
I	Y	Toucra	48	z	1,5	Toucra may possess H phase Rz_{58}.
II	Y		48	z	1,5	
VI	Y		48	z_{10}	1,5	
II	Y	Ngozi	48	z_{10}	[1,5]	
I	Y	Isaszeg	48	z_{10}	e,n,x	
IIIb	Y		48	z_{10}	e,n,x,z_{15}	(Ar. 5:27:28)
IIIb	Y		48	z_{10}	z	(Ar. 5,29:27:31)
II	Y		48	z_{29}	–	
IIIa	Y		48	z_{29}	–	(Ar. 5:16,18). This is not in IP book, but is on Rohde's list.
IV	Y		48	z_{29}	–	
V	Y	Bongor	48	z_{35}	–	
IIIb	Y		48	z_{35}	z_{52}	(Ar. 5:21:26)
IIIa	Y		48	z_{36}	–	(Ar. 5,29:17,20:-)
IV	Y		48	z_{36},[z_{38}]	–	
V	Y		48	z_{39}	–	
IIIa	Y		48	z_4,z_{23}	–	(Ar. 5:1,2,5:-; 5:1,2,5,6:-; and 5:1,6:-)
IV	Y		48	z_4,z_{23}	–	
IIIa	Y		48	z_4,z_{23},z_{32}	–	(Ar. 5:1,6,7,9:-). IP calls this 5:1,6,7:-.
I	Y	Djakarta	48	z_4,z_{24}	–	
IIIa	Y		48	z_4,z_{24}	–	(Ar. 5:1,3,11:-)
IIIa	Y		48	z_4,z_{32}	–	(Ar. 5:1,6,7:-; 5:1,7,8:-; and Ar. 5:1,2,10:-). IP calls z_4,z_{32}, Ar. 1,7,8; and would call z_4,z_{23},z_{32}, Ar. 1,2,10.
IV	Y		48	z_4,z_{32}	–	
V	Y	Balboa	48	z_{41}	–	
IIIb	Y		48	z_{52}	e,n,x,z_{15}	(Ar. 29:26:28)
IIIb	Y		48	z_{52}	z	(Ar. 5:26:31)
V	Y		48	z_{65}	–	
V	Y		48	z_{81}	–	
IV	Z		50	a	–	
IV	Z		50	b	–	
I	Z	Rochdale	50	b	e,n,x	
II	Z		50	b	z_6	
IV	Z		50	d	-	
I	Z	Hemingford	50	d	1,5	Hemingford may possess H phase Rz_{82}.
II	Z	Krugersdorp	50	e,n,x	1,7	
II	Z	Namib	50	g,[m],s,t	[1,5]	
IV	Z	Wassenaar	50	g,z_{51}	-	
II	Z		50	g,z_{62}	e,n,x	
IIIb	Z		50	i	1,5,7	(Ar. 9a,9c:33:30)
IIIb	Z		50	i	e,n,x,z_{15}	(Ar. 9a,9c:33:28)
IIIb	Z		50	i	z	(Ar. 9a,9c:33:31)
IIIb	Z		50	k	1,5,7	(Ar. 9a,9c:29:30)
IIIb	Z		50	k	e,n,x,z_{15}	(Ar. 9a,9c:29:28)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	Z		50	k	e,n,x:z_{42}	
IIIb	Z		50	k	z	(Ar. 9a,9b:29:31 and 9a,9c:29:31). Ar. 9a,9b may possess H phase Rz_{50} (Ar. 42).
IIIb	Z		50	k	z_{35}	(Ar. 9a,9b:29:21)
IIIb	Z		50	k	z_{53}	(Ar. 9a,9b:29:25 and 9a,9c:29:25). IP and Rohde only list the 9a,9c.
II	Z	Seaforth	50	k	z_6	
IIIb	Z		50	(k)	z	(Ar. 9a,9b:22:31)
IIIb	Z		50	(k)	z_{35}	(Ar. 9a,9b:22:21)
I	Z	Fass	50	l,v	1,2	
IIIb	Z		50	l,v	e,n,x,z_{15}	(Ar. 9a,9b:23:28)
IIIb	Z		50	l,v	z	(Ar. 9a,9b:23:31 and 9a,9c:23:31). IP only lists 9a,9c.
IIIb	Z		50	l,v	z_{35}	(Ar. 9a,9c:23:21)
II	Z		50	l,w	e,n,x,z_{15}:z_{42}	
II	Z		50	l,z_{28}	z_{42}	
II	Z	Atra	50	m,t	z_6:z_{42}	
IIIb	Z		50	r	1,5,(7)	(Ar. 9a,9b:24:30)
IIIb	Z		50	r	e,n,x,z_{15}	(Ar. 9a,9c:24:28)
IIIb	Z		50	r	z	(Ar. 9a,9b:24:31 and 9a,9c:24:31).
IIIb	Z		50	r	z_{35}	(Ar. 9a,9b:24:21). May possess H phase Rz_{58} (Ar. Rz58). This is not in IP book, but is on Rohde's list.
IIIb	Z		50	r	z_{53}	(Ar. 9a,9b:24:25). May possess H phase Rz_{50} (Ar. 42). This is not in IP book, but is on Rohde's list.
I	Z	Dougi	50	y	1,6	
II	Z	Greenside	50	z	e,n,x	
IIIb	Z		50	z_{10}	z	(Ar. 9a,9c:27:31). May possess H phase Rz_{56} (Ar. 38).
IIIb	Z		50	z_{10}	z_{53}	(Ar. 9a,9c:27:25)
II	Z	Hooggraven	50	z_{10}	z_6:z_{42}	
I	Z	Ivorycoast	50	z_{29}	–	
IIIa	Z		50	z_{29}	–	(Ar. 9a,9b:16,18:-)
IIIa	Z		50	z_{36}	–	(Ar. 9a,9b:17,20:-)
IIIa	Z		50	z_4,z_{23}	–	(Ar. 9a,9b:1,2,5:- and 9a,9b:1,2,6:-)
IV	Z	Flint	50	z_4,z_{23}	–	
IIIa	Z		50	z_4,z_{23},z_{32}	–	(Ar. 9a,9b:1,2,10:-). Called 9a,9b:1,6,7:- by IP and Rohde.
IIIa	Z		50	z_4,z_{24}	–	(Ar. 9a,9b:1,3,11:-)
IV	Z		50	z_4,z_{24}	–	
IIIa	Z		50	z_4,z_{32}	–	(Ar. 9a,9b:1,2,10; 9a,9b:1,6,7:-; and 9a,9b:1,7,8:-). 9a,9b:1,2,10:- and 9a,9b:1,7,8:- used by IP and Rohde.
IV	Z	Bonaire	50	z_4,z_{32}	–	
II	Z	Faure	50	z_{42}	1,7	
IIIb	Z		50	z_{52}	1,5,7	(Ar. 9a,9b:26:30 and 9a,9c:26:30)
IIIb	Z		50	z_{52}	z	(Ar. 9a,9b:26:31 and 9a,9c:26:31)
IIIb	Z		50	z_{52}	z_{35}	(Ar. 9a,9b:26:21 and 9a,9c:26:21)
IIIb	Z		50	z_{52}	z_{53}	(Ar. 9a,9b:26:25 and 9a,9c:26:25)
II	51	Roggeveld	51	–	1,7	
I	51	Tione	51	a	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IV	51		51	b	–	
I	51	Karaya	51	b	1,5	
II	51		51	c	–	
I	51	Gokul	1,51	d	[1,5]	
I	51	Meskin	51	e,h	1,2	
II	51		51	g,s,t	e,n,x	
IIIa	51		51	g,z_{51}	–	(Ar. 1,2:13,14:-)
I	51	Kabete	51	i	1,5	
I	51	Dan	51	k	e,n,z_{15}	
IIIb	51		51	k	z_{35}	(Ar. 1,2:29:21)
I	51	Harcourt	51	l,v	1,2	
I	51	Overschie	51	l,v	1,5	
I	51	Dadzie	51	l,v	e,n,x	
IIIb	51		51	l,v	z	(Ar. 1,2:23:31)
I	51	Moundou	51	l,z_{28}	1,5	
II	51	Askraal	51	l,z_{28}	[z_6]	
I	51	Lutetia	51	r,i	l,z_{13},z_{28}	
I	51	Antsalova	51	z	1,5	
I	51	Treforest	1,51	z	1,6	
I	51	Lechler	51	z	e,n,z_{15}	
I	51	Bergues	51	z_{10}	1,5	
II	51		51	z_{29}	e,n,x,z_{15}	
IIIa	51		51	z_4,z_{23}	–	(Ar. 1,2:1,2,5:- and 1,2:1,2,6:-)
IV	51	Harmelen	51	z_4,z_{23}	–	
IIIa	51		51	z_4,z_{24}	–	(Ar. 1,2:1,3,11:-)
IIIa	51		51	z_4,z_{32}	–	(Ar. 1,2:1,7,8:-)
I	52	Uithof	52	a	1,5	
I	52	Ord	52	a	e,n,z_{15}	
I	52	Molesey	52	b	1,5	
I	51	Flottbek	52	b	[e,n,x]	
II	52		52	c	k	
IIIb	52		52	c	k	(Ar. 31:32:29). This is not in IP book, but is on Rohde's list.
I	52	Utrecht	52	d	1,5	
II	52		52	d	e,n,x,z_{15}	
II	52		52	d	z_{39}	CDC does not have this.
I	52	Butare	52	e,h	1,6	
I	52	Derkle	52	e,h	1,7	
I	52	Saintemarie	52	g,t	–	
II	52		52	g,t	–	
I	52	Bordeaux	52	k	1,5	
IIIb	52		52	k	z_{35}	(Ar. 31:29:21)
IIIb	52		52	k	z_{53}	(Ar. 31:29:25)
IIIb	52		52	(k)	z_{35}	(Ar. 31:22:21)
IIIb	52		52	l,v	z_{53}	(Ar. 31:23:25)
II	52		52	z	z_{39}	
II	52	Wilhemstrasse	52	z_{44}	1,5	IP combined Wilhemstrasse with Lobatsi (52:z44:1,5,7). The name Wilhemstrasse has been dropped.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	52	Lobatsi	52	z_{44}	1,5,7	
IIIb	52		52	z_{52}	z	(Ar. 31:26:31)
II	53		53	c	1,5	
II	53		53	d	1,5	
II	53		1,53	d	z_{39}	
II	53		53	d	z_{42}	
IIIa	53		53	g,z_{51}	–	(Ar. 1,4:13,14:-)
IV	53		1,53	g,z_{51}	–	
IIIb	53		53	i	z	(Ar. 1,4:33:31)
IIIb	53		53	k	e,n,x,z_{15}	(Ar. 1,4:29:28)
IIIb	53		53	k	z	(Ar. 1,4:29:31)
IIIb	53		53	(k)	z	(Ar. 1,4:22:31)
IIIb	53		53	(k)	z_{35}	(Ar. 1,4:22:21)
IIIb	53		53	l,v	e,n,x,z_{15}	(Ar. 1,4:23:28)
IIIb	53		53	l,v	z_{35}	(Ar. 1,4:23:21)
II	53		53	l,z_{28}	e,n,x	
II	53	Midhurst	53	l,z_{28}	z_{39}	
II	53		53	l,z_{28}	z_6	
IIIb	53		53	r	z	(Ar. 1,4:24:31)
IIIb	53		53	r	z_{35}	(Ar. 1,4:24:21)
IIIb	53		53	r	z_{68}	(Ar. 1,4:24:47). This was formerly called z_{56} (Ar. 38), but was changed to z_{68} (Ar. 47).
II	53		53	z	1,5	
IIIb	53		53	z	1,5,(7)	(Ar. 1,4:30:31)
II	53		53	z	z_6	
IIIb	53		53	z_{10}	z_{35}	(Ar. 1,4:27:21)
IIIa	53		53	z_{29}	–	(Ar. 1,4:16,18:-)
IV	53	Bockenheim	1,53	z_{36},z_{38}	–	
IIIa	53		53	z_4,z_{23}	–	(Ar. 1,4:1,2,5:- and 1,4:1,2,6:-)
IV	53		53	z_4,z_{23}	–	
IIIa	53		53	z_4,z_{23},z_{32}	–	(Ar. 1,4:1,6,7:- and 1,4:1,6,7,9:-)
II	53	Humber	53	z_4,z_{24}	–	
IIIa	53		53	z_4,z_{24}	–	(Ar. 1,4:1,3,11:-)
IIIa	53		53	z_4,z_{32}	–	(Ar. 1,4:1,6,7:-). IP combined this with 53:z4,z23,z32:- (Ar. 1,4:1,6,7,9:-).
IIIb	53		53	z_{52}	z_{35}	(Ar. 1,4:26:21)
IIIb	53		53	z_{52}	z_{53}	(Ar. 1,4:26:25)
I	54	Tonev	21,54	b	e,n,x	
I	54	Winnipeg	54	e,h	1,5	
I	54	Rossleben	54	e,h	1,6	
I	54	Borreze	54	f,g,s	–	
I	54	Uccle	3,54	g,s,t	–	
I	54	Poeseldorf	8,20,54	i	z_6	
I	54	Ochsenwerder	6,7,54	k	1,5	
I	54	Newholland	4,12,54	m,t	–	
I	54	Czernyring	54	r	1,5	
I	54	Steinwerder	3,15,54	y	1,5	
I	54	Canton	54	z_{10}	e,n,x	
I	54	Barry	54	z_{10}	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	54	Yerba	54	z_4,z_{23}	–	
II	55	Tranoroa	55	k	z_{39}	
II	56	Artis	56	b	–	
II	56		56	d	–	
II	56		56	e,n,x	1,7	
II	56		56	l,v	z_{39}	
II	56		56	l,z_{28}	–	
II	56		56	z	z_6	
II	56		56	z_{10}	e,n,x	
IIIa	56		56	z_{29}	–	(Ar. 14:16,18:-)
IIIa	56		56	z_4,z_{23}	–	(Ar. 14:1,2,5:- and 14:1,2,6:-)
IIIa	56		56	z_4,z_{23},z_{32}	-	(Ar. 14:1,6,7,9:-)
II	57		57	a	z_{42}	
I	57	Antonio	57	a	z_6	
I	57	Maryland	57	b	1,7	
I	57	Batonrouge	57	b	e,n,z_{15}	
IIIb	57		57	c	z:[z_{60}]	(Ar. 34:32:31:[44])
II	57		57	d	1,5	
II	57		57	g,[m],s,t	z_{42}	
II	57		57	g,t	-	
IIIb	57		57	i	e,n,x,z_{15}	(Ar. 34:33:28)
IIIb	57		57	i	z	(Ar. 34:33:31)
IIIb	57		57	k	e,n,x,z_{15}	(Ar. 34:29:28). CDC does not have this and not on Rohde's list.
IIIb	57		57	z_{10}	z	(Ar. 34:27:31)
II	57	Locarno	57	z_{29}	z_{42}	
II	57	Manombo	57	z_{39}	e,n,x,z_{15}	
IV	57		57	z_4,z_{23}	-	
II	57	Tokai	57	z_{42}	1,6:z_{53}	
II	58		58	a	z_6	
II	58		58	b	1,5	
II	58		58	c	z_6	
II	58		58	d	z_6	
IIIb	58		58	i	e,n,x,z_{15}	(Ar. 1,33:33:28)
IIIb	58		58	k	z	(Ar. 1,33:29:31)
IIIb	58		58	l,v	e,n,x,z_{15}	(Ar. 1,33:23:28)
IIIb	58		58	l,v	z_{35}	(Ar. 1,33:23:21)
II	58	Basel	58	l,z_{13},z_{28}	1,5	
II	58		58	l,z_{13},z_{28}	z_6	
IIIb	58		58	r	e,n,x,z_{15}	(Ar. 1,33:24:28)
IIIb	58		58	r	z	(Ar. 1,33:24:31)
IIIb	58		58	r	z_{53}	(Ar. 1,33:24:25). May possess H phase Rz_{47} (Ar. 39) or Rz_{57} (Ar. 40) or Rz_{70} (Ar. Rz_{70}).
II	58		58	z_{10}	1,6	
IIIb	58		58	z_{10}	e,n,x,z_{15}	(Ar. 1,33:27:28)
IIIb	58		58	z_{10}	z_{53}	(Ar. 1,33:27:25). May possess H phase Rz_{50} (Ar. 42).
II	58		58	z_{10}	z_6	
II	58		58	z_{39}	e,n,x,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	58		58	z_{52}	z	(Ar. 1,33:26:31)
IIIb	58		58	z_{52}	z_{35}	(Ar. 1,33:26:21)
II	58		58	z_6	1,6	
IIIb	59		59	c	e,n,x,z_{15}	(Ar. 19:32:28)
IIIb	59		59	i	e,n,x,z_{15}	(Ar. 19:33:28)
IIIb	59		59	i	z	(Ar. 19:33:31)
IIIb	59		59	i	z_{35}	(Ar. 19:33:21)
II	59	Betioky	59	k	(z)	
IIIb	59		59	k	z_{53}	(Ar. 19:29:25)
IIIb	59		59	(k)	e,n,x,z_{15}	(Ar. 19:22:28)
IIIb	59		59	(k)	z	(Ar. 19:22:31)
IIIb	59		59	(k)	z_{35}	(Ar. 19:22:21)
IIIb	59		59	l,v	z	(Ar. 19:23:31)
IIIb	59		59	l,v	z_{53}	(Ar. 19:23:25)
IIIb	59		59	r	z_{35}	(Ar. 19:24:21)
II	59		1,59	z	z_6	
IIIb	59		59	z_{10}	z_{53}	(Ar. 19:27:25)
IIIb	59		59	z_{10}	z_{57}	(Ar. 19:27:40)
IIIa	59		59	z_{29}	–	(Ar. 19:16,18:-)
IIIa	59		59	z_{36}	–	(Ar. 19:17,20:-)
IIIa	59		59	z_4,z_{23}	–	(Ar. 19:1,2,5:- and 19:1,2,6:-)
IIIb	59		59	z_{52}	[z_{53}]	(Ar. 19:26:[25])
II	60		60	b	[1,16]	
II	60	Setubal	60	g,m,t	z_6	
IIIb	60		60	i	–	(Ar. 24:33:-). May possess H phase Rz_{50} (Ar. 42).
IIIb	60		60	i	e,n,x,z_{15}	(Ar. 24:33:28)
IIIb	60		60	i	z_{35}	(Ar. 24:33:21)
IIIb	60		60	k	z	(Ar. 24:29:31)
IIIb	60		60	k	z_{35}	(Ar. 24:29:21)
IIIb	60		60	(k)	z_{53}	(Ar. 24:22:25)
IIIb	60		60	l,v	z	(Ar. 24:23:31)
IIIb	60		60	r	e,n,x,z_{15}	(Ar. 24:24:28)
IIIb	60		60	r	z	(Ar. 24:24:31)
IIIb	60		60	r	z_{35}	(Ar. 24:24:21)
IIIb	60		60	r	z_{53}	(Ar. 24:24:25)
II	60	Luton	60	z	e,n,x	
IIIb	60		60	z_{10}	z	(Ar. 24:27:31)
IIIb	60		60	z_{10}	z_{35}	(Ar. 24:27:21)
IIIb	60		60	z_{10}	z_{53}	(Ar. 24:27:25)
II	60		60	z_{29}	e,n,x	
V	60		60	z_{41}	–	
IIIb	60		60	z_{52}	1,5,[7]	(Ar. 24:26:30)
IIIb	60		60	z_{52}	z	(Ar. 24:26:31)
IIIb	60		60	z_{52}	z_{35}	(Ar. 24:26:21)
IIIb	60		60	z_{52}	z_{53}	(Ar. 24:26:25)
IIIb	61		61	c	1,5,(7)	(Ar. 26:32:30)
IIIb	61		61	c	z_{35}	(Ar. 26:32:21)
IIIb	61		61	i	e,n,x,z_{15}	(Ar. 26:33:28)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	61	Eilbeck	61	i	z	Eilbeck was formerly in subspecies II, but is now combined with *Arizona* 26:33:31. The name Eilbeck has been dropped.
IIIb	61		61	i	z	(Ar. 26:33:31)
IIIb	61		61	i	z_{35}	(Ar. 26:33:21)
IIIb	61		61	i	z_{53}	(Ar. 26:33:25)
IIIb	61		61	k	1,5,(7)	(Ar. 26:29:30)
IIIb	61		61	k	z_{35}	(Ar. 26:29:21). CDC does not have this.
IIIb	61		61	(k)	z53	(Ar. 26:22:25)
IIIb	61		61	l,v	1,5,7:[z_{57}]	(Ar. 26:23:30:[40])
IIIb	61		61	l,v	z	(Ar. 26:23:31)
IIIb	61		61	l,v	z_{35}	(Ar. 26:23:21)
IIIb	61		61	r	1,5,7	(Ar. 26:24:30)
IIIb	61		61	r	z	(Ar. 26:24:31)
IIIb	61		61	r	z_{35}	(Ar. 26:24:21)
IIIb	61		61	r	z_{53}	(Ar. 26:24:25). May possess H phase Rz_{47} (Ar. 39).
IIIb	61		61	z_{10}	z_{35}	(Ar. 26:27:21)
V	61		61	z_{35}	–	
IIIb	61		61	z_{52}	1,5,7	(Ar. 26:26:30)
IIIb	61		61	z_{52}	z	(Ar. 26:26:31)
IIIb	61		61	z_{52}	z_{35}	(Ar. 26:26:21)
IIIb	61		61	z_{52}	z_{53}	(Ar. 26:26:25)
IIIa	62		62	g,z_{51}	–	(Ar. 6:13,14:-)
IIIa	62		62	z_{29}	–	(Ar. 6:17,18:-)
IIIa	62		62	z_{36}	–	(Ar. 6:17,20:-)
IIIa	62		62	z_4,z_{23}	–	(Ar. 6:1,2,5:-)
IIIa	62		62	z_4,z_{32}	–	(Ar. 6:1,7,8:-)
IIIa	63		63	g,z_{51}	–	(Ar. 8:13,14:-)
IIIa	63		63	z_{36}	–	(Ar. 8:17,20:-)
IIIa	63		63	z_4,z_{23}	–	(Ar. 8:1,2,5:-)
IIIa	63		63	z_4,z_{32}	–	(Ar. 8:1,7,8:-)
II	65		65	–	1,6	
IIIb	65		65	c	1,5,7	(Ar. 30:32:30)
IIIb	65		65	c	z	(Ar. 30:32:31)
IIIb	65		65	c	z_{53}	(Ar. 30:32:25)
II	65		65	g,t	-	
IIIb	65		65	i	e,n,x,z_{15}	(Ar. 30:33:28)
IIIb	65		65	(k)	z	(Ar. 30:22:31)
IIIb	65		65	(k)	z_{35}	(Ar. 30:22:21)
IIIb	65		65	(k)	z_{53}	(Ar. 30:22:25)
IIIb	65		65	l,v	e,n,x,z_{15}	(Ar. 30:23:28)
IIIb	65		65	l,v	z	(Ar. 30:23:31)
IIIb	65		65	l,v	z_{35}	(Ar. 30:23:21)
IIIb	65		65	l,v	z_{53}	(Ar. 30:23:25)
IIIb	65		65	r	z_{35}	(Ar. 30:24:21)
IIIb	65		65	z_{10}	e,n,x,z_{15}	(Ar. 30:27:28)
IIIb	65		65	z_{10}	z	(Ar. 30:27:31)
IIIb	65		65	z_{52}	e,n,x,z_{15}	(Ar. 30:26:28)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	65		65	z_{52}	z	(Ar. 30:26:31)
IIIb	65		65	z_{52}	z_{35}	(Ar. 30:26:21)
IIIb	65		65	z_{52}	z_{53}	(Ar. 30:26:25)
V	66	Maregrosso	66	z_{35}	–	
V	66		66	z_{39}	–	
V	66	Brookfield	66	z_{41}	–	
V	66	Malawi	66	z_{65}	–	
V	66		66	z_{81}	–	
I	67	Crossness	67	r	1,2	

Appendix B

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	K	Aarhus	18	z_4,z_{23}	z_{64}	
I	C_2	Aba	6,8	i	e,n,z_{15}	
I	M	Abadina	28	g,m	[e,n,z_{15}]	
I	F	Abaetetuba	11	k	1,5	
I	F	Aberdeen	11	i	1,2	
I	Q	Abidjan	39	b	l,w	
I	I	Ablogame	16	l,z_{13},z_{28}	z_6	
I	I	Abobo	16	i	z_6	
I	B	Abony	1,4,5,12	b	e,n,x	IP combined Sladun (1,4,12,27:b:e,n,x) with Abony to form Abony 1,4,[5],12,27:b:e,n,x (gelatin neg.).
I	B	Abortusbovis	1,4,12,27	b	e,n,x	Gelatin pos., mucate pos.1-4 days. Abortusbovis was combined with Abony (1,4,5,12:b:e,n,x), gelatin neg. The name Abortusbovis was dropped.
I	B	Abortuscanis	4,5,12	b	Rz_5	Abortuscanis was combined with Paratyphi B (1,4,[5],12:b:1,2) in 1938 and the name Abortuscanis was dropped.
I	B	Abortusequi	4,12	–	e,n,x	
I	B	Abortusovis	4,12	c	1,6	
I	E_4	Accra	1,3,19	b	z6	
I	D_2	Ackwepe	9,46	l,w	–	
II	G	Acres	1,13,23	b	[1,5]:z_{42}	
I	E_1	Adabraka	3,10	z_4,z_{23}	[1,7]	
I	M	Adamstown	28	k	1,6	
I	F	Adamstua	11	e,h	1,6	
I	U	Adana	43	z_{10}	1,5	
I	O	Adelaide	35	f,g	–	Adelaide may possess H phase Rz_{27}.
I	I	Adeoyo	16	g,m,[t]	–	
I	M	Aderike	28	z_{38}	[e,n,z_{15}]	
I	C_1	Adime	6,7	b	1,6	
I	G	Adjame	13,23	r	1,6	
I	C_1	Aequatoria	6,7	z_4,z_{23}	[e,n,z_{15}]	
I	C_2	Aesch	6,8	z_{60}	1,2	
I	H	Aflao	1,6,14,25	l,z_{28}	e,n,x	
I	B	Africana	4,12	r,i	l,w	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_1	Afula	6,7	f,g,t	e,n,x	
I	B	Agama	4,12	i	1,6	
I	I	Agbara	16	i	1,6	
I	G	Agbeni	1,13,23	g,m,[t]	–	
I	E_1	Agege	3,10	c	e,n,z_{15}	
I	N	Ago	30	z_{38}	–	
I	O	Agodi	35	g,t	–	
I	B	Agona	1,4,[5],12	f,g,s	[1,2]	
I	G	Agoueve	13,22	z_{29}	–	
I	J	Ahanou	17	i	1,7	
I	U	Ahepe	43	z_{35}	1,6	
I	E_4	Ahmadi	1,3,19	d	1,5	
I	S	Ahoutoue	41	z_{35}	1,6	
I	U	Ahuza	43	k	1,5	
I	G	Ajiobo	13,23	z_4,z_{23}	–	
I	C_2	Akanji	6,8	r	1,7	
I	I	Akuafo	16	y	1,6	
I	D_1	Alabama	9,12	c	e,n,z_{15}	
I	O	Alachua	35	z_4,z_{23}	–	Alachua may possess H phase Rz_{37} or Rz_{45}.
I	C_2	Alagbon	8	y	1,7	
I	C_1	Alamo	6,7	g,z_{51}	1,5	
I	C_2	Albany	8,20	z_4,z_{24}	–	Albany may possess H phase Rz_{45}.
I	B	Albert	4,12	z_{10}	e,n,x	
I	H	Albuquerque	1,6,14,24	d	z_6	
II	E_1	Alexander	3,10	z	1,5	
I	X	Alexanderplatz	47	z_{38}	–	
I	C_2	Alexanderpolder	8	c	l,w	
I	E_1	Alfort	3,10	f,g	e,n,x	
I	P	Alger	38	l,v	1,2	
I	E_4	Alkmaar	1,3,19	a	l,w	
I	R	Allandale	1,40	k	1,6	
I	E_1	Allerton	3,10	b	1,6	
I	C_2	Alminko	8,20	g,s,t	–	
II	R	Alsterdorf	1,40	g,m,[s],t	[1,5]	
I	B	Altendorf	4,12	c	1,7	IP combined Womba (4,12,27:c:1,7) with Altendorf to form Altendorf 4,12,27:c:1,7.
I	C_2	Altona	8,20	r,[i]	z_6	Pikine (8,20:r:z_6) was combined with Altona and called Altona.
I	E_1	Amager	3,10	y	1,2	IP combined Tuebingen (3,15:y:1,2) with Amager to form Amager 3,10,[15]:y:1,2. Amager may possess H phase Rz_{45}.
I	F	Amba	11	k	l,z_{13},z_{28}	
I	C_1	Amersfoort	6,7	d	e,n,x	IP combined Omderman (6,7,14:d:e,n,x) with Amersfoort to form Amersfoort 6,7,14:d:e,n,x.
I	C_2	Amherstiana	8	l,(v)	1,6	
I	I	Amina	16	i	1,5	
I	E_1	Aminatu	3,10	a	1,2	
I	E_1	Amounderness	3,10	i	1,5	
I	M	Amoutive	28	d	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_1	Amsterdam	3,10	g,m,s	–	IP combined Drypool (3,15:g,m,s) and Drypool var. O 34+ with Amsterdam to form Amsterdam 3,10,[15],[15,34]:g,m,s:-.
I	I	Amunigun	16	a	1,6	
I	E_1	Anatum	3,10	e,h	1,6	IP combined Newington (3,15:e,h:1,6) and Minneapolis (3,15,34:e,h:1,6) with Anatum to form Anatum 3,10,[15],[15,34]:e,h:1,6.
I	E_1	Anderlecht	3,10	c	l,w	
I	O	Anecho	35	g,s,t	–	
I	Q	Anfo	39	y	1,2	
I	C_2	Angers	8,20	z_{35}	z_6	
I	N	Angoda	30	k	e,n,x	
II	D_1	Angola	1,9,12	z	z_6	
I	I	Angouleme	16	z_{10}	z_6	
I	X	Anie	47	(g),m,t	–	IP combined Anie with Mesbit (47:m,t:[e,n,z_{15}]) and called it Mesbit.
I	M	Ank	28	k	e,n,z_{15}	
I	G	Anna	13,23	z_{35}	e,n,z_{15}	
I	I	Annedal	16	r,i	e,n,x	
I	D_1	Antarctica	9,12	g,z_{63}	–	
I	57	Antonio	57	a	z_6	
I	51	Antsalova	51	z	1,5	
I	T	Antwerpen	1,42	c	e,n,z_{15}	
I	W	Apapa	45	m,t	–	
I	C_2	Apeyeme	8,20	z_{38}	–	
I	N	Aqua	30	k	1,6	
I	N	Aragua	30	z_{29}	–	
I	H	Arapahoe	1,6,14	z_4,z_{23}	1,5	
I	C_1	Ardwick	6,7,14	f,g	–	IP combined Ardwick with Rissen (6,7:f,g:-) to form Rissen 6,7,14:f,g:-. Ardwick is now called Rissen var. O 14+ by IP.
I	B	Arechavaleta	4,[5],12	a	[1,7]	
IV	C_1	Argentina	6,7	z_{36}	–	
I	E_3	Arkansas	3,15,34	e,h	1,5	IP combined Arkansas and Newhaw (3,15:e,h:1,5) with Muenster (3,10:e,h:1,5) to form Muenster 3,10,[15],[15,34]:e,h:1,5. Arkansas is now callled Muenster var. O 15+, 34+ by IP.
II	56	Artis	56	b	–	
I	U	Arusha	43	z	e,n,z_{15}	
I	N	Aschersleben	30	b	1,5	
I	M	Ashanti	28	b	1,6	
II	51	Askraal	51	l,z_{28}	[z_6]	
I	L	Assen	21	a	[1,5]	
I	E_1	Assinie	3,10	l,w	z_6	Assinie may possess H phase Rz$_{45}$.
I	E_1	Asylanta	3,10	c	1,2	
I	C_2	Atakpame	8,20	e,h	1,7	
I	F	Atento	11	b	1,2	
I	C_1	Athinai	6,7	i	e,n,z_{15}	
I	F	Ati	11	d	1,2	
I	G	Atlanta	13,23	b	–	Atlanta was combined with Mississippi (1,13,23:b:1,5). The name Atlanta has been dropped.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	Z	Atra	50	m,t	z_6:z_{42}	
I	C_1	Augustenborg	6,7,14	i	1,2	
I	C_1	Austin	6,7	a	1,7	
I	Y	Australia	48	l,v	1,5	
I	I	Avignon	16	y	e,n,z_{15}	
I	E_4	Avonmouth	1,3,19	i	e,n,z_{15}	
I	B	Ayinde	1,4,12,27	d	z_6	
I	B	Ayton	1,4,12,27	l,w	z_6	
I	B	Azteca	4,[5],12,27	l,v	1,5	
I	M	Babelsberg	28	z_4,z_{23}	[e,n,z_{15}]	
I	M	Babili	28	z_{35}	1,7	
II	C_1	Bacongo	6,7	z_{36}	z_{42}	
I	I	Badagry	16	z_{10}	1,5	
I	L	Baguida	21	z_4,z_{23}	–	
I	N	Baguirmi	30	y	e,n,x	
I	G	Bahati	13,22	b	e,n,z_{15}	
I	H	Bahrenfeld	6,14,24	e,h	1,5	
I	C_1	Baiboukoum	6,7	k	1,7	
I	D_2	Baildon	9,46	a	e,n,x	
I	M	Bakau	28	a	1,7	
V	Y	Balboa	48	z_{41}	–	
I	W	Balcones	45	z_{36}	–	
I	B	Ball	1,4,12,27	y	e,n,x	IP combined Ball with Ruki (4,5,12:y:e,n,x) and Dalat (4,5,27:y:e,n,x) to form Ball 1,4,[5],12,27:y:e,n,x.
I	J	Bama	17	m,t	–	
I	D_2	Bamboye	9,46	b	l,w	
I	D_2	Bambylor	9,46	z	e,n,z_{15}	
I	C_2	Banalia	6,8	b	z_6	
I	B	Banana	1,4,[5],12	m,t	[1,5]	Banana may possess H phase Rz_{45}.
I	M	Banco	28	r,i	1,7	
I	O	Bandia	35	i	l,w	
I	P	Bangkok	38	z_4,z_{24}	–	
I	D_1	Bangui	9,12	d	e,n,z_{15}	
I	H	Banjul	1,6,14,25	a	e,n,z_{15}	
II	C_2	Baragwanath	6,8	m,t	1,5	
I	C_2	Bardo	8	e,h	1,2	
I	C_1	Bareilly	6,7,14	y	1,5	
I	C_2	Bargny	8,20	i	1,5	
I	I	Barmbek	16	d	z_6	
I	I	Barranquilla	16	d	e,n,x	
I	54	Barry	54	z_{10}	e,n,z_{15}	
II	58	Basel	58	l,z_{13},z_{28}	1,5	
I	D	Basingstoke	9,46	z_{35}	e,n,z_{15}	
I	C_2	Bassa	6,8	m,t	–	
I	M	Bassadji	28	r	1,6	
I	57	Batonrouge	57	b	e,n,z_{15}	
I	I	Battle	16	l,z_{13},z_{28}	1,6	
I	C_2	Bazenheid	8,20	z_{10}	1,2	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_2	Be	8,20	a	[z_6]	
I	H	Beaudesert	[1],6,14,[25]	e,h	1,7	
II	B	Bechuana	1,4,12,27	g,[m],t	[1,5]	
I	E_4	Bedford	1,3,19	l,z_{13},z_{28}	e,n,z_{15}	
I	C_2	Belem	6,8	c	e,n,x	
I	C_2	Belfast	6,8	c	1,7	
I	C_2	Bellevue	8	z_4,z_{23}	1,7	
I	I	Bellville	16	e,n,x	1,(5),7	
II	K	Beloha	18	z_{36}	–	
I	E_1	Benfica	3,10	b	e,n,x	
I	R	Benguella	40	b	z_6	
I	D_2	Benin	9,46	y	1,7	
I	C_2	Benue	6,8	y	l,w	
I	X	Bere	47	z_4,z_{23}	[z_6]	Bere may possess H phase Rz_{45}.
I	D_2	Bergedorf	9,46	e,h	1,2	
I	X	Bergen	47	i	e,n,z_{15}	
I	51	Bergues	51	z_{10}	1,5	
I	U	Berkeley	43	a	1,5	
I	J	Berlin	17	d	1,5	
IV	R	Bern	1,40	z_4,z_{32}	–	
I	D_1	Berta	1,9,12	[f],g,t	–	
I	E_1	Bessi	3,10	i	e,n,x	
I	E_4	Bethune	1,3,19	k	1,7	
II	59	Betioky	59	k	(z)	
I	E_1	Biafra	3,10	z_{10}	z_6	
I	E_4	Bida	1,3,19	c	1,6	
I	N	Bietri	30	y	1,5	
I	J	Bignona	17	b	e,n,z_{15}	
I	R	Bijlmer	1,40	g,m	–	
II	X	Bilthoven	47	a	[1,5]	
I	E_4	Bilu	(1),3,10,(19)	f,g,t	1,(2),7	
I	X	Binche	47	z_4,z_{23}	l,w	
I	X	Bingerville	47	z_{35}	e,n,z_{15}	
I	W	Binningen	45	g,s,t	–	
I	E_2	Binza	3,15	y	1,5	IP combined Binza and Thomasville (3,15,34:y:1,5) with Orion (3,10:y:1,5) to form Orion 3,10,[15],[15,34]:y:1,5. Binza is now called Orion var. O 15+ by IP.
I	C_1	Birkenhead	6,7	c	1,6	
I	E_1	Birmingham	3,10	d	l,w	
I	B	Bispebjerg	1,4,[5],12	a	e,n,x	
I	B	Bissau	4,12	c	e,n,x	
II	D_1	Blankenese	1,9,12	b	z_6	
II	J	Bleadon	17	(f),g,t	[e,n,x,z_{15}]	IP has dropped f.
I	D_1	Blegdam	9,12	g,m,q	–	
I	H	Blijdorp	1,6,14,25	c	1,5	
I	X	Blitta	47	y	e,n,x	
I	C_2	Blockley	6,8	k	1,5	Blockley may possess H phase Rz_{58}
II	C_1	Bloemfontein	6,7	b	[e,n,x]:z_{42}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_1	Bloomsbury	3,10	g,t	1,5	
I	K	Blukwa	18	z_4,z_{24}	–	
I	V	Bobo	44	d	1,5	
I	B	Bochum	4,[5],12	r	l,w	
IV	53	Bockenheim	1,53	z_{36},z_{38}	–	
I	N	Bodjonegoro	30	z_4,z_{24}	–	
I	H	Boecker	[1],6,14,[25]	l,v	1,7	
I	M	Bokanjac	28	b	1,7	
II	R	Boksburg	40	g,[m],s,[t]	e,n,x	
I	V	Bolama	44	z	e,n,x	
I	E_1	Bolombo	3,10	z_{38}	$[z_6]$	
I	E_1	Bolton	3,10	y	e,n,z_{15}	
IV	Z	Bonaire	50	z_4,z_{32}	–	
I	J	Bonames	17	a	1,2	
I	C_2	Bonariensis	6,8	i	e,n,x	
V	Y	Bongor	48	z_{35}	–	
I	C_1	Bonn	6,7	l,v	e,n,x	
I	X	Bootle	47	k	1,5	
I	G	Borbeck	13,22	l,v	1,6	
I	52	Bordeaux	52	k	1,5	
VI	H	Bornheim	1,6,14,25	z_{10}	1,(2),7	Bornheim was formerly in Subspecies II.
I	C_1	Bornum	6,7,14	z_{38}	–	IP combined Bornum with Lille (6,7:z_{38}:-) to form Lille 6,7,14:z_{38}:-. Bornum is now called Lille var. O 14+ by IP.
I	54	Borreze	54	f,g,s	–	
I	T	Borromea	42	i	1,6	
I	I	Bouake	16	z	z_6	
II	G	Boulders	1,13,23	m,t	z_{42}	
I	D_1	Bournemouth	9,12	e,h	1,2	
I	H	Bousso	1,6,14,25	z_4,z_{23}	$[e,n,z_{15}]$	
I	C_2	Bovismorbificans	6,8	r,[i]	1,5	
I	G	Bracknell	13,23	b	1,6	
I	B	Bradford	4,12,27	r	1,5	
I	C_1	Braenderup	6,7,14	e,h	e,n,z_{15}	
I	B	Brancaster	1,4,12,27	z_{29}	–	
I	B	Brandenburg	1,4,[5],12,27	l,v	e,n,z_{15}	
I	I	Brazil	16	a	1,5	
I	K	Brazos	6,14,18	a	e,n,z_{15}	
I	C_1	Brazzaville	6,7	b	1,2	
I	C2	Breda	6,8	z_4,z_{23}	e,n,x	
I	B	Bredeney	1,4,12,27	l,v	1,7	Bredeney may possess H phase Rl,z_{40} instead of l,v.
I	V	Brefet	44	r	e,n,z_{15}	
II	W	Bremen	45	g,m,s,t	e,n,x	
I	C_2	Breukelen	6,8	$l,z_{13},[z_{28}]$	e,n,z_{15}	
I	I	Brevik	16	z	$e,n,[x],z_{15}$	
I	B	Brezany	1,4,12,27	d	1,6	
I	F	Brijbhumi	11	i	1,5	
I	C_2	Brikama	8,20	r,[i]	l,w	
I	M	Brisbane	28	z	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	G	Bristol	13,22	z	1,7	
I	T	Brive	1,42	r	l,w	
I	T	Broc	42	z_4,z_{23}	e,n,z_{15}	
I	G	Bron	13,22	g,m	[e,n,z_{15}]	
I	C_2	Bronx	6,8	c	1,6	
V	66	Brookfield	66	z_{41}	–	
I	I	Brooklyn	16	l,w	e,n,x	
I	E_4	Broughton	1,3,19	b	l,w	
I		Broxbourne				Combined with Wien. The name Broxbourne has been dropped.
I	C_1	Bruck	6,7	z	l,w	
I	C_2	Brunei	8,20	y	1,5	
I	I	Brunflo	16	r	1,7	
I	C_2	Bsilla	6,8	r	1,2	
I	B	Budapest	1,4,12,27	g,t	–	
I	R	Bukavu	1,40	l,z_{28}	1,5	
I	C_2	Bukuru	6,8	b	l,w	
II	R	Bulawayo	1,40	z	1,5	
I	C_2	Bulgaria	6,8	y	1,6	
I	F	Bullbay	11	l,v	e,n,z15	
I	C_1	Bulovka	6,7	z_{44}	–	
II	U	Bunnik	43	z_{42}	[1,5,7]	
I	I	Burgas	16	l,v	e,n,z_{15}	
I	S	Burundi	41	a	–	
I	B	Bury	4,12,27	c	z_6	
I	C_1	Businga	6,7	z	e,n,z_{15}	
I	E_1	Butantan	3,10	b	1,5	IP combined Rosenthal (3,15:b:1,5) and unnamed 3,15,34:b:1,5 with Butantan to form Butantan 3,10,[15],[15,34]:b:1,5.
I	52	Butare	52	e,h	1,6	
I	H	Buzu	[1],6,14,[25]	i	1,7	
I	I	Caen	16	d	l,w	
I	E_1	Cairina	3,10	z_{35}	z_6	
I	W	Cairns	45	k	e,n,z_{15}	
I	B	Cairo	1,4,12,27	d	1,2	IP combined Cairo with Stanley (4,5,12:d:1,2) to form Stanley 1,4,[5],12,27:d:1,2. The name Cairo has been dropped.
I	E_4	Calabar	1,3,19	e,h	l,w	
II	B	Caledon	1,4,12,27	g,[m],[s],t	e,n,x	
I	B	California	4,12	g,m,t	–	
II	C_1	Calvinia	6,7	a	z_{42}	
I	O	Camberene	35	z_{10}	1,5	
I	D_1	Camberwell	9,12	r	1,7	
I	E_2	Cambridge	3,15	e,h	l,w	IP combined Cambridge and Wildwood (3,15,34:e,h:l,w) with Meleagridis (3,10:e,h:l,w) to form Meleagridis 3,10,[15],[15,34]:e,h:l,w. Cambridge is now called Meleagridis var. O 15+ by IP.
V	V	Camdeni	44	r	–	
I	D_1	Campinense	9,12	r	e,n,z_{15}	
I	B	Canada	4,12,27	b	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	R	Canary	40	l,v	1,6	
II	D_1	Canastel	9,12	z_{29}	[1,5]	
I	M	Cannobio	28	z_4,z_{23}	1,5	
I	E_4	Cannonhill	1,3,15,19	y	e,n,x	
I	E_4	Cannstatt	1,3,19	m,t	–	
I	E_3	Canoga	3,15,34	g,s,t	–	IP combined Canoga and Halmstad (3,15:g,s,t:-) with Westhampton (3,10:g,s,t:-) to form Westhampton 3,10,[15],[15,34]:g,s,t:-. Canoga is now called Westhampton var. O 15+, 34+ by IP.
I	54	Canton	54	z_{10}	e,n,x	
II	C_1	Cape	6,7	z_6	1,7	
I	H	Caracas	[1],6,14,[25]	g,m,s	–	
I	C_1	Cardiff	6,7	k	R1,10	IP combined Cardiff that contains H phase R1,10 with Thompson (6,7,14:k:1,5).
I	I	Cardoner	16	g,s,t	–	
II	P	Carletonville	38	d	[1,5]	
I	J	Carmel	17	l,v	e,n,x	
I	K	Carnac	18	z_{10}	z_6	
I	E_4	Carno	1,3,19	z	l,w	
I	H	Carrau	6,14,[24]	y	1,7	
I	V	Carswell	44	g,z_{51}	–	
I	W	Casablanca	45	k	1,7	
I	R	Casamance	40	z	e,n,x	
I	M	Catalunia	28	l,z_{13},z_{28}	1,5	
I	H	Catanzaro	6,14	g,s,t	–	
I	C_1	Cayar	6,7	z	e,n,x	
II	M	Ceres	28	z	z_{39}	
I	K	Cerro	18	z_4,z_{23}	[1,5]	Cerro was combined with Siegburg (6,14,18:z_4,z_{23}:[1,5]) and called Cerro. Cerro may possess H phase Rz_{45}.
I	D_2	Ceyco	9,46	k	z_{35}	
I	G	Chagoua	1,13,23	a	1,5	
I	C_2	Chailey	6,8	z_4,z_{23}	$[e,n,z_{15}]$	
IV	I	Chameleon	16	z_4,z_{32}	–	
I	Q	Champaign	39	k	1,5	Champaign may possess H phase Rz_{48}
I	F	Chandans	11	d	e,n,x:[r]	
I	H	Charity	[1],6,14,[25]	d	e,n,x	
I	C_2	Charlottenburg	6,8	k	e,n,z_{15}	
I	D_2	Cheltenham	9,46	b	1,5	
II	X	Chersina	47	z	z_6	
I	B	Chester	1,4,[5],12	e,h	e,n,x	
I	M	Chicago	28	r,[i]	1,5	
I	E_4	Chichester	1,3,19	i	1,6	
I	H	Chichiri	6,14,24	z_4,z_{24}	–	
I	C_1	Chile	6,7	z	1,2	
I	C_2	Chincol	6,8	g,m,[s]	[e,n,x]	
I	F	Chingola	11	e,h	1,2	
II	T	Chinovum	42	b	1,5	
I	F	Chiredzi	11	c	1,5	
I	E4	Chittagong	1,3,10,19	b	z_{35}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_1	Choleraesuis	6,7	c	1,5	H_2S negative
I	C_1	Choleraesuis var. Kunzendorf		6,7	c	[1,5] H_2S positive
I	C_2	Chomedey	8,20	z_{10}	e,n,z_{15}	
I	V	Christiansborg	44	z_4,z_{24}	–	
II	E_1	Chudleigh	3,10	e,n,x	1,7	
I	B	Clackamas	4,12	l,v,[z13]	1,6	IP does not get z_{13}
I	D_1	Claibornei	1,9,12	k	1,5	
I	E_1	Clerkenwell	3,10	z	l,w	
I	C_2	Cleveland	6,8	z_{10}	1,7	
I	E_2	Clichy	3,15	a	1,5	IP combined Clichy with Goelzau (3,10:a:1,5) to form Goelzau 3,10,[15]:a:1,5. Clichy is now called Goelzau var. O 15+ by IP.
II	G	Clifton	13,22	z_{29}	1,5	
II	V	Clovelly	1,44	z_{39}	[e,n,x,z_{15}]	
I	D_2	Cochin	9,46	k	1,5	
I	C_2	Cocody	8,20	r,i	e,n,z_{15}	
I	B	Coeln	4,[5],12	y	1,2	
I	C_1	Coleypark	6,7,14	a	l,w	
I	C_1	Colindale	6,7	r	1,7	
I	F	Colobane	11	k	1,7	
I	P	Colombo	38	y	1,6	
I	C_1	Colorado	6,7	l,w	1,5	
I	C_1	Concord	6,7	l,v	1,2	
I	G	Congo	13,23	g,[m],[s],t	–	IP calls Congo 13,23:g,m,s,t:-.
I	F	Connecticut	11	l,z_{13},z_{28}	1,5	
II	J	Constantia	17	z	l,w:z_{42}	
I	T	Coogee	42	l,v	e,n,z_{15}	
I	Q	Cook	39	Rz_{48}	1,5	IP combined Cook with Champaign (39:k:1,5). The name Cook has been dropped.
I	E_1	Coquilhatville	3,10	z_{10}	1,7	
I	C_1	Coromandel	6,7	l,v	z_{35}	
I	C_2	Corvallis	8,20	z_4,z_{23}	[z_6]	
I	M	Cotham	28	i	1,5	
I	K	Cotia	18	–	1,6	
I	C_2	Cremieu	6,8	e,h	1,[6]	
I	F	Crewe	11	z	1,5	
I	M	Croft	28	g,m,s	[e,n,z_{15}]	
I	67	Crossness	67	r	1,2	
I	G	Cubana	1,13,23	z_{29}	–	Cubana may possess H phase Rz_{37} or Rz_{43}.
I	E_1	Cuckmere	3,10	i	1,2	
I	M	Cullingworth	28	d	l,w	
I	Q	Cumberland	39	i	e,n,x	
I	C_2	Curacao	6,8	a	1,6	
I	C_2	Cyprus	6,8	i	l,w	
I	54	Czernyring	54	r	1,5	
I	C_2	Daarle	6,8	y	e,n,x	
I	C_2	Dabou	8,20	z_4,z_{23}	l,w	
I	51	Dadzie	51	l,v	e,n,x	
I	Y	Dahlem	48	k	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	X	Dahomey	47	k	1,6	Dahomey may possess H phase Rz_{58}.
I	J	Dahra	17	b	1,5	
I	M	Dakar	28	a	1,6	
I	I	Dakota	16	z_{35}	e,n,z_{15}	
I	B	Dalat	4,5,27	y	e,n,x	Dalat was combined with Ball. The name Dalat has been dropped.
I	E_4	Dallgow	1,3,19	z_{10}	e,n,z_{15}	
I	C_1	Damman	6,7	a	z_6	
I	51	Dan	51	k	e,n,z_{15}	
I	X	Dapango	47	r	1,2	
II	D_1	Daressalaam	1,9,12	l,w	e,n,x	
I	C_2	Daula	8,20	z	z_6	
I	C_1	Daytona	6,7	k	1,6	
I	C_1	Decatur	6,7	c	1,5	IP has dropped Decatur and calls it dulcitol positive, mucate positive variant of Choleraesuis.
I	D_2	Deckstein	9,46	r	1,7	
II	R	Degania	40	z_4,z_{24}	[z_{39}]	
IV	R	Degania var. subsp. IV	40	z_4,z_{24}	–	
I	K	Delmenhorst	18	z_{71}	–	
I	O	Dembe	35	d	l,w	
I	G	Demerara	13,23	z_{10}	l,w	
I	C_1	Denver	6,7	a	e,n,z_{15}	
I	B	Derby	1,4,[5],12	f,g	[1,2]	
I	52	Derkle	52	e,h	1,7	
I	E_4	Dessau	1,3,15,19	g,s,t	–	
II	T	Detroit	42	z	1,5	
I	W	Deversoir	45	c	e,n,x	
I	M	Dibra	28	a	z_6	
I	M	Dieuppeul	28	i	1,7	
I	G	Diguel	1,13,22	d	e,n,z_{15}	
I	C_2	Diogoye	8,20	z_{41}	z_6	
I	L	Diourbel	21	i	1,2	
I	Y	Djakarta	48	z_4,z_{24}	–	
I	T	Djama	1,42	z_{29}	[1,5]	
I	C_2	Djelfa	8	b	1,2	
I	M	Djermaia	28	z_{29}	–	
I	J	Djibouti	17	z_{10}	e,n,x	
I	C_1	Djugu	6,7	z_{10}	e,n,x	
I	D_2	Doba	9,46	a	e,n,z_{15}	
I	M	Doel	28	z	1,6	
I	C_2	Doncaster	6,8	a	1,5	
I	N	Donna	30	l,v	1,5	
I	M	Doorn	28	i	1,2	
I	M	Douala	28	i	l,w	
I	Z	Dougi	50	y	1,6	
I	N	Doulassame	30	a	e,n,z_{15}	
I	M	Dresden	28	c	e,n,x	
I	R	Driffield	1,40	d	1,5	
I	B	Drogana	1,4,12,27	r,(i)	e,n,z_{15}	IP calls Drogana r,i.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_2	Drypool	3,[15],[15,34]	g,m,s	–	IP combined Drypool 3,15:g,m,s:- and Drypool var. O34+ with Amsterdam (3,10:g,m,s:-) to form Amsterdam 3,10,[15],[15,34]:g,m,s:-. Drypool is now called Amsterdam var. O 15+ or O 15+, 34+ by IP.
I	D_1	Dublin	1,9,12,[Vi]	g,p	–	
II	S	Dubrovnik	41	z	1,5	
I	C_2	Duesseldorf	6,8	z_4,z_{24}	–	
I	W	Dugbe	45	d	1,6	
I	B	Duisburg	1,4,12,27	d	e,n,z_{15}	
II	D_2	Duivenhoks	9,46	g,[m],[s],t	[e,n,x]	
I	E_1	Dumfries	3,10	r,[i]	1,6	
I	C_2	Dunkwa	6,8	d	1,7	
I	D_1	Durban	9,12	a	e,n,z_{15}	
II	B	Durbanville	1,4,12,27	$[z_{39}]$	1,[5],7	
I	G	Durham	13,23	b	e,n,z_{15}	
I	R	Duval	1,40	b	e,n,z_{15}	
I	O	Ealing	35	g,m,s	–	
I	D_1	Eastbourne	1,9,12	e,h	1,5	
I	E_4	Eastglam	1,3,19	c	1,5	
I	M	Eberswalde	28	c	1,6	
I	C_2	Eboko	6,8	b	1,7	
I	O	Ebrie	35	g,m,t	–	
I	P	Echa	38	k	1,2	
I	C_1	Edinburg	6,7	b	1,5	
I	C_2	Edmonton	6,8	l,v	e,n,z_{15}	
I	S	Egusi	41	d	[1,5]	
I	T	Egusitoo	1,42	b	z_6	
IIIb	61	Eilbeck	61	i	z	Eilbeck was formerly in subspecies II, but is now combined with *Arizona* 26:33:31. The name Eilbeck has been dropped.
I	C_1	Eimsbuettel	6,7,14	d	l,w	IP combined Eimsbuettel with Livingstone (6,7:d:l,w) to form Livingstone 6,7,14:d:l,w. Eimbuettel is now called Livingstone var. O 14+ by IP.
I	C_1	Eingedi	6,7	f,g,t	1,2,7	
II	W	Ejeda	45	a	z_{10}	
I	B	Eko	4,12	e,h	1,6	
I	D_2	Ekotedo	9,46	z_4,z_{23}	–	
I	X	Ekpoui	47	z_{29}	–	
I	E_1	Elisabethville	3,10	r	1,7	
I	D_1	Elokate	9,12	c	1,7	
I	D_1	Elomrane	1,9,12	z38	–	
II	I	Elsiesrivier	16	[e,n,x]	$1,6:z_{42}$	
I	C_2	Emek	8,20	g,m,s	–	
I	P	Emmastad	38	r	1,6	
II	H	Emmerich	6,14	[m,t]	e,n,x	
	I	H	Encino	1,6,14,25	d	l,z_{13},z_{28}
I	O	Enschede	35	z_{10}	l,w	
I	B	Entebbe	1,4,12,27	z	z_6	
I	D_1	Enteritidis	1,9,12	[f],g,m,[p],[t]	[1,7]	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	I	Enugu	16	l,[z13],z_{28}	[1,5]	
I	E_1	Epicrates	3,10	b	l,w	
I	F	Epinay	11	a	l,z_{13},z_{28}	
I	B	Eppendorf	1,4,12,27	d	1,5	
II	G	Epping	1,13,23	e,n,x	1,[5],7	
II	Y	Erlangen	48	g,m,t	–	
I	C_1	Escanaba	6,7	k	e,n,z_{15}	
I	D_1	Eschberg	9,12	d	1,7	
I	E_2	Eschersheim	3,15	d	e,n,x	IP combined Eschersheim with Souza (3,10:d:e,n,x) to form Souza 3,10,[15]:d:e,n,x. Eschersheim is now called Souza var. O 15+ by IP.
I	C_1	Eschweiler	6,7	z_{10}	1,6	
I	B	Essen	4,12	g,m	–	
II	Y	Etosha	48	d	1,11	Etosha was not considered a new serotype by Kauffmann and is not used.
I	F	Etterbeek	11	z_4,z_{23}	e,n,z_{15}	
I	F	Euston	11	r,i	e,n,x,z_{15}	
I	E_1	Everleigh	3,10	z_{29}	e,n,x	
I	M	Ezra	28	z	1,7	
I	M	Fairfield	28	r	l,w	
I	M	Fajara	28	l,z_{28}	e,n,x	
I	T	Faji	1,42	a	e,n,z_{15}	
I	E_1	Falkensee	3,10	i	e,n,z_{15}	
I	E_1	Fallowfield	3,10	l,z_{13},z_{28}	e,n,z_{15}	
II	R	Fandran	1,40	z_{35}	e,n,x,z_{15}	
I	F	Fann	11	l,v	e,n,x	
I	G	Fanti	13,23	z_{38}	–	
I	M	Farakan	28	z_{10}	1,5	
I	U	Farcha	43	y	1,2	
I	E_4	Fareham	1,3,19	r,i	l,w	
I	G	Farmsen	13,23	z	1,6	
I	B	Farsta	4,12	i	e,n,x	
I	Z	Fass	50	l,v	1,2	
II	Z	Faure	50	z_{42}	1,7	
I	C_2	Fayed	6,8	l,w	1,2	
VI	H	Ferlac	1,6,14,25	a	e,n,x	
I	S	Ferlo	41	k	1,6	
I	C_2	Ferruch	8	e,h	1,5	
I	B	Finaghy	4,12	y	1,6	
II	E_1	Finchley	3,10	z	e,n,x	
I	F	Findorff	11	d	z_6	
I	H	Finkenwerder	[1],6,14,[25]	d	1,5	
I	I	Fischerhuette	16	a	e,n,z_{15}	
I	H	Fischerkietz	1,6,14,25	y	e,n,x	
I	V	Fischerstrasse	44	d	e,n,z_{15}	
I	Y	Fitzroy	48	e,h	1,5	
IV	Z	Flint	50	z_4,z_{23}	–	
I	E_1	Florian	3,10,[15]	z4,z24	–	
I	H	Florida	[1],6,14,[25]	d	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	51	Flottbek	52	b	[e,n,x]	
I	K	Fluntern	6,14,18	b	1,5	
I	W	Fomeco	45	b	e,n,z_{15}	
I	I	Fortlamy	16	z	1,6	
I	B	Fortune	1,4,12,27	z_{10}	z6	
II	P	Foulpointe	38	g,t	–	
I	D_1	Franken	1,9,12	z_{60}	z_{67}	
I	I	Frankfurt	16	i	e,n,z_{15}	
I	P	Freetown	38	y	1,5	
I	E_1	Freiburg	3,10	l,z_{13}	1,2	
II	T	Fremantle	42	(f),g,t	–	
I	D_2	Fresno	9,46	z_{38}	–	
I	G	Friedenau	13,22	d	1,6	
I	M	Friedrichsfelde	28	f,g	–	
I	D_1	Frintrop	1,9,12	b	1,5	
I	E_1	Fufu	3,10	z	1,5	
II	E_1	Fuhlsbuettel	3,10	l,v	z_6	
I	E_4	Fulda	1,3,19	l,w	1,5	
I	B	Fulica	4,[5],12	a	1,5	
I	B	Fyris	4,[5],12	l,v	1,2	
I	C_1	Gabon	6,7	l,w	1,2	
I	I	Gafsa	16	c	1,6	
I	C_1	Galiema	6,7,14	k	1,2	
I	E_1	Galil	3,10	a	e,n,z_{15}	
I	F	Gallen	11	a	1,2	
I	D_1	Gallinarum	1,9,12	–	–	Gallinarum must be identified biochemically.
I	V	Gamaba	1,44	g,m,[s]	–	
I	L	Gambaga	21	z_{35}	e,n,z_{15}	
I	O	Gambia	35	i	e,n,z_{15}	
I	I	Gaminara	16	d	1,7	
I	H	Garba	1,6,14,25	a	1,5	
I	C_1	Garoli	6,7	i	1,6	
I	O	Gassi	35	e,h	z_6	
I	D_2	Gateshead	9,46	g,s,t	–	
I	E_4	Gatineau	1,3,19	y	1,5	
I	C_1	Gatow	6,7	y	1,7	
I	C_2	Gatuni	6,8	b	e,n,x	
I	E_1	Gbadago	3,10,[15]	c	1,5	
I	C_1	Gdansk	6,7	l,v	z_6	IP combined Gelsenkirchen (6,7,14:l,v:z_6) with Gdansk to form Gdansk 6,7,14:l,v:z_6.
I	N	Gege	30	r	1,5	
I	C_1	Gelsenkirchen	6,7,14	l,v	z_6	IP combined Gelsenkirchen with Gdansk (6,7:l,v:z_6) to form Gdansk 6,7,14:l,v:z_6. Gelsenkirchen is now called Gdansk var. O 14+ by IP.
I	C_1	Georgia	6,7	b	e,n,z_{15}	
I	T	Gera	1,42	z_4,z_{23}	[1,6]	
I	D_2	Geraldton	9,46	l,v	1,6	
II	C_2	Germiston	6,8	m,t	e,n,x	
I	L	Ghana	21	b	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	N	Giessen	30	g,m,s	–	
II	C_1	Gilbert	6,7	z_{39}	1,5,7	
I	E_1	Give	3,10	l,v	1,7	IP combined Newbrunswick (3,15:l,v:1,7) and Menhaden (3,15,34:l,v:1,7) with Give to form Give 3,10,[15],[15,34]:[d],l,v:[d],1,7. Give may possess H phase d; Rl,z_{40}; or Rz_{77}.
I	C_2	Giza	8,20	y	1,2	
I	I	Glasgow	16	b	1,6	
II	F	Glencairn	11	a	z_6:z_{42}	
I	F	Glidji	11	l,w	1,5	
I	C_2	Glostrup	6,8	z_{10}	e,n,z_{15}	
I	B	Gloucester	1,4,12,27	i	l,w	
I	E_4	Gnesta	1,3,19	b	1,5	
I	N	Godesberg	30	g,m,[t]	–	
I	E_1	Goelzau	3,10	a	1,5	IP combined Clichy (3,15:a:1,5) with Goelzau to form Goelzau 3,10,[15]:a:1,5.
I	E_2	Goerlitz	3,15	e,h	1,2	IP combined Goerlitz with Vejle (3,10:e,h:1,2) to form Vejle 3,10,15:e,h:1,2. Goerlitz is now called Vejle var. O 15+ by IP.
I	D_1	Goeteborg	9,12	c	1,5	
I	D_1	Goettingen	9,12	l,v	e,n,z_{15}	
II	G	Gojenberg	1,13,23	g,t	1,5	
I	51	Gokul	1,51	d	[1,5]	
I	C_2	Goldcoast	6,8	r	l,w	
I	C_1	Goma	6,7	z_4,z_{23}	z_6	
I	C_1	Gombe	6,7,14	d	e,n,z_{15}	
I	M	Good	21	f,g	e,n,x	
II	G	Goodwood	13,22	z_{29}	e,n,x	
I	J	Gori	17	z	1,2	
I	R	Goulfey	1,40	k	1,5	
I	O	Gouloumbo	35	c	1,5	
I	D_1	Goverdhan	9,12	k	1,6	
I	M	Gozo	28	e,h	e,n,z_{15}	
II	F	Grabouw	11	g,[m],s,t	[z_{39}]	
I	C_1	Grampian	6,7	r	l,w	
I	I	Grancanaria	16	z_{39}	[1,6]	Grancanaria can be d-tartrate neg., dulcitol neg., ONPG pos., and anaerogenic.
I	N	Grandhaven	30	r	1,2	
I	J	Granlo	17	l,z_{28}	e,n,x	
I	U	Graz	43	a	1,2	
II	Z	Greenside	50	z	e,n,x	
I	R	Greiz	40	a	z_6	
I	K	Groenekan	18	d	1,5	
		Group A	1,2,12			
		Group B	4,12; 1,4,5,12; or 1,4,12,27			
		Group C1	6,7,[Vi] or 6,7,14			
		Group C2	6,8			IP combined C_2 and C_3.
		Group C3	8; or 8,20			IP combined with C_2.
		Group D1	1,9,12			
		Group D2	9,46			

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
		Group D3	1,9,12,46,27			
		Group E1	3,10			
		Group E2	3,15			IP combined E_2 and E_3 with E_1.
		Group E3	3,15,34			IP combined E_2 and E_3 with E_1.
		Group E4	1,3,19			
		Group F	11			
		Group G	13,22 or 13,23			
		Group H	6,14; 6,14,24; or 1,6,14,25			
		Group I	16			
		Group J	17			
		Group K	18			
		Group L	21			
		Group M	28			
		Group N	30			
		Group O	35			
		Group P	38			
		Group Q	39			
		Group R	40			
		Group S	41			
		Group T	42			
		Group U	43			
		Group V	44			
		Group W	45			
		Group X	47			
		Group Y	48			
		Group Z	50			
		Group 51	51			
		Group 52	52			
		Group 53	53			
		Group 54	54			
		Group 55	55			
		Group 56	56			
		Group 57	57			
		Group 58	58			
		Group 59	59			
		Group 60	60			
		Group 61	61			
		Group 62	62			
		Group 63	63			
		Group 65	65			
		Group 66	66			
		Group 67	67			
I	G	Grumpensis	1,13,23	d	1,7	
II	R	Grunty	1,40	z_{39}	1,6	
I	N	Guarapiranga	30	a	e,n,x	
I	D_2	Guerin	9,46	e,h	z_6	
I	M	Guildford	28	k	1,2	
I	V	Guinea	1,44	z_{10}	[1,7]	
I	F	Gustavia	11	d	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	L	Gwaai	21	z_4,z_{24}	–	
I	T	Gwale	1,42	k	z_6	
I	E_4	Gwoza	1,3,19	a	e,n,z_{15}	
I	C_2	Haardt	8	k	1,5	
II	D_2	Haarlem	9,46	z	e,n,x	
I	C_2	Hadar	6,8	z_{10}	e,n,x	
II	I	Haddon	16	z_4,z_{23}	–	
I	J	Hadejia	17	y	e,n,z_{15}	
I	B	Haduna	4,12	l,z_{13},[z_{28}]	1,6	
I	C_1	Haelsingborg	6,7	m,p,t,[u]	–	
I	T	Haferbreite	42	k	[1,6]	
I	O	Haga	35	z_{38}	–	
II	Y	Hagenbeck	48	d	z_6	
I	B	Haifa	1,4,[5],12	z_{10}	1,2	
I	M	Halle	28	c	1,7	
I	B	Hallfold	1,4,12,27	c	l,w	
I	E_2	Halmstad	3,15	g,s,t	–	IP combined Halmstad and Canoga (3,15,34:g,s,t:-) with Westhampton (3,10:g,s,t:-) to form Westhampton 3,10,[15],[15,34]:g,s,t:-. Halmstad is now called Westhampton var. O 15+ by IP.
II	D_1	Hamburg	1,9,12	g,t	–	IP combined Hamburg with Manica (1,9,12:g,m,s,t:z42) and Muizenberg (9,12:g,m,s,t:1,5) to form *S.* II 1,9,12:g,m,[s],t:[1,5,7]:[z_{42}].
I	E_2	Hamilton	3,15	Rz_{27}	–	IP combined Hamilton with Goerlitz (3,15:e,h:1,2) and Vejle (3,10:e,h:1,2) to form Vejle 3,10,15:e,h:1,2:Rz_{27}. Hamilton is now called Vejle var. Rz_{27}+. The name Hamilton has been dropped.
II	Y	Hammonia	48	e,n,x,z15	z_6	
I	G	Handen	1,13,23	d	1,2	
I	R	Hann	40	k	e,n,x	
I	I	Hannover	16	a	1,2	
I	G	Haouaria	13,22	c	e,n,x,z_{15}	
I	H	Harburg	[1],6,14,[25]	k	1,5	
I	51	Harcourt	51	l,v	1,2	
I	E_1	Harleystreet	3,10	z	1,6	
IV	51	Harmelen	51	z_4,z_{23}	–	
I	E_1	Harrisonburg	3,10,[15],[15,34]	z_{10}	1,6	
I	C_1	Hartford	6,7	y	e,n,x	Hartford may possess H phase Rz_{50} or Rz_{67}.
I	T	Harvestehude	1,42	y	z6	
I	M	Hatfield	28	d	1,6	
I	B	Hato	4,[5],12	g,m,s	–	
I	G	Havana	1,13,23	f,g,[s]	–	Havana may possess H phase Rz_{45} or Rz_{79}.
I	E_4	Hayindogo	1,3,19	e,h	1,6	
I	F	Heerlen	11	i	1,6	
I	Q	Hegau	39	z_{10}	–	
I	B	Heidelberg	1,4,[5],12	r	1,2	
II	C_1	Heilbron	6,7	l,z_{28}	1,5:[z_{42}]	
II	B	Helsinki	1,4,12	z_{29}	[e,n,x]	
I	Z	Hemingford	50	d	1,5	Hemingford may possess H phase Rz_{82}.

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	S	Hennepin	41	d	z_6	
I	M	Hermannswerder	28	c	1,5	
I	I	Heron	16	a	z_6	
I	C_2	Herston	6,8	d	e,n,z_{15}	
I	F	Herzliya	11	y	e,n,x	
I	B	Hessarek	4,12,27	a	1,5	
I	H	Heves	6,14,[24]	d	1,5	
I	C_2	Hidalgo	6,8	r,i	e,n,z_{15}	
I	C_2	Hiduddify	6,8	l,z_{13},z_{28}	1,5	
II	J	Hillbrow	17	b	e,n,x,z_{15}	
I	D_2	Hillegersberg	9,46	z_{35}	1,5	
I	D_2	Hillingdon	9,46	g,m	–	
I	C_1	Hillsborough	6,7	z_{41}	l,w	
I	N	Hilversum	30	k	1,2	
I	C_2	Hindmarsh	8,20	r	1,5	
I	Y	Hisingen	48	a	1,5,7	
I	C_1	Hissar	6,7,14	c	1,2	
I	I	Hithergreen	16	c	e,n,z_{15}	
I	E_1	Hoboken	3,10	i	l,w	
I	Q	Hofit	39	i	1,5	
I	E_1	Hoghton	3,10	l,z_{13},z_{28}	z_6	
I	C_2	Holcomb	6,8	l,v	e,n,x	
I	H	Homosassa	1,6,14,25	z	1,5	
I	M	Honelis	28	a	e,n,z_{15}	
I	E_4	Hongkong	1,3,19	z	z_6	
II	Z	Hooggraven	50	z_{10}	z_6:z_{42}	
I	H	Horsham	1,6,14,[25]	l,v	e,n,x	
IV	U	Houten	43	z_4,z_{23}	–	
I	E_1	Huddinge	3,10	z	1,7	
II	D_1	Hueningen	9,12	z	z_{39}	
I	B	Huettwilen	1,4,12	a	l,w	
II	F	Huila	11	l,z_{28}	e,n,x	
I	I	Hull	16	b	1,2	
II	53	Humber	53	z_4,z_{24}	–	
I	E_1	Huvudsta	3,10	b	1,7	
I	I	Hvittingfoss	16	b	e,n,x	
I	L	Hydra	21	c	1,6	
I	G	Ibadan	13,22	b	1,5	
I	L	Ibaragi	21	y	1,2	
I	G	Idikan	1,13,23	i	1,5	
I	E_1	Ikayi	3,10,[15]	c	1,6	Ikayi Var. O 15+ was described after E_1 and E_2 were combined.
I	M	Ikeja	28	k	1,7	
I	M	Ilala	28	k	1,5	
I	E_3	Illinois	3,15,34	z_{10}	1,5	IP combined Illinois and Manila (3,15:z_{10}:1,5) with Lexington (3,10:z10:1,5) to form Lexington 3,10,[15],[15,34]:z_{10}:1,5. Illinois is now called Lexington var. O 15+, 34+ by IP.
I	E_4	Ilugun	1,3,10,19	z_4,z_{23}	z_6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	W	Imo	45	l,v	[e,n,z_{15}]	
I	C_2	Inchpark	6,8	y	1,7	
I	D_2	India	9,46	l,v	1,5	
I	B	Indiana	1,4,12	z	1,7	
I	C_1	Infantis	6,7,14	r	1,5	Infantis may possess H phase Rz_{49}.
I	C_1	Inganda	6,7	z_{10}	1,5	
I	D_2	Inglis	9,46	z_{10}	e,n,x	
I	S	Inpraw	41	z_{10}	e,n,x	
I	P	Inverness	38	k	1,6	
I	D_1	Ipeko	9,12	c	1,6	
I	S	Ipswich	41	z_4,z_{24}	[1,5]	
I	D_2	Irchel	9,46	y	e,n,x	
I	J	Irenea	17	k	1,5	
I	U	Irigny	43	z_{38}	–	
I	C_1	Irumu	6,7	l,v	1,5	
I	C_1	Isangi	6,7,14	d	1,5	
I	Y	Isaszeg	48	z_{10}	e,n,x	
II	E_1	Islington	3,10	g,t	–	
I	D_1	Israel	9,12	e,h	e,n,z_{15}	
I	C_2	Istanbul	8	z_{10}	e,n,x	
I	H	Istoria	1,6,14,25	r,i	1,5	
I	G	Isuge	13,23	d	z_6	
I	D_1	Italiana	9,12	l,v	R1,11	IP combined Italiana that contains H phase R1,11 with Panama (1,9,12:l,v:1,5). The name Italiana has been dropped.
I	D_1	Itami	9,12	l,z_{13}	1,5	
I	B	Ituri	1,4,12	z_{10}	1,5	
I	D_2	Itutaba	9,46	c	z_6	
I	I	Ivory	16	r	1,6	
I	Z	Ivorycoast	50	z_{29}	–	
II	I	Jacksonville	16	z_{29}	[e,n,x]	
I	D_1	Jaffna	1,9,12	d	z_{35}	
I	B	Jaja	4,12,27	z_4,z_{23}	–	IP combined Jaja with Stanleyville (1,4,[5],12:z_4,z_{23}:[1,5]) to form Stanleyville 1,4,[5],12,27:z_4,z_{23}:[1,5]. Jaja is now called Stanleyville var. O 27+. The name Jaja has been dropped.
I	F	Jalisco	11	y	1,7	
I	D_1	Jamaica	9,12	r	1,5	
I	L	Jambur	21	l,z_{28}	e,n,z_{15}	
I	J	Jangwani	17	a	1,5	
I	B	Java	1,4,5,12	b	[1,2], (tartrate +)	IP calls Java, Paratyphi B var. Java. Java is often monophasic in the U.S. May possess H phase Rz_{33}.
I	D_1	Javiana	1,9,12	l,z_{28}	1,5	
I	E_1	Jedburgh	3,10,[15]	z_{29}	–	
I	B	Jericho	1,4,12,27	c	e,n,z_{15}	
I	C_1	Jerusalem	6,7,14	z_{10}	l,w	
I	E_1	Joal	3,10	l,z_{28}	1,7	
I	W	Jodhpur	45	z_{29}	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	B	Joenkoeping	4,5,12	g,s,t	–	IP combined Joenkoeping with Kingston (1,4,12,27:g,s,t:-) to form Kingston 1,4,[5],12,27:g,s,t:-. The name Joenkoeping has been dropped.
I	R	Johannesburg	1,40	b	e,n,x	
I	B	Jos	1,4,12,27	y	e,n,z_{15}	
I	E_4	Juba	1,3,19	a	1,7	
I	J	Jubilee	17	e,h	1,2	
I	G	Jukestown	13,23	i	e,n,z_{15}	
I	B	Kaapstad	4,12	e,h	1,7	
I	51	Kabete	51	i	1,5	
I	C_1	Kaduna	6,7,14	c	e,n,z_{15}	
I	T	Kahla	1,42	z_{35}	1,6	
I	E_4	Kainji	1,3,19	z	1,6	
I	H	Kaitaan	1,6,14,25	m,t	–	
I	B	Kalamu	4,[5],12	z_4,z_{24}	[1,5]	
I	E_1	Kalina	3,10	b	1,2	
I	C_2	Kallo	6,8	k	1,2	
II	M	Kaltenhausen	28	b	z_6	
I	C_2	Kalumburu	6,8	z	e,n,z_{15}	
I	C_1	Kambole	6,7	d	1,[2],7	
I	B	Kamoru	4,12,27	y	z_6	
I	T	Kampala	1,42	c	z_6	
I	E_4	Kande	1,3,19	b	e,n,z_{15}	
I	J	Kandla	17	z_{29}	–	
I	T	Kaneshie	1,42	i	l,w	
I	H	Kanifing	1,6,14,25	z	1,6	
I	B	Kano	1,4,12,27	l,z_{13},z_{28}	e,n,x	
I	X	Kaolack	47	z	1,6	
I	D_1	Kapemba	9,12	l,v	1,7	
I	W	Karachi	45	d	e,n,x	
I	R	Karamoja	40	z_{41}	1,2	
I	51	Karaya	51	b	1,5	
I	P	Kasenyi	38	e,h	1,5	
I	H	Kassberg	1,6,14,25	c	1,6	
II	G	Katesgrove	1,13,23	m,t	1,5	
I	G	Kedougou	1,13,23	i	l,w	
I	C_2	Kentucky	8,20	i	z6	
I	C_1	Kenya	6,7	l,z13	e,n,x	
I	V	Kermel	44	d	e,n,x	
I	L	Keve	21	l,w	–	
II	X	Khami	47	b	[e,n,x,z_{15}]	
I	E_3	Khartoum	3,15,34	a	1,7	IP combined Khartoum with Oxford (3,10:a:1,7) to form Oxford 3,10,[15],[15,34]:a:1,7. Khartoum is now called Oxford var. O 15+ by IP. CDC has no 3,15:a:1,7. Khartoum was found by IP with colonies containing O 3,15.
I	B	Kiambu	4,12	z	1,5	
I	I	Kibi	16	z_4,z_{23}	[1,6]	
I	M	Kibusi	28	r	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	P	Kidderminster	38	c	1,6	
I	A	Kiel	1,2,12	g,p	–	
I	I	Kikoma	16	y	e,n,x	
II	B	Kilwa	4,12	l,w	e,n,x	
I	P	Kimberley	38	l,v	1,5	
I	D_1	Kimpese	9,12	z	1,6	
I	B	Kimuenza	1,4,12,27	l,v	e,n,x	
I	E_4	Kindia	1,3,19	l,z_{28}	e,n,x	
I	U	Kingabwa	43	y	1,5	
I	B	Kingston	1,4,12,27	g,s,t	[1,2]	IP combined Kingston with Joenkoeping (4,5,12:g,s,t:-) to form Kingston 1,4,[5],12,27:g,s,t:[1,2]. Kingston may possess H phase Rz_{27} or Rz_{43}.
I	J	Kinondoni	17	a	e,n,x	
I	E_2	Kinshasa	3,15	l,z_{13}	1,5	IP combined Kinshasa with Uganda (3,10:l,z_{13}:1,5) to form Uganda 3,10,[15]:l,z_{13}:1,5. Kinshasa is now called Uganda var. O 15+ by IP.
I	E_4	Kinson	1,3,19	y	e,n,x	
I	G	Kintambo	1,13,23	m,t	–	
I	J	Kirkee	17	b	1,2	
I	B	Kisangani	1,4,[5],12	a	1,2	
I	F	Kisarawe	11	k	e,n,x,[z_{15}]	
I	C_1	Kisii	6,7	d	1,2	
I	M	Kitenge	28	y	e,n,x	
I	C_1	Kivu	6,7	d	1,6	
II	W	Klapmuts	45	z	z_{39}	
I	P	Klouto	38	z_{38}	–	
II	B	Kluetjenfelde	4,12	d	e,n,x	
I	X	Kodjovi	47	c	[1,6]	Kodjovi may possess H phase Rz_{78}.
I	B	Koenigstuhl	1,4,[5],12	z	e,n,z_{15}	
I	A	Koessen	2,12	l,v	1,5	
I	W	Kofandoka	45	r	e,n,z_{15}	
I	V	Koketime	44	z_{38}	–	
I	N	Kokoli	30	z_{35}	1,6	
I	Q	Kokomlemle	39	l,v	e,n,x	
I	D_2	Kolar	9,46	b	z_{35}	
I	C_2	Kolda	8,20	z_{35}	1,2	
II	U	Kommetje	43	b	z_{42}	
I	M	Konolfingen	28	z_{35}	1,6	
I	C_2	Konstanz	8	b	e,n,x	
I	C_2	Korbol	8,20	b	1,5	
I	E_4	Korlebu	1,3,19	z	1,5	
I	P	Korovi	38	g,m,[s]	–	
I	C_1	Kortrijk	6,7	l,v	1,7	
I	C_2	Kottbus	6,8	e,h	1,5	
I	C_1	Kotte	6,7	b	z_{35}	
I	D_1	Kotu	9,12	l,z_{28}	1,6	
I	E_4	Kouka	1,3,19	g,m,[t]	–	
I	C_1	Koumra	6,7	b	1,7	
I	M	Kpeme	28	e,h	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	G	Kraaifontein	1,13,23	g,m,t	[e,n,x]	IP combined Kraaifontein with Luanshya (1,13,23:g,m,s,t:[e,n,x]) to form Luanshya 1,13,23:g,m,[s],t:[e,n,x]. The name Kraaifontein has been dropped.
IV	C_1	Kralendyk	6,7	z_4,z_{24}	–	
I	C_2	Kralingen	8,20	y	z6	
I	E_4	Krefeld	1,3,19	y	l,w	
I	E_1	Kristianstad	3,10	z_{10}	e,n,z_{15}	
II	Z	Krugersdorp	50	e,n,x	1,7	
I	V	Kua	44	z_4,z_{23}	–	
I	B	Kubacha	1,4,12,27	l,z_{13},z_{28}	1,7	
I	M	Kuessel	28	i	e,n,z_{15}	
II	D_1	Kuilsrivier	1,9,12	g,m,s,t	e,n,x	
I	N	Kumasi	30	z_{10}	e,n,z_{15}	
I	B	Kunduchi	1,4,[5],12,27	l,[z13],[z28]	[1,2]	
I	H	Kuntair	1,6,14,25	b	1,5	
I	C_2	Kuru	6,8	z	l,w	
I	C_2	Labadi	8,20	d	z_6	
I	B	Lagos	1,4,[5],12	i	1,5	
I	E_1	Lamberhurst	3,10	e,h	e,n,z_{15}	
I	E_1	Lamin	3,10	l,z_{28}	e,n,x	
I	J	Lancaster	17	l,v	1,7	
I	S	Landala	41	z_{10}	1,6	
I	N	Landau	30	i	1,2	
I	E_1	Landwasser	3,10	z	z_6	
I	K	Langenhorn	18	m,t	–	
I	E_1	Langensalza	3,10	y	l,w	
I	M	Langford	28	b	e,n,z_{15}	
I	E_2	Lanka	3,15	r	z_6	IP combined Lanka with Weltevreden (3,10:r:z_6) to form Weltevreden 3,10,[15]:r:z_6. Lanka is now called Weltevreden var. O 15+ by IP.
I	P	Lansing	38	i	1,5	
I	C_1	Larochelle	6,7	e,h	1,2	
I	W	Lattenkamp	45	z_{35}	1,5	
I	D_1	Lawndale	1,9,12	z	1,5	
I	V	Lawra	44	k	e,n,z_{15}	
I	S	Leatherhead	41	m,t	1,6	
I	51	Lechler	51	z	e,n,z_{15}	
I	K	Leer	18	z_{10}	1,5	
I	F	Leeuwarden	11	b	1,5	
I	B	Legon	1,4,12,27	c	1,5	
I	G	Leiden	13,22	z_{38}	–	
I	S	Leipzig	41	z_{10}	1,5	
I	C_2	Leith	6,8	a	e,n,z_{15}	
I	E_1	Lekke	3,10	d	1,6	
I	F	Lene	11	z_{38}	–	
I	M	Leoben	28	l,v	1,5	
I	C_1	Leopoldville	6,7,14	b	z_6	
I	E_4	Lerum	1,3,19	z	1,7	
II	S	Lethe	41	g,t	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_1	Lexington	3,10	z_{10}	1,5	IP combined Lexington with Manila (3,15:z_{10}:1,5) and Illinois (3,15,34:z10:1,5) to form Lexington 3,10,[15],[15,34]:z10,1,5. Lexington may possess H phase Rz_{49}.
I	C_2	Lezennes	6,8	z_4,z_{23}	1,7	
I	M	Libreville	28	z_{10}	1,6	
II	S	Lichtenberg	41	z_{10}	[z_6]	
I	N	Ligeo	30	l,v	1,2	
I	O	Ligna	35	z_{10}	z_6	
I	C_1	Lika	6,7	i	1,7	
I	C_1	Lille	6,7	z_{38}	–	IP combined Lille with Bornum (6,7,14:z_{38}:-) to form Lille 6,7,14:z_{38}:-.
II	G	Limbe	1,13,22	g,m,t	[1,5]	
I	B	Limete	1,4,12,27	b	1,5	
II	F	Lincoln	11	m,t	e,n,x	
I	C_2	Lindenburg	6,8	i	1,2	
I	H	Lindern	6,14,[24]	d	e,n,x	
I	P	Lindi	38	r	1,5	
II	D_1	Lindrick	9,12	e,n,x	1,[5],7	
I	D_2	Linguere	9,46	b	z_6	
I	I	Lingwala	16	z	1,7	
I	G	Linton	13,23	r	e,n,z_{15}	
I	I	Lisboa	16	z_{10}	1,6	
I	D_2	Lishabi	9,46	z_{10}	1,7	
I	C_2	Litchfield	6,8	l,v	1,2	
I	E_4	Liverpool	1,3,19	d	e,n,z_{15}	
I	C_1	Livingstone	6,7	d	l,w	IP combined Eimsbuettel (6,7,14:d:l,w) with Livingstone to form Livingstone 6,7,14:d:l,w.
I	N	Livulu	30	e,h	1,2	
I	B	Ljubljana	4,12,27	k	e,n,x	
I	E_4	Llandoff	1,3,19	z_{29}	[z_6]	
II	M	Llandudno	28	g,[m],[s],t	1,5	
I	V	Llobregat	1,44	z_{10}	e,n,x	
I	C_2	Loanda	6,8	l,v	1,5	
II	52	Lobatsi	52	z_{44}	1,5,7	
II	57	Locarno	57	z_{29}	z_{42}	
I	C_1	Lockleaze	6,7,14	b	e,n,x	
I	J	Lode	17	r	1,2	
I	S	Lodz	41	z_{29}	–	
I	T	Loenga	1,42	z_{10}	z_6	
I	Q	Logone	39	d	1,5	
IV	V	Lohbruegge	44	z_4,z_{32}	–	
I	E_4	Lokstedt	1,3,19	l,z_{13},z_{28}	1,2	
I	D_1	Lomalinda	1,9,12	a	e,n,x	
I	D_1	Lome	9,12	r	z_6	
I	C_1	Lomita	6,7	e,h	1,5	
I	I	Lomnava	16	l,w	e,n,z_{15}	
I	E_1	London	3,10	l,v	1,6	IP combined London with Portsmouth (3,15:l,v:1,6) to form London 3,10,[15]:l,v:1,6.
I	I	Losangeles	16	l,v	z_6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	B	Loubomo	4,12	z	1,6	
I	N	Louga	30	b	1,2	
I	D_2	Louisiana	9,46	z_{10}	z_6	
II	I	Louwbester	16	z	[e,n,x]	
I	G	Lovelace	13,22	l,v	1,5	
I	J	Lowestoft	17	g,s,t	–	
II	G	Luanshya	1,13,23	g,m,s,t	[e,n,x]	IP combined Luanshya with Kraaifontein (1,13,23:g,m,t:[e,n,x]) to form Luanshya 1,13,23:g,m,[s],t:[e,n,x].
I	S	Lubumbashi	41	r	1,5	
I	F	Luciana	11	a	e,n,z_{15}	
I	M	Luckenwalde	28	z_{10}	e,n,z_{15}	
I	X	Luke	1,47	g,m	–	
II	D_2	Lundby	9,46	b	e,n,x	
II	S	Lurup	41	z_{10}	e,n,x,z_{15}	
I	51	Lutetia	51	r,i	l,z_{13},z_{28}	
II	60	Luton	60	z	e,n,x	
I	X	Lyon	47	k	e,n,z_{15}	
II	D_2	Maarssen	9,46	z_4,z_{24}	z_{39}:z_{42}	
I	F	Maastricht	11	z_{41}	1,2	
I	E_1	Macallen	3,10	z_{36}	–	
I	D_2	Macclesfield	9,46	g,m,s,t	1,(2),7	
I	E_4	Machaga	1,3,19	i	e,n,x	
I	H	Madelia	1,6,14,25	y	1,7	
I	E_4	Madiago	1,3,19	c	1,7	
I	V	Madigan	44	c	1,5	
I	L	Madison	21	d	z_6	
I	E_1	Madjorio	3,10	d	e,n,z_{15}	
I	B	Madras	4,[5],12	m,t	e,n,z_{15}	
I	C_2	Magherafelt	8,20	i	l,w	
I	H	Magumeri	1,6,14,25	e,h	1,6	
I	L	Magwa	21	d	e,n,x	
I	D_2	Mahina	9,46	z_{10}	e,n,z_{15}	
I	E_4	Maiduguri	1,3,19	f,g,t	e,n,z_{15}	
I	U	Makiling	43	z_{29}	–	
I	C_1	Makiso	6,7	l,z_{13},z_{28}	z_6	
II	B	Makoma	1,4,[5],12,27	a	[e,n,x]	
II	B	Makumira	1,4,12,27	e,n,x	1,[5],7	
I	I	Malakal	16	e,h	1,2	
V	66	Malawi	66	z_{65}	–	
I	M	Malaysia	28	z_{10}	1,7	
I	V	Malika	44	l,z_{28}	1,5	
I	C_2	Malmoe	6,8	i	1,7	
I	I	Malstatt	16	b	z_6	
I	H	Mampeza	1,6,14,25	i	1,5	
I	G	Mampong	13,22	z_{35}	1,6	
I	C_2	Manchester	6,8	l,v	1,7	
I	I	Mandera	16	l,z_{13}	e,n,z_{15}	
I	P	Mango	38	k	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_2	Manhattan	6,8	d	1,5	
II	D_1	Manica	1,9,12	g,m,s,t	z_{42}	IP combined Manica with Hamburg (1,9,12:g,t:-) and Muizenberg (9,12:g,m,s,t:1,5) to form *S.* II 1,9,12:g,[m],[s],t:[1,5,7]:[z_{42}].
I	E_2	Manila	3,15	z_{10}	1,5	IP combined Manila and Illinois (3,15,34:z_{10}:1,5) with Lexington (3,10:z_{10}:1,5) to form Lexington 3,10,[15],[15,34]:z_{10}:1,5. Manila is now called Lexington var. O 15+ by IP.
I	F	Mannheim	11	k	l,w	
II	57	Manombo	57	z_{39}	e,n,x,z_{15}	
I	C_2	Mapo	6,8	z_{10}	1,5	
I	Q	Mara	39	e,h	[1,5]	
I	F	Maracaibo	11	l,v	1,5	
I	G	Marburg	13,23	k	–	
V	66	Maregrosso	66	z_{35}	–	
I	T	Maricopa	1,42	g,z_{51}	1,5	
I	E_1	Marienthal	3,10	k	e,n,z_{15}	
IV	Y	Marina	48	g,z_{51}	–	
I	V	Maritzburg	1,44	i	e,n,z_{15}	
I	E_1	Maron	3,10	d	z_{35}	
I	F	Maroua	11	z	1,7	
I	F	Marseille	11	a	1,5	
I	G	Marshall	13,22	a	l,z_{13},z_{28}	
I	57	Maryland	57	b	1,7	
I	D_2	Marylebone	9,46	k	1,2	
I	E_1	Masembe	3,10	a	e,n,x	Masembe may possess H phase Rz_5.
I	B	Maska	1,4,12,27	z_{41}	e,n,z_{15}	
I	O	Massakory	35	r	l,w	
I	B	Massenya	1,4,12,27	k	1,5	
I	J	Matadi	17	k	e,n,x	
I	D_2	Mathura	9,46	i	e,n,z_{15}	
I	N	Matopeni	30	y	1,2	
II	E_1	Matroosfontein	3,10	a	e,n,x	
I	D_2	Mayday	9,46	y	z_6	
I	C_1	Mbandaka	6,7,14	z_{10}	e,n,z_{15}	
I	U	Mbao	43	i	1,2	
I	W	Meekatharra	45	a	e,n,z_{15}	
I	T	Melbourne	42	z	e,n,z_{15}	
I	E_1	Meleagridis	3,10	e,h	l,w	IP combined Meleagridis with Cambridge (3,15:e,h:l,w) and Wildwood (3,15,34:e,h:l,w) to form Meleagridis 3,10,[15],[15,34]:e,h:l,w.
I	K	Memphis	18	k	1,5	
I	C_1	Menden	6,7	z_{10}	1,2	
I	D_1	Mendoza	9,12	l,v	1,2	
I	E_3	Menhaden	3,15,34	l,v	1,7	IP combined Menhaden with Give (3,10:l,v:1,7) and Newbrunswick (3,15:l,v:1,7) to form Give 3,10,[15],[15,34]:[d],l,v:1,7. Menhaden is now called Give var. O 15+, 34+ by IP.
I	C_1	Menston	6,7	g,s,[t]	[1,6]	
II	I	Merseyside	16	g,t	[1,5]	
I	X	Mesbit	47	m,t	[e,n,z_{15}]	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	51	Meskin	51	e,h	1,2	
I	N	Messina	30	d	1,5	
I	C_2	Mexicana	6,8	d	1,2	Mexicana was combined with Muenchen. The name Mexicana has been dropped.
I	P	Mgulani	38	i	1,2	
I	D_1	Miami	1,9,12	a	1,5	Miami must be differentiated from Sendai with biochemical tests. Miami is pos. for H_2S, citrate, and tartrate; Sendai is neg.
I	J	Michigan	17	l,v	1,5	
I	T	Middlesbrough	1,42	i	z_6	
II	53	Midhurst	53	l,z_{28}	z_{39}	
I	H	Midway	6,14,24	d	1,7	
I	C_1	Mikawasima	6,7,14	y	e,n,z_{15}	Mikawasima may possess H phase Rz_{47} or Rz_{50}.
I	R	Millesi	1,40	l,v	1,2	
I	U	Milwaukee	43	f,g,[t]	-	
I	G	Mim	13,22	a	1,6	
I	H	Minna	1,6,14,25	c	l,w	
I	E_3	Minneapolis	3,15,34	e,h	1,6	IP combined Minneapolis and Newington (3,15:e,h:1,6) with Anatum (3,10:e,h:1,6) to form Anatum 3,10,[15],[15,34]:e,h:1,6. Minneapolis is now called Anatum var. O 15+ by IP.
I	L	Minnesota	21	b	e,n,x	Minnesota may possess H phase Rz_{33} or Rz_{49}.
I	G	Mishmarhaemek	1,13,23	d	1,5	
I	C_1	Mission	6,7	d	1,5	Mission was combined with Isangi 6,7,14:d:1,5. The name Mission has been dropped.
I	G	Mississippi	1,13,23	b	[1,5]	
I	F	Missouri	11	g,s,t	–	
I	D_1	Miyazaki	9,12	l,z_{13}	1,7	
II	D_1	Mjimwema	1,9,12	b	e,n,x	
I	N	Mjordan	30	i	e,n,z_{15}	
I	C_1	Mkamba	6,7	l,v	1,6	
II	I	Mobeni	16	g,[m],[s],t	[e,n,x]	
I	M	Mocamedes	28	d	e,n,x	
I	M	Moero	28	b	1,5	
I	F	Moers	11	m,t	–	
I	E_1	Mokola	3,10	y	1,7	
I	C_2	Molade	8,20	z_{10}	z6	
I	52	Molesey	52	b	1,5	
II	Q	Mondeor	39	l,z_{28}	e,n,x	
I	B	Mono	4,12	l,w	1,5	
I	B	Mons	1,4,12,27	d	l,w	
I	O	Monschaui	35	m,t	–	
I	C_1	Montevideo	6,7,14	g,m,[p],s	[1,2,7]	
II	F	Montgomery	11	a,[d]	$[d]:e,n,z_{15}$	
I	U	Montreal	43	c	1,5	
I	N	Morehead	30	i	1,5	
I	M	Morillons	28	m,t	1,6	
I	N	Morningside	30	c	e,n,z_{15}	
I	H	Mornington	1,6,14,25	y	e,n,z_{15}	
I	N	Morocco	30	l,z_{13},z_{28}	e,n,z_{15}	
I	J	Morotai	17	l,v	1,2	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	M	Moroto	28	z_{10}	l,w	
I	D_1	Moscow	9,12	g,q	–	
II	U	Mosselbay	43	g,m,[s],t	[z_{42}]	
I	X	Moualine	47	y	1,6	
I	51	Moundou	51	l,z_{28}	1,5	
I	L	Mountmagnet	21	r	–	
I	X	Mountpleasant	47	z	1,5	
I	H	Moussoro	1,6,14,25	i	e,n,z_{15}	
I	C_2	Mowanjum	6,8	z	1,5	
II	E_1	Mpila	3,10	z_{38}	z_{42}	
I	I	Mpouto	16	m,t	–	
I	C_2	Muenchen	6,8	d	1,2	
I	E_1	Muenster	3,10	e,h	1,5	IP combined Muenster with Newhaw (3,15:e,h:1,5) and Arkansas (3,15,34:e,h:1,5) to form Muenster 3,10,[15],[15,34]:e,h:1,5.
I	V	Muguga	44	m,t	–	
II	D_1	Muizenberg	9,12	g,m,s,t	1,5	IP combined Muizenberg with Hamburg (1,9,12:g,t:-) and Manica (1,9,12:g,m,s,t:z_{42}) to form *S.* II 1,9,12:g,[m],[s],t:[1,5,7]:[z_{42}].
I	M	Mundonobo	28	d	1,7	
IV	F	Mundsburg	11	g,z_{51}	–	
I	B	Mura	1,4,12	z_{10}	l,w	
II	G	Nachshonim	1,13,23	z	1,5	
I	D_1	Naestved	1,9,12	g,p,s	–	
I	C_2	Nagoya	6,8	b	1,5	
II	T	Nairobi	42	r	–	
I	B	Nakuru	1,4,12,27	a	z_6	
II	Z	Namib	50	g,[m],s,t	[1,5]	
I	C_1	Namibia	6,7	c	e,n,x	
I	E_2	Nancy	3,15	l,v	1,2	IP combined Nancy with Nchanga (3,10:l,v:1,2) to form Nchanga 3,10,[15]:l,v:1,2. Nancy is now called Nchanga var. O 15+ by IP.
I	C_2	Nanergou	6,8	g,s,t	–	
I	G	Nanga	1,13,23	l,v	e,n,z_{15}	
I	D_2	Nantes	9,46	y	l,w	
I	D_1	Napoli	1,9,12	l,z_{13}	e,n,x	
I	C_2	Narashino	6,8	a	e,n,x	
I	M	Nashua	28	l,v	e,n,z_{15}	
I	D_1	Natal	9,12	z_4,z_{24}	–	
I	I	Naware	16	z_{38}	–	
I	E_1	Nchanga	3,10	l,v	1,2	IP combined Nchanga with Nancy (3,15:l,v:1,2) to form Nchanga 3,10,[15]:l,v:1,2.
I	H	Ndjamena	1,6,14,25	b	1,2	
I	D_1	Ndolo	1,9,12	d	1,5	
II	D_1	Neasden	9,12	g,s,t	e,n,x	
I	B	Neftenbach	4,12	z	e,n,x	
II	S	Negev	41	z_{10}	1,2	
I	H	Nessa	1,6,14,25	z_{10}	1,2	
I	C_1	Nessziona	6,7	l,z_{13}	1,5	
I	N	Neudorf	30	b	e,n,z_{15}	
I	C_1	Neukoelin	6,7	l,z_{13},[z_{28}]	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	B	Neumuenster	1,4,12,27	k	1,6	
I	P	Neunkirchen	38	z_{10}	-	
I	E_2	Newbrunswick	3,15	l,v	1,7	IP combined Newbrunswick and Menhaden (3,15,34:l,v:1,7) with Give (3,10:l,v:1,7) to form Give 3,10,[15],[15,34]:[d],l,v:[d],1,7. Newbrunswick is now called Give var. O 15+ by IP.
I	E_2	Newhaw	3,15	e,h	1,5	IP combined Newhaw and Arkansas (3,15,34:e,h:1,5) with Muenster (3,10:e,h:1,5) to form Muenster 3,10,[15],[15,34]:e,h:1,5. Newhaw is now called Muenster var. O 15+ by IP.
I	54	Newholland	4,12,54	m,t	–	
I	E_2	Newington	3,15	e,h	1,6	IP combined Newington and Minneapolis (3,15,34:e,h:1,6) with Anatum (3,10:e,h:1,6) to form Anatum 3,10,[15],[15,34]:e,h:1,6. Newington is now called Anatum var. O 15+ by IP.
I	E_1	Newlands	3,10,[15,34]	e,h	e,n,x	
I	D_1	Newmexico	9,12	g,z_{51}	1,5	
I	C_2	Newport	6,8,20	e,h	1,2	Newport may possess H phase Rz_{50} or Rz_{58} or Rz_{78} or R1,12
I	C_2	Newport var. Puerto Rico	6,8	–	1,2	
I	E_1	Newrochelle	3,10	k	l,w	
I	G	Newyork	13,22	g,s,t	–	
I	D_2	Ngaparou	9,46	z_4,z_{24}	–	
I	C_1	Ngili	6,7	z10	1,7	
I	E_4	Ngor	1,3,19	l,v	1,5	
II	Y	Ngozi	48	z_{10}	[1,5]	
I	V	Niakhar	44	a	1,5	
I	J	Niamey	17	d	l,w	
I	V	Niarembe	44	a	l,w	
I	C_1	Nienstedten	6,7,14	b	[l,w]	Nienstedten was combined with Nissii (6,7,14:b:-) and called Nienstedten; then IP combined Nienstedten with Ohio (6,7:b:l,w) to form Ohio (6,7,14:b:[l,w]). Nienstedten is now called Ohio var.O 14+ by IP.
I	C_1	Nieukerk	6,7,14	d	z_6	
I	C_1	Nigeria	6,7	r	1,6	
I	N	Nijmegen	30	y	e,n,z_{15}	
I	I	Nikolaifleet	16	g,m,s	–	
I	E_4	Niloese	1,3,19	d	z_6	
I	M	Nima	28	y	1,5	
I	G	Nimes	13,22	z_{35}	e,n,z_{15}	
I	C_1	Nissii	6,7,14	b	–	Nissii was combined with Nienstedten (6,7,14:b:l,w) as a monophasic variant of Nienstedten. Nienstedten is now called a variant of Ohio by IP. The name Nissii has been dropped.
I	A	Nitra	2,12	g,m	–	
I	E_4	Niumi	1,3,19	a	1,5	
I	P	Njala	38	k	e,n,x	
I	C_1	Nola	6,7	e,h	1,7	
II	I	Noordhoek	16	l,w	z_6	
II	B	Nordenham	1,4,12,27	z	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_2	Nordufer	6,8	a	1,7	
I	C_1	Norton	6,7	i	l,w	
I	C_1	Norwich	6,7	e,h	1,6	
I	I	Nottingham	16	d	e,n,z_{15}	
I	R	Nowawes	40	z	z_6	
I	C_2	Noya	8	r	1,7	
I	I	Nuatja	16	k	e,n,x	
II	T	Nuernberg	42	z	z_6	
I	F	Nyanza	11	z	z_6	
I	E_1	Nyborg	3,10	e,h	1,7	IP combined Selandia (3,15:e,h:1,5) with Nyborg to form Nyborg 3,10,[15]:e,h:1,7.
I	I	Nyeko	16	a	1,7	
I	C_1	Oakey	6,7	m,t	z_{64}	
I	C_1	Oakland	6,7	z	1,6,[7]	
I	C_1	Obogu	6,7	z_4,z_{23}	1,5	
I	E_4	Ochiogu	1,3,19	z_{38}	[e,n,z_{15}]	
I	54	Ochsenwerder	6,7,54	k	1,5	
IV	I	Ochsenzoll	16	z_4,z_{23}	–	
I	N	Ockenheim	30	l,z_{13},z_{28}	1,6	
I	R	Odienne	40	y	1,5	
II	N	Odijk	30	a	z_{39}	
I	N	Odozi	30	k	e,n,[x],z_{15}	
I	Q	Oerlikon	39	l,v	e,n,z_{15}	
II	M	Oevelgoenne	28	r	e,n,z_{15}	
I	S	Offa	41	z_{38}	–	
I	U	Ogbete	43	z	1,5	
I	C_1	Ohio	6,7	b	l,w	IP combined Nienstedten (6,7,14:b:[l,w]) with Ohio to form Ohio 6,7,14:b:[l,w}. Ohio may possess H phase Rz_{59}.
I	E_1	Ohlstedt	3,10	y	e,n,x	
I	G	Okatie	13,23	g,[s],t	–	
I	E_1	Okefoko	3,10	c	z_6	
I	E_1	Okerara	3,10	z_{10}	1,2	
I	I	Oldenburg	16	d	1,2	
I	D_2	Olten	9,46	d	e,n,z_{15}	
I	C_1	Omderman	6,7,14	d	e,n,x	IP combined Omderman with Amersfoort (6,7:d:e,n,x) to form Amersfoort 6,7,14:d:e,n,x. Omderman is now called Amersfoort var. O 14+ by IP.
I	R	Omifisan	40	z_{29}	–	
I	C_1	Omuna	6,7	z_{10}	z_{35}	
I	M	Ona	28	g,s,t	–	
I	D_1	Onarimon	1,9,12	b	1,2	
I	H	Onderstepoort	1,6,14,[25]	e,h	1,5	
I	E_1	Onireke	3,10	d	1,7	
I	D_2	Ontario	9,46	d	1,5	
I	C_1	Oranienburg	6,7	m,t	–	IP combined Theilallee (6,7,14:m,t:-) with Oranienburg to form Oranienburg 6,7,14:m,t:-. Oranienburg may possess H phase Rz_{57}.
I	T	Orbe	42	b	1,6	
I	52	Ord	52	a	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	G	Ordonez	1,13,23	y	l,w	
I	I	Orientalis	16	k	e,n,z_{15}	
I	E_1	Orion	3,10	y	1,5	IP combined Binza (3,15:y:1,5) and Thomasville (3,15,34:y:1,5) with Orion to form Orion 3,10,[15],[15,34]:y:1,5.
I	C_1	Oritamerin	6,7	i	1,5	
I	K	Orlando	18	l,v	e,n,z_{15}	
I	U	Orleans	43	d	1,5	
ßßßI	D_1	Os	9,12	a	1,6	
I	M	Oskarshamn	28	y	1,2	
I	C_1	Oslo	6,7,14	a	e,n,x	
I	F	Osnabrueck	11	l,z_{13},z_{28}	e,n,x	
I	C_1	Othmarschen	6,7,14	g,m,[t]	–	
I	D_1	Ottawa	1,9,12	z_{41}	1,5	
II	R	Ottershaw	40	d	–	
I	D_2	Ouakam	9,46	z_{29}	–	
I	G	Oudwijk	13,22	b	1,6	
I	R	Overchurch	1,40	l,w	[1,2]	
I	51	Overschie	51	l,v	1,5	
I	N	Overvecht	30	a	1,2	
I	E_1	Oxford	3,10	a	1,7	IP combined Khartoum (3,15,34:a:1,7) with Oxford to form Oxford 3,10,[15],[15,34]:a:1,7.
I	C_1	Oyonnax	6,7	y	1,6	
II	C_1	Oysterbeds	6,7	z	z_{42}	
I	C_2	Pakistan	8	l,v	1,2	
I	V	Palamaner	1,44	d	z_{35}	
I	C_1	Palime	6,7	z_{35}	e,n,z_{15}	
I	D_1	Panama	1,9,12	l,v	1,5	Panama may possess H phase R1,11
I	E_2	Pankow	3,15	d	1,5	IP combined Pankow with Shangani (3,10:d:1,5) to form Shangani 3,10,15:d:1,5. Pankow is now called Shangani var. O 15+ by IP.
I	C_1	Papuana	6,7	r	e,n,z_{15}	
I	A	Paratyphi A	1,2,12	a	[1,5]	
I	B	Paratyphi B	1,4,[5],12	[b]	[1,2]	Paratyphi B is tartrate neg.; Paratyphi B var. Java (CDC calls this *S.* ser. Java) is often monophasic (1,4,5,12:b:-) and is tartrate pos. Paratyphi B and Java may possess H phase Rz_{33}.
I	C_1	Paratyphi C	6,7,[Vi]	c	1,5	
IV	C_2	Parera	11	z_4,z_{23}	–	
I	C_2	Paris	8,20	z_{10}	1,5	
I	E_4	Parkroyal	1,3,19	l,v	1,7	
II	E_1	Parow	3,10,[15]	g,m,s,t	–	
I	B	Pasing	4,12	z_{35}	1,5	
I	M	Patience	28	d	e,n,z_{15}	
I	D_1	Penarth	9,12	z_{35}	z_6	
I	M	Penilla	28	l,z_{13},z_{28}	e,n,z_{15}	
I	F	Pennsylvania	11	d	e,n,z_{15}	
I	D_1	Pensacola	1,9,12	m,t	[1,2]	
II	W	Perinet	45	g,m,t	e,n,x,z_{15}	
I	P	Perth	38	y	e,n,x	
I	E_4	Petahtikva	1,3,19	f,g,t	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	C_2	Phaliron	8	z	e,n,z_{15}	
I	F	Pharr	11	b	e,n,z_{15}	
II	X	Phoenix	47	b	1,5	
I	E_1	Pietersburg	3,10,[15,34]	z_{69}	1,7	
I	C_2	Pikine	8,20	r	z_6	Pikine was combined with Altona (8,20:r,[i]:z_6). The name Pikine has been dropped.
I	I	Pisa	16	i	l,w	
I	C_1	Planckendael	6,7	z_4,z_{23}	1,6	
I	V	Ploufragan	1,44	z_4,z_{23}	e,n,z_{15}	
I	D_2	Plymouth	9,46	d	z_6	
I	H	Poano	1,6,14,25	z	l,z_{13},z_{28}	
I	54	Poeseldorf	8,20,54	i	z_6	
I	C_1	Poitiers	6,7	z	1,5	
I	M	Pomona	28	y	1,7	Pomona may possess H phases Rz_{60}, Rz_{70} or Rz_{80}.
I	K	Pontypridd	18	g,m	–	
I	G	Poona	1,13,22	z	1,6	Poona may possess H phase Rz59.
I	C_2	Portanigra	8,20	d	1,7	
II	T	Portbech	42	l,v	e,n,x,z_{15}	
I	D_1	Portland	9,12	z_{10}	1,5	
I	E_2	Portsmouth	3,15	l,v	1,6	IP combined Portsmouth with London (3,10:l,v:1,6) to form London 3,10,[15]:l,v:1,6. Portsmouth is now called London var. O 15+ by IP.
I	K	Potengi	18	z	–	
I	H	Potosi	6,14	z_{36}	1,5	
I	C_1	Potsdam	6,7,14	l,v	e,n,z_{15}	
I	D_2	Potto	9,46	i	z_6	
I	D_1	Powell	9,12	y	1,7	
I	C_2	Praha	6,8	y	e,n,z_{15}	
I	E_1	Pramiso	3,10	c	1,7	
I	C_2	Presov	6,8	b	e,n,z_{15}	
I	B	Preston	1,4,12	z	l,w	
I	F	Pretoria	11	k	1,2	
I	D_1	Pullorum	1,9,12	–	–	IP combined Pullorum with Gallinarum (1,9,12:-:-). They must be identified biochemically.
I	G	Putten	13,23	d	l,w	
I	V	Quebec	44	c	e,n,z_{15}	
I	D_2	Quentin	9,46	d	1,6	
II	X	Quimbamba	47	d	z_{39}	
I	X	Quinhon	47	z_{44}	–	
I	C_2	Quiniela	6,8	c	e,n,z_{15}	
I	N	Ramatgan	30	k	1,5	
I	M	Ramsey	28	l,w	1,6	
II	T	Rand	42	z	e,n,x,z_{15}	
I	G	Raus	13,22	f,g	e,n,x	
I	K	Rawash	6,14,18	c	e,n,x	
I	B	Reading	1,4,[5],12	e,h	[1,5]	
I	C_2	Rechovot	8,20	e,h	z_6	
I	C_1	Redba	6,7	z_{10}	z_6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	F	Redhill	11	e,h	l,z_{13},z_{28}	
I	I	Redlands	16	z_{10}	e,n,z_{15}	
I	E_1	Regent	3,10	f,g,[s]	[1,6]	
I	B	Reinickendorf	4,12	l,z_{28}	e,n,x	
I	F	Remete	11	z_4,z_{23}	1,6	
I	C_2	Remiremont	8,20	z_{10}	l,w	
I	B	Remo	1,4,12,27	r	1,7	
I	C_2	Reubeuss	8,20	g,m,t	–	
II	D_1	Rhodesiense	9,12	d	e,n,x	
I	L	Rhone	21	c	e,n,x	
I	I	Rhydyfelin	16	e,h	e,n,x	
I	C_1	Richmond	6,7	y	1,2	
I	E_4	Rideau	1,3,19	f,g	–	
I	D_1	Ridge	9,12	c	z_6	
I	G	Ried	1,13,22	z_4,z_{23}	[e,n,z_{15}]	
I	C_1	Riggil	6,7	g,t	–	
I	R	Riogrande	40	b	1,5	
I	C_1	Rissen	6,7	f,g	–	IP combined Ardwick (6,7,14:f,g:-) with Rissen for form Rissen 6,7,14:f,g:-.
I	P	Rittersbach	38	b	e,n,z_{15}	
I	W	Riverside	45	b	1,5	
I	P	Roan	38	l,v	e,n,x	
I	Z	Rochdale	50	b	e,n,x	
II	51	Roggeveld	51	–	1,7	
I	M	Rogy	28	z_{10}	1,2	
I	G	Romanby	1,13,23	z_4,z_{24}	–	
I	G	Roodepoort	1,13,22	z_{10}	1,5	
II	H	Rooikrantz	1,6,14	m,t	1,5	
I	E_2	Rosenthal	3,15	b	1,5	IP combined Rosenthal and unnamed 3,15,34:b:1,5 with Butantan (3,10:b:1,5) to form Butantan 3,10,[15],[15,34]:b:1,5. Rosenthal is now called Butantan var. O 15+ by IP.
I	54	Rossleben	54	e,h	1,6	
I	D_1	Rostock	1,9,12	g,p,u	–	
IV	C_1	Roterberg	6,7	z_4,z_{23}	–	
I	P	Rothenburgsort	38	m,t	–	
II	G	Rotterdam	1,13,22	g,t	1,5	
I	G	Rottnest	1,13,22	b	1,7	
I	I	Rovaniemi	16	r,[i]	1,5	
II	I	Rowburton	16	m,t	[z_{42}]	
I	H	Royan	1,6,14,25	z	e,n,z_{15}	
I	D_1	Ruanda	9,12	z_{10}	e,n,z_{15}	
I	F	Rubislaw	11	r	[e,n,x]	
I	L	Ruiru	21	y	e,n,x	
I	B	Ruki	4,5,12	y	e,n,x	IP combined Ruki with Ball (1,4,12,27:y:e,n,x) and Dalat (4,5,27:y:e,n,x) to form Ball 1,4,[5],12,27:y:e,n,x. The name Ruki has been dropped.
I	C_1	Rumford	6,7	z_{38}	1,2	
I	H	Runby	1,6,14,25	c	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_1	Rutgers	3,10	Rl,z_{40}	1,7	Rutgers has been dropped from the scheme and the H phase Rl,z_{40} is now considered an R phase of Give.
I	E_1	Ruzizi	3,10	l,v	e,n,z_{15}	
I	D_1	Saarbruecken	1,9,12	a	1,7	
I	I	Saboya	16	e,h	1,5	
IV	R	Sachsenwald	1,40	z_4,z_{23}	–	
I	N	Sada	30	z_{10}	1,2	
I	52	Saintemarie	52	g,t	–	
I	B	Saintpaul	1,4,[5],12	e,h	1,2	
I	X	Saka	47	b	–	IP combined Saka with Sya (47:b:z_6) and called it Sya.
II	Y	Sakaraha	48	[k]	z_{39}	
I	I	Salford	16	l,v	e,n,x	
I	B	Salinatis	4,12	d,e,h	d,e,n,z_{15}	IP states that Salinatis was combined with Duisburg (1,4,12,27:d:e,n,z_{15}). This is incorrect; IP should have stated that it was combined with Sandiego (4,[5],12:e,h:e,n,z_{15}), because Salinatis loses the d and becomes Sandiego.
I	I	Saloniki	16	z_{29}	–	
I	S	Samaru	41	i	1,5	
I	E_4	Sambre	1,3,19	z_4,z_{24}	–	
I	B	Sandiego	4,[5],12	[e,h]	e,n,z_{15}	
I	C_2	Sandow	6,8	f,g	e,n,z_{15}	
I	C_2	Sanga	8	b	1,7	
I	D_2	Sangalkam	9,46	m,t	–	
I	I	Sangera	16	b	e,n,z_{15}	
I	C_1	Sanjuan	6,7	a	1,5	
I	M	Sanktgeorg	28	r,[i]	e,n,z_{15}	
I	E_4	Sanktmarx	1,3,19	e,h	1,7	
I	M	Santander	28	z_{35}	e,n,z_{15}	
I	R	Santhiaba	40	l,z_{28}	1,6	
I	C_2	Santiago	8,20	c	e,n,x	
I	E_4	Sao	1,3,19	e,h	e,n,z_{15}	
I	I	Saphra	16	y	1,5	
I	H	Sara	1,6,14,25	z_{38}	[e,n,x]	
I	B	Sarajane	1,4,[5],12,27	d	e,n,x	
II	I	Sarepta	16	l,z_{28}	z_{42}	
I	R	Saugus	40	b	1,7	
I	H	Schalkwijk	6,14,[24]	i	e,n,..	
I	B	Schleissheim	4,12,27	b	–	
I	E_4	Schoeneberg	1,3,19	z	e,n,z_{15}	
I	C_1	Schwabach	6,7	c	1,7	
I	B	Schwarzengrund	1,4,12,27	d	1,7	
I	C_2	Schwerin	6,8	k	e,n,x	
I	I	Sculcoates	16	d	1,5	
II	Z	Seaforth	50	k	z_6	
I	M	Seattle	28	a	e,n,x	
I	V	Sedgwick	44	b	e,n,z_{15}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_1	Seegefeld	3,10	r,[i]	1,2	
I	E_1	Sekondi	3,10	e,h	z_6	
I	E_2	Selandia	3,15	e,h	1,7	IP combined Selandia with Nyborg (3,10:e,h:1,7) to form Nyborg 3,10,[15]:e,h:1,7. Selandia is now called Nyborg var. O 15+ by IP.
I	M	Selby	28	y	z_6	
IV	R	Seminole	1,40	g,z_{51}	–	
I	D_1	Sendai	1,9,12	a	1,5	Sendai must be differentiated from Miami with biochemical tests. Sendai is neg. for H_2S, citrate, and tartrate; Miami is pos.
I	F	Senegal	11	r	1,5	
I	E_4	Senftenberg	1,3,19	g,[s],t		Senftenberg may possess H phase Rz_{37} or Rz_{43} or Rz_{45} or Rz_{46}. Simsbury (1,3,19:Rz_{27}:-) is now considered an H phase Rz_{27} of Senftenberg.
I	N	Senneville	30	z_{10}	1,5	
I	D_1	Seremban	9,12	i	1,5	
I	E_1	Serrekunda	3,10	k	1,7	
II	60	Setubal	60	g,m,t	z_6	
I	I	Shamba	16	c	e,n,x	
I	E_1	Shangani	3,10	d	1,5	IP combined Pankow (3,15:d:1,5) with Shangani to form Shangani 3,10,[15]:d:1,5.
ßßI	I	Shanghai	16	l,v	1,6	
I	E_1	Shannon	3,10	z_{35}	l,w	
I	F	Sharon	11	k	1,6	
I	P	Sheffield	38	c	1,5	
I	I	Sherbrooke	16	d	1,6	
I	R	Shikmonah	40	a	1,5	
I	C_2	Shipley	8,20	b	e,n,z_{15}	
I	M	Shomolu	28	y	l,w	
IIIa	K	Shomron	18	z_4,z_{32}	–	Shomron was formerly in Subspecies II, but is now combined with *Arizona* 7a,7b:1,7,8:-. The name Shomron has been dropped.
I	D_2	Shoreditch	9,46	r	e,n,z_{15}	
I	B	Shubra	4,[5],12	z	1,2	
I	S	Sica	41	b	e,n,z_{15}	
I	K	Siegburg	6,14,18	z_4,z_{23}	[1,5]	IP combined Siegburg with Cerro (18:z_4,z_{23}:[1,5]) to form Cerro 6,14,18:z_4,z_{23}:[1,5]. Siegburg is now called Cerro var. O 14+. The name Siegburg has been dropped.
I	E_1	Simi	3,10	r	e,n,z_{15}	
II	H	Simonstown	1,6,14	z10	1,5	
I	E_4	Simsbury	1,3,19	Rz_{27}	–	IP combined Simsbury with Senftenberg 1,3,19:g,[s],t:-. Simsbury is now considered an R phase of Senftenberg. The name Simsbury has been dropped.
I	E_1	Sinchew	3,10	l,v	z_{35}	
I	C_2	Sindelfingen	8,20	y	l,w	
I	C_1	Singapore	6,7	k	e,n,x	
I	E_1	Sinstorf	3,10	l,v	1,5	
I	K	Sinthia	18	z_{38}	–	
I	T	Sipane	1,42	r	e,n,z_{15}	
I	C_2	Skansen	6,8	b	1,2	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_4	Slade	1,3,19	y	e,n,z_{15}	
I	B	Sladun	1,4,12,27	b	e,n,x	IP combined Sladun with Abony (1,4,5,12:b:e,n,x) to form Abony 1,4,[5],12,27:b:e,n,x. Sladun is now called Abony var. O 27+. The name Sladun has been
II	H	Slangkop	1,6,14	z_{10}	z_6:z_{42}	
II	N	Slatograd	30	g,t	–	
I	X	Sljeme	1,47	f,g	–	
I	B	Sloterdijk	1,4,12,27	z_{35}	z_6	
I	H	Soahanina	6,14,24	z	e,n,x	
I	N	Soerenga	30	i	l,w	
IV	L	Soesterberg	21	z_4,z_{23}	–	
II	B	Sofia	1,4,12,27	b	[e,n,x]	
I	D_2	Sokode	9,46	r	z_6	
I	M	Solna	28	a	1,5	
I	F	Solt	11	y	1,5	
I	C_1	Somone	6,7	z_4,z_{24}	–	
I	M	Soumbedioune	28	b	e,n,x	
I	B	Southampton	1,4,12,27	r	z_6	
I	E_1	Southbank	3,10,15,34	m,t	[1,6]	
II	F	Soutpan	11	z	z_{39}	
I	E_1	Souza	3,10	d	e,n,x	IP combined Eschersheim (3,15:d:e,n,x) with Souza to form Souza 3,10,[15]:d:e,n,x.
I	T	Spalentor	1,42	y	e,n,z_{15}	
I	L	Spartel	21	d	1,5	
I	V	Splott	44	g,s,t	–	
II	R	Springs	40	a	z_{39}	
VI	F	Srinagar	11	b	e,n,x	
I	P	Stachus	38	z	–	
I	B	Stanley	4,5,12	d	1,2	IP combined Cairo (1,4,12,27:d:1,2) with Stanley to form Stanley 1,4,[5],12,27:d:1,2
I	B	Stanleyville	1,4,[5],12	z_4,z_{23}	[1,2]	IP combined Jaja (4,12,27:z_4,z_{23}:-) with Stanleyville to form Stanleyville 1,4,[5],12,27:z_4,z_{23}:[1,2].
I	X	Staoueli	47	k	1,2	
I	N	Steinplatz	30	y	1,6	
I	54	Steinwerder	3,15,54	y	1,5	
II	D_1	Stellenbosch	1,9,12	z	1,7	
I	X	Stellingen	47	d	[e,n,x]	
I	F	Stendal	11	l,v	1,2	
I	N	Sternschanze	30	g,s,t	–	Sternschanze may possess H phase Rz_{59}.
I	C_2	Sterrenbos	6,8	d	e,n,x	
II	G	Stevenage	1,13,23	[z_{42}]	1,[5],7	
II	E_1	Stikland	3,10	m,t	e,n,x	
I	E_1	Stockholm	3,10	y	z_6	IP combined Tournai (3,15:y:z6) with Stockholm to form Stockholm 3,10,[15]:y:z_6.
I	N	Stoneferry	30	z_4,z_{23}	–	
I	E_1	Stormont	3,10	d	1,2	
I	C_2	Stourbridge	6,8	b	1,6	
I	F	Straengnaes	11	z_{10}	1,5	
I	D_2	Strasbourg	9,46	d	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	E_4	Stratford	1,3,19	i	1,2	
I	C_1	Strathcona	6,7	l,z_{13},z_{28}	1,7	
I	E_4	Stuivenberg	1,3,19	l,z_{13},z_{28}	1,5	
I	C_1	Stuttgart	6,7,14	i	z_6	
II	R	Suarez	1,40	c	e,n,x,z_{15}	
I	E_1	Suberu	3,10	g,m	–	
I	U	Sudan	43	l,z_{13}	–	
II	D_1	Suederelbe	1,9,12	b	z_{39}	
I	W	Suelldorf	45	f,g	–	
II	C_1	Sullivan	6,7	z_{42}	1,7	
I	H	Sundsvall	[1],6,14,[25]	z	e,n,x	
I	C_2	Sunnycove	8	y	e,n,x	
II	R	Sunnydale	1,40	k	e,n,x,z_{15}	
I	H	Surat	[1],6,14,[25]	[r],[i]	e,n,z_{15}	
I	E_4	Svedvi	1,3,19	l,v	e,n,z_{15}	
I	X	Sya	47	b	z_6	
IIIb	Y	Sydney	48	i	z	Sydney was formerly in subspecies II, but it is now combined with *Arizona* 5:33:31. The name Sydney has been dropped.
I	H	Sylvania	[1],6,14,[25]	g,p	–	
I	I	Szentes	16	k	1,2	
I	X	Tabligbo	47	z_4,z_{23}	[e,n,z_{15}]	
I	C_2	Tado	8,20	c	z_6	
II	E_1	Tafelbaai	3,10	z	z_{39}	
I	B	Tafo	1,4,12,27	z_{35}	1,7	
I	C_2	Takoradi	6,8	i	1,5	
I	E_4	Taksony	1,3,19	[i]	z_6	
I	C_2	Tallahassee	6,8	z_4,z_{32}	–	
I	C_2	Tamale	8,20	z_{29}	[e,n,z_{15}]	
I	E_4	Tambacounda	1,3,19	b	e,n,x	
I	X	Tamberma	47	z_4,z_{24}	–	
I	C_1	Tamilnadu	6,7	z_{41}	z_{35}	
I	C_1	Tampico	6,7	z_{36}	e,n,z_{15}	
I	C_2	Tananarive	6,8	y	1,5	
I	G	Tanger	1,13,22	y	1,6	
I	G	Tanzania	1,13,22	z	e,n,z_{15}	
I	D_1	Tarshyne	9,12	d	1,6	
I	T	Taset	1,42	z_{41}	–	
I	M	Taunton	28	k	e,n,x	
I	O	Tchad	35	b	–	
I	J	Tchamba	17	z	e,n,z_{15}	
I	M	Techimani	28	c	z_6	
I	B	Teddington	1,4,12,27	y	1,7	
I	I	Tees	16	f,g	–	
I	B	Tejas	4,12	z_{36}	–	
I	H	Teko	1,6,14,25	d	e,n,z_{15}	
I	M	Telaviv	28	y	e,n,z_{15}	
I	G	Telelkebir	13,23	d	e,n,z_{15}	
I	F	Telhashomer	11	z_{10}	e,n,x	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	M	Teltow	28	z_4,z_{23}	1,6	
I	T	Tema	1,42	z_{35}	z_6	
I	C_1	Tennessee	6,7,14	z_{29}	[1,2,7]	
I	B	Tennyson	4,5,12	g,z_{51}	e,n,z_{15}	
I	X	Teshie	1,47	l,z_{13},z_{28}	e,n,z_{15}	
I	B	Texas	4,[5],12	k	e,n,z_{15}	
I	B	Thayngen	1,4,12,27	z_{41}	1,(2),5	
I	U	Thetford	43	k	1,2	
I	P	Thiaroye	38	e,h	1,2	
I	C_1	Thielallee	6,7,14	m,t	–	IP combined Thielallee with Oranienburg (6,7:m,t:-) to form Oranienburg 6,7,14:m,t:-. Theilallee is now called Oranienburg var. O 14+ by IP.
I	E_4	Thies	1,3,19	y	1,7	
I	E_3	Thomasville	3,15,34	y	1,5	IP combined Thomasville and Binza (3,15:y:1,5) with Orion (3,10:y:1,5) to form Orion 3,10,[15],[15,34]:y:1,5. Thomasville is now called Orion var. O 15+ by IP.
I	C_1	Thompson	6,7,14	[k]	[1,5]	IP combined Cardiff that contains H phase R1,10 (6,7:k:R1,10) with Thompson.
I	C_1	Tienba	6,7	z_{35}	1,6	
I	V	Tiergarten	44	a	e,n,x	
I	R	Tiko	40	l,z_{13},z_{28}	1,2	
I	E_4	Tilburg	1,3,19	d	l,w	Tilburg may possess H phase Rz_{49}.
I	R	Tilene	1,40	e,h	1,2	
I	B	Tinda	1,4,5,27	a	e,n,z_{15}	
I	51	Tione	51	a	e,n,x	
I	I	Togba	16	a	e,n,x	
I	B	Togo	4,12	l,w	1,6	
II	57	Tokai	57	z_{42}	$1,6:z_{53}$	
I	B	Tokoin	4,12	z_{10}	e,n,z_{15}	
I	T	Tomegbe	1,42	b	e,n,z_{15}	
I	E_4	Tomelilla	1,3,19	l,z28	1,7	
I	54	Tonev	21,54	b	e,n,x	
I	F	Toowong	11	a	1,7	
I	N	Torhout	30	e,h	1,5	
I	T	Toricada	1,42	z_4,z_{24}	–	
I	W	Tornow	45	g,m,[s],[t]	–	
I	D_2	Toronto	9,46	l,v	$e,n,x;[z_{44}]$	
II	C_1	Tosamanga	6,7	z	1,5	
I	Y	Toucra	48	z	1,5	Toucra may possess H phase Rz_{58}.
I	K	Toulon	18	l,w	e,n,z_{15}	
I	C_2	Tounouma	8,20	b	z_6	
I	E_2	Tournai	3,15	y	z_6	IP combined Tournai with Stockholm (3,10:y:z_6) to form Stockholm 3,10,[15]:y:z_6. Tournai is now called Stockholm var. O 15+ by IP.
I	B	Trachau	4,12,27	y	1,5	
II	55	Tranoroa	55	k	z_{39}	
I	W	Transvaal	45	z_4,z_{24}	-	
I	B	Travis	4,[5],12	g,z_{51}	1,7	
I	51	Treforest	1,51	z	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	D1	Treguier	1,9,12	z_{10}	z_6	
I	I	Trier	16	z_{35}	1,6	
I	D_2	Trimdon	9,46	z_{35}	z_6	
I	B	Tripoli	1,4,12,27	b	z_6	
I	R	Trotha	40	z_{10}	z_6	
I	E_1	Truro	3,10	i	1,7	
I	G	Tschangu	1,13,23	e,h	1,5	
I	B	Tsevie	4,12	i	e,n,z_{15}	
I	C_2	Tshiongwe	6,8	e,h	e,n,z_{15}	
I	H	Tucson	[1],6,14,[25]	b	[1,7]	
I	B	Tudu	4,12	z_{10}	1,6	
I	E_2	Tuebingen	3,15	y	1,2	IP combined Tuebingen with Amager (e,10:y:1,2) to form Amager 3,10,[15]:y:1,2. Tuebingen is now called Amager var. O 15+ by IP.
IV	U	Tuindorp	43	z_4,z_{32}	–	
II	C_2	Tulear	6,8	a	z_{52}	
I	B	Tumodi	1,4,12	i	z_6	
I	G	Tunis	1,13,23	y	z_6	
II	G	Tygerberg	1,13,23	a	z_{42}	
I	D_1	Typhi	9,12,[Vi]	d	–	Typhi may possess H phase Rj or Rz_{66}.
I	B	Typhimurium	1,4,5,12	i	1,2,[7]	
I	B	Typhimurium var. Copenhagen		1,4,12	i	1,2
I	C_1	Typhisuis	6,7	c	1,5	Typhisuis is a bioserotype found in pigs. It is like Choleraesuis except tartrate negative.
I	B	Tyresoe	4,12	l,[z_{13}],z_{28}	1,5	
I	54	Uccle	3,54	g,s,t	–	
I	E_1	Uganda	3,10,15	l,z_{13}	1,5	
I	E_1	Ughelli	3,10	r	1,5	
I	V	Uhlenhorst	44	z	l,w	
I	52	Uithof	52	a	1,5	
I	G	Ullevi	1,13,23	b	e,n,x	
I	M	Umbilo	28	z_{10}	e,n,x	
I	C_1	Umhlali	6,7	a	1,6	
I	O	Umhlatazana	35	a	e,n,z_{15}	
I	C_2	Uno	6,8	z_{29}	[e,n,z_{15}]	
II	T	Uphill	42	b	e,n,x,z_{15}	
I	B	Uppsala	4,12,27	b	1,7	
I	N	Urbana	30	b	e,n,x	
I	T	Ursenbach	1,42	z	1,6	
I	K	Usumbura	6,14,18	d	1,7	
I	C_2	Utah	6,8	c	1,5	
II	O	Utbremen	35	z_{29}	e,n,x	
I	52	Utrecht	52	d	1,5	
I	H	Uzaramo	1,6,14,25	z_4,z_{24}	–	
I	G	Vaertan	13,22	b	e,n,x	
I	C_2	Valdosta	6,8	a	1,2	
I	I	Vancouver	16	c	1,5	
I	M	Vanier	28	z	1,5	
I	S	Vaugirard	41	b	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	U	Veddel	43	g,t	–	
I	I	Vegesack	16	b	l,w	
I	E_1	Vejle	3,10	e,h	1,2	IP combined Goerlitz (3,15:e,h:1,2) with Vejle to form Vejle 3,10,[15]:e,h:1,2.
I	B	Vellore	1,4,12,27	z_{10}	z_{35}	
I	F	Veneziana	11	i	e,n,x	
II	J	Verity	17	e,n,x,z_{15}	1,6	
I	S	Verona	41	i	1,6	
I	W	Verviers	45	k	1,5	
I	D_1	Victoria	1,9,12	l,w	1,5	
I	J	Victoriaborg	17	c	1,6	
I	S	Vietnam	41	b	z_6	
II	S	Vietnam var. subsp. II	41	b	–	
I	E_4	Vilvoorde	1,3,19	e,h	1,5	
I	M	Vinohrady	28	m,t	[e,n,z_{15}]	
I	C_1	Virchow	6,7	r	1,2	
I	C_2	Virginia	8	d	[1,2]	
I	E_4	Visby	1,3,19	b	1,6	
I	M	Vitkin	28	l,v	e,n,x	
I	V	Vleuten	44	f,g	–	
I	T	Vogan	1,42	z_{38}	z6	
IV	U	Volksdorf	43	z_{36},z_{38}	–	
I	M	Volksmarsdorf	28	i	1,6	
I	F	Volta	11	r	l,z_{13},z_{28}	
I	B	Vom	1,4,12,27	l,[z_{13}],[z_{28}]	e,n,z_{15}	
I	U	Voulte	43	i	e,n,x	
II	G	Vredelust	1,13,23	l,z_{28}	z_{42}	
I	G	Vridi	1,13,23	e,h	l,w	
VI	W	Vrindaban	45	a	e,n,x	
I	B	Vuadens	4,12,27	z_4,z_{23}	z_6	
I	I	Wa	16	b	1,5	
I	D_2	Waedenswil	9,46	e,h	1,5	
I	E_1	Wagadugu	3,10	z_4,z_{23}	z_6	
I	B	Wagenia	1,4,12,27	b	e,n,z_{15}	
II	L	Wandsbek	21	z_{10}	[z_6]	
I	Q	Wandsworth	39	b	1,2	
I	D_1	Wangata	1,9,12	z_4,z_{23}	[1,7]	
I	T	Waral	1,42	m,t	–	
I	J	Warengo	17	z	1,5	
I	W	Warmsen	45	d	e,n,z_{15}	
I	M	Warnemuende	28	i	e,n,x	
I	C_2	Warnow	6,8	i	1,6	
I	H	Warragul	[1],6,14,[25]	g,m	–	
I	J	Warri	17	k	1,7	
I	G	Washington	13,22	m,t	–	
IV	Z	Wassenaar	50	g,z_{51}	–	
I	S	Waycross	41	z_4,z_{23}	[e,n,z_{15}]	
IV	S	Waycross var. subsp.IV	41	z_4,z_{23}	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	N	Wayne	30	g,z_{51}	–	
I	M	Wedding	28	c	e,n,z_{15}	
I	I	Welikade	16	l,v	1,7	
I	E_1	Weltevreden	3,10	r	z_6	IP combined Lanka 3,15:r:z_6 with Weltevreden to form Weltevreden 3,10,[15]:r:z_6.
I	X	Wenatchee	47	b	1,2	
I	F	Wentworth	11	z_{10}	1,2	
I	D_2	Wernigerode	9,46	f,g	–	
I	T	Weslaco	42	z_{36}	–	
I	D_1	Westafrica	9,12	e,h	1,7	
I	I	Westeinde	16	l,w	1,6	
I	E_4	Westerstede	1,3,19	l,z_{13}	[1,2]	
I	E_1	Westhampton	3,10	g,s,t	–	IP combined Halmstad (3,15:g,s,t:-) and Canoga (3,15,34:g,s,t:-) with Westhampton to form Westhampton 3,10,[15],[15,34]:g,s,t:-. Westhampton may possess H phase Rz_{37} or Rz_{43} or Rz_{45}.
I	E_1	Westminster	3,10,[15]	b	z_{35}	CDC has no 3,10:b:z35.
I	I	Weston	16	e,h	z6	
II	E_1	Westpark	3,10	l,z_{28}	e,n,x	
I	O	Westphalia	35	z_4,z_{24}	–	
I	E_1	Weybridge	3,10	d	z_6	
I	G	Wichita	1,13,23	d	1,6	Wichita may possess H phase Rz_{37}.
I	O	Widemarsh	35	z_{29}	–	
I	B	Wien	1,4,12,27	b	l,w	
I	C_1	Wil	6,7	d	l,z_{13},z_{28}	
I	E_3	Wildwood	3,15,34	e,h	l,w	IP combined Wildwood and Cambridge (3,15:e,h:l,w) with Meleagridis (3,10:e,h:l,w) to form Meleagridis 3,10,[15],[15,34]:e,h:l,w. Wildwood is now called Meleagridis var. O 15+, 34+ by IP.
I	B	Wilhelmsburg	1,4,[5],12,27	z_{38}	[e,n,z_{15}]	
II	52	Wilhemstrasse	52	z_{44}	1,5	IP combined Wilhemstrasse with Lobatsi (52:z_{44}:1,5,7). The name Wilhemstrasse has been dropped.
I	G	Willemstad	1,13,22	e,h	1,6	
I	E_1	Wilmington	3,10	b	z_6	
I	E_1	Wimborne	3,10	k	1,2	
II	E_1	Winchester	3,10	z_{39}	1,[5],7	
I	Q	Windermere	39	y	1,5	
II	W	Windhoek	45	g,m,s,t	1,5	
I	C_2	Wingrove	6,8	c	1,2	
I	B	Winneba	4,12	r	1,6	
I	54	Winnipeg	54	e,h	1,5	
I	C_1	Winston	6,7	m,t	1,6	
I	E_4	Winterthur	1,3,19	l,z_{13}	1,6	
I	C_2	Wippra	6,8	z_{10}	z_6	
I	I	Wisbech	16	i	1,7	
II	J	Woerden	17	c	z_{39}	
I	F	Wohlen	11	b	1,6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
I	B	Womba	4,12,27	c	1,7	IP combined Womba with Altendorf (4,12:c:1,7) to form Altendorf 4,12,27:c:1,7. Womba is now called Altendorf var. O 27+. The name Womba has been dropped.
I	H	Woodhull	1,6,14,25	d	1,6	
I	F	Woodinville	11	c	e,n,x	
II	I	Woodstock	16	z_{42}	1,[5],7	
I	D_2	Worb	9,46	b	e,n,x	
II	G	Worcester	1,13,23	m,t	e,n,x	
I	G	Worthington	1,13,23	z	l,w	Worthington may possess H phase Rz_{45}.
I	N	Wuiti	30	z_{35}	e,n,z_{15}	
I	D_2	Wuppertal	9,46	z_{41}	–	
I	G	Wyldegreen	1,13,23	a	l,w	
II	D_1	Wynberg	1,9,12	z_{39}	1,7	
I	E_1	Yaba	3,10,[15]	b	e,n,z_{15}	
I	E_4	Yalding	1,3,19	r	e,n,z_{15}	
I	B	Yaounde	1,4,12,27	z_{35}	e,n,z_{15}	
I	M	Yardley	28	g,m	1,6	
I	C_2	Yarm	6,8	z_{35}	1,2	
I	G	Yarrabah	13,23	y	1,7	
I	E_1	Yeerongpilly	3,10	i	z_6	
I	F	Yehuda	11	z_4,z_{24}	–	
I	R	Yekepa	1,40	z_{35}	e,n,z_{15}	
I	54	Yerba	54	z_4,z_{23}	–	
I	P	Yoff	38	z_4,z_{23}	1,2	
I	C_2	Yokoe	8,20	m,t	–	
I	O	Yolo	35	c	[e,n,z_{15}]	
I	W	Yopougon	45	z	e,n,z_{15}	
I	I	Yoruba	16	c	l,w	
I	C_2	Yovokome	8,20	d	1,5	
I	E_1	Yundum	3,10	k	e,n,x	
I	D_2	Zadar	9,46	b	1,6	
I	D_1	Zaiman	9,12	l,v	e,n,x	
I	N	Zaire	30	c	1,7	
I	E_1	Zanzibar	3,10,[15]	k	1,5	
I	J	Zaria	17	k	e,n,z15	
I	D_1	Zega	9,12	d	z6	
I	N	Zehlendorf	30	a	1,5	
II	K	Zeist	18	z_{10}	z_6	
I	C_2	Zerifin	6,8	z_{10}	1,2	
I	I	Zigong	16	l,w	1,5	
I	V	Zinder	44	z_{29}	–	
I	E_1	Zongo	3,10	z_{35}	1,7	
II	D_3	Zuerich	1,9,12,46,27	c	z_{39}	
I	E_4	Zuilen	1,3,19	i	l,w	
I	I	Zwickau	16	r,i	e,n,z_{15}	
II	B		1,4,[5],12,27	a	e,n,x	
II	B		1,4,12,27	a	z_{39}	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	B		4,12	b	1,5	
II	B		4,12	e,n,x	1,2,7	
II	B		4,[5],12	f,g,t	z_6,z_{42}	
II	B		4,12	(f),g	–	Not in IP book
II	B		4,12	g,m,t	z_{39}	
II	B		4,12	g,m,t	–	IP calls this monophasic var. of Bechuana.
II	B		4,12	g,z_{62}	–	
II	B		4,12,27	i	z_{35}	
II	B		1,4,12,27	k	1,6	
II	B		1,4,12,27	l,v	e,n,x	
II	B		1,4,12,27	l,v	z_{39}	
II	B		4,12	l,z_{28}	–	
II	B		1,4,12,27	z	1,5	
II	B		4,12	z	1,7	
II	B		4,12	z	z_{39}	
II	B		4,12	–	1,6	
II	C_1		6,7,14	a	1,5	
II	C_1		6,7	a	z_6	
II	C_1		6,7	b	z_{39}	
II	C_1		6,7	d	z_{42}	
II	C_1		6,7	g,m,[s],t	e,n,x	
II	C_1		6,7	(g),m,[s],t	[1,5]	
II	C_1		6,7	g,[m],s,t	[z_{42}]	
II	C_1		6,7	g,t	e,n,x:z_{42}	
IV	C_1		6,7	g,z_{51}	–	
II	C_1		6,7	k	[z6]	
IIIa	C_1		6,7	(k)	z:[z_{55}]	(Ar. 27:22:31:[37])
IIIb	C_1		6,7	l,v	z_{53}	(Ar. 27:23:25)
II	C_1		6,7	l,w	1,5,7	
II	C_1		6,7	l,w	z_{42}	
II	C_1		6,7	l,z_{28}	e,n,x	
II	C_1		6,7	l,z_{28}	z_6	
II	C_1		6,7	m,t	–	
II	C_1		6,7	z	z_6	
II	C_1		6,7	z	z_{39}	
II	C_1		6,7	z_4,z_{24}	z_{42}	
II	C_1		6,7	z_{10}	z_{35}	
II	C_1		6,7	z_{29}	–	
VI	C_1		6,7	z_{41}	1,7	
II	C_1		6,7	z_{42}	e,n,x:1,6	
II	C_1		6,7	–	1,6	
II	C_2		6,8	a	e,n,x	
II	C_2		6,8	a	z_{39}	
II	C_2		6,8	b	1,5	
II	C_2		6,8	d	z_6:z_{42}	
II	C_2		6,8	f,g,m,t	[e,n,x]	
II	C_2		6,8	g,m,t	1,7	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	C_2		6,8	l,v	e,n,x	
II	C_2		6,8	l,w	z_6:z_{42}	
II	C_2		6,8	l,z_{28}	e,n,x	
II	C_2		6,8	y	1,6:z_{42}	
II	C_2		6,8	z	1,5	
II	C_2		6,8	z_{29}	1,5	
II	C_2		8	z_{29}	e,n,x:z_{42}	
II	C_2		6,8	z_{29}	e,n,x	
II	C_2		6,8	–	1,5,7	
II	D_1		9,12	a	1,5	
II	D_1		1,9,12	a	e,n,x	
II	D_1		9,12	a	z_{39}	
II	D_1		1,9,12	a	z_{42}	
II	D_1		9,12	d	z_{39}	
II	D_1		9,12	e,n,x	1,6	
II	D_1		1,9,12	g,m,[s],t	[1,5,7]:[z_{42}]	
II	D_1		1,9,12	g,z_{62}	–	
II	D_1		9,12	l,v	e,n,x	
II	D_1		9,12	l,v	z_{39}	
II	D_1		9,12	l,z_{28}	1,5:[z_{42}]	
II	D_1		9,12	l,z_{28}	e,n,x	
II	D_1		1,9,12	m,t	1,5	
II	D_1		1,9,12	m,t	z_{39}	
II	D_1		9,12	m,t	–	
II	D_1		1,9,12	z_{29}	e,n,x	
II	D_1		1,9,12	z_{42}	1,[5],7	
II	D_2		9,46	e,n,x	1,5,7	
II	D_2		9,46	g,z_{62}	–	
II	D_2		9,46	m,t	e,n,x	
II	D_2		9,46	z	1,5	
II	D_2		9,46	z_{10}	z_{39}	
II	D_2		9,46	z_{10}	z_6	
II	D_2		9,46	z_{39}	1,7	
II	D_3		9,12,46,27	g,t	e,n,x	
II	D_3		1,9,12,46,27	l,z_{13},z_{28}	z_{39}	
II	D_3		1,9,12,46,27	y	z_{39}	
II	D_3		1,9,12,46,27	z_{10}	1,5	
II	D_3		1,9,12,46,27	z_{10}	e,n,x	
II	D_3		1,9,12,46,27	z_{10}	z_{39}	
II	D_3		1,9,12,46,27	z_4,z_{24}	[1,5]	
II	E_1		3,10	a	z_{39}	
II	E_1		3,10	b	e,n,x	
II	E_1		3,10	b	z_{39}	
II	E_1		3,10	d	e,n,x	
II	E_1		3,10	l,v	e,n,x	
II	E_1		3,10	l,z_{28}	1,5	
II	E_1		3,10	l,z_{28}	z_{39}	
II	E_1		3,10	m,t	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	E_1		3,10	z_4,z_{24}	–	
II	E_1		3,10	z_{29}	e,n,x	
II	E_1		3,10	z_{29}	–	
VI	F		11	a	1,5	
VI	F		11	b	1,7	
II	F		11	c	e,n,z_{15}	
IIIb	F		11	k	z53	(Ar. 17:29:25)
IIIb	F		11	l,v	z	(Ar. 17:23:31). May possess H phase Rz_{56} (Ar. 38).
IIIb	F		11	l,v	z_{53}	(Ar. 17:23:25)
II	F		11	z	e,n,x	
IIIa	F		11	z_4,z_{23}	–	(Ar. 17:1,2,5:-)
IV	F		11	z_4,z_{32}	–	
II	F		11	–	1,5	
II	G		1,13,23	a	1,5	
II	G		13,22	a	e,n,x	
II	G		1,13,22	b	z_{42}	
II	G		13,23	d	e,n,x	
II	G		1,13,23	d	e,n,z_{15}	
II	G		1,13,23	g,m,s,t	1,5	
II	G		1,13,23	g,m,s,t	z_{42}	
II	G		1,13,23	g,[s],t	z_{42}	
IIIa	G		1,13,23	g,51	–	(Ar. 18:13,14:-)
V	G		1,13,22	i	–	
II	G		13,22	k	1,5:z_{42}	
II	G		13,23	k	z_{41}	
IIIb	G		13,22	l,v	1,5,7	(Ar. 18:23:30)
II	G		13,23	l,w	e,n,x	
II	G		13,22	l,z_{28}	1,5	
II	G		13,23	l,z_{28}	1,5	
II	G		13,23	l,z_{28}	z_6	
II	G		13,22	m,t	z_{42}:z_{39}	
V	G		13,22	r	–	
II	G		13,22	z	–	
II	G		1,13,23	z	z_{42}	
IIIa	G		13,22	z_4,z_{23}	–	(Ar. 18:1,2,5:-)
IIIa	G		13,23	z_4,z_{23},z_{32}	–	(Ar. 18:1,6,7:-). CDC would call this 1,6,7,9.
IIIa	G		1,13,23	z_4,z_{24}	–	(Ar. 18:1,3,11:-)
II	G		1,13,22	z_{10}	z_6	
II	G		1,13,23	z_{29}	1,5	
II	G		1,13,23	z_{29}	e,n,x	
II	G		1,13,23	z_{39}	1,5,7	
II	G		13,22	z_{39}	1,7	
II	G		13,23	–	1,6	
VI	H		[1],6,14	a	1,5	
IIIb	H		(6),14	b	e,n,x,z_{15}	(Ar. 7a,7c:43:28)
II	H		6,14,[24]	k	1,6	
II	H		6,14	k	[e,n,x]	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	H		(6),14	k	z	(Ar. 7a,7c:29:31)
II	H		1,6,14	k	z_6:z_{42}	
IIIb	H		(6),14	k	z_{53}	(Ar. 7a,7c:29:25)
IIIb	H		(6),14	l,v	z	(Ar. 7a,7c:23:31)
IIIb	H		(6),14	l,v	z_{35}	(Ar. 7a,7c:23:21)
IIIb	H		(6),14	l,v	z_{53}	(Ar. 7a,7c:23:25)
IIIb	H		(6),14	r	z	(Ar. 7a,7c:24:31)
IV	H		6,14	z_4,z_{23}	-	
IIIb	H		(6),14	z_{10}	e,n,x,z_{15}	(Ar. 7a,7c:27:28)
IIIb	H		(6),14	z_{10}	z:[z_{53}]	(Ar. 7a,7c:27:31:[25])
IIIb	H		(6),14	z_{10}	z_{53}	(Ar. 7a,7c:27:25)
II	H		1,6,14	z_{42}	1,6	
IIIb	H		(6),14	z_{52}	e,n,x,z_{15}	(Ar. 7a,7c:26:28)
IIIb	H		(6),14	z_{52}	z_{35}	(Ar. 7a,7c:26:21)
II	I		16	b	e,n,x	
II	I		16	b	z_{39}	
II	I		16	b	z_{42}	
II	I		16	d	1,5	
II	I		16	g,[m],[s],t	z_{42}	
IIIb	I		16	i	z_{35}	(Ar. 25:33:21)
IIIb	I		16	k	z	(Ar. 25:29:31)
IIIb	I		16	k	z_{53}	(Ar. 25:29:25)
IIIb	I		16	(k)	z_{35}	(Ar. 25:22:21)
IIIb	I		16	l,v	1,5,7	(Ar. 25:23:30)
IIIb	I		16	l,v	z:[z_{61}]	(Ar. 25:23:31:[41])
IIIb	I		16	l,v	z_{35}	(Ar. 25:23:21)
IIIb	I		16	l,v	z_{53}	(Ar. 25:23:25)
II	I		16	m,t	e,n,x	
II	I		16	z	z_{42}	
II	I		16	z_4,z_{24}	–	
II	I		16	z_6	1,6	
IIIb	I		16	z_{10}	1,5,7	(Ar. 25:27:30)
IIIb	I		16	z_{10}	e,n,x,z_{15}	(Ar. 25:27:28)
II	I		16	z_{29}	1,5	
IV	I		16	z_{36}	–	
IIIb	I		16	z_{52}	z_{35}	(Ar. 25:26:21)
II	J		17	b	z_6	
II	J		17	e,n,x,z_{15}	1,[5],7	
II	J		17	g,m,s,t	–	
II	J		17	g,t	z_{39}	
IIIb	J		17	i	z_{35}	(Ar. 12:33:21)
IIIb	J		17	k	z	(Ar. 12:29:32)
II	J		17	k	–	
IIIb	J		17	l,v	e,n,x,z_{15}	(Ar. 12:23:28)
IIIb	J		17	l,v	z_{35}	(Ar. 12:23:21)
II	J		17	m,t	–	
IIIb	J		17	r	z	(Ar. 12:24:31)
II	J		17	y	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIa	J		17	z_4,z_{23}	–	(Ar. 12:1,2,5:- and 12:1,2,6:-)
IIIa	J		17	z_4,z_{23},z_{32}	–	(Ar. 12:1,6,7,9:-)
IIIa	J		17	z_4,z_{24}	–	(Ar. 12:1,3,11:-)
IIIa	J		17	z_4,z_{32}	–	(Ar. 12:1,6,7:- and 12:1,7,8:-)
IIIb	J		17	z_{10}	e,n,x,z_{15}	(Ar.12:27:28). May possess H phase Rz_{56} (Ar. 38).
IIIb	J		17	z_{10}	z	(Ar. 12:27:31)
IIIa	J		17	z_{29}	–	(Ar. 12:16,17,18:-)
IV	J		17	z_{29}	–	
IIIa	J		17	z_{36}	–	(Ar. 12:17,20:-)
IV	J		17	z_{36}	–	
IIIa	K		18	g,z_{51}	–	(Ar. 7a,7b:13,14:-)
IIIb	K		18	(k)	z_{53}	(Ar. 7a,7b:22:25)
IIIb	K		18	(k)	z_{54}	(Ar. 7a,7b:22:34)
IIIb	K		18	l,v	e,n,x,z_{15}	(Ar. 7a,7b:23:28)
IIIb	K		18	l,v	z	(Ar. 7a,7b:23:31)
IIIb	K		18	l,v	z_{53}	(Ar. 7a,7b:23:25)
II	K		18	m,t	1,5	
IIIb	K		18	r	z	(Ar. 7a,7b:24,31)
II	K		18	y	e,n,x,z_{15}	
II	K		18	z_4,z_{23}	–	
IIIa	K		18	z_4,z_{23}	–	(Ar. 7a,7b:1,2,5:- and 7a,7b:1,2,6:-)
II	K		18	z_4,z_{24}	–	
IIIa	K		18	z_4,z_{32}	–	(Ar. 7a,7b:1,6,7:- and 7a,7b:1,7,8:-)
IIIb	K		18	z_{10}	e,n,x,z_{15}	(Ar. 7a,7b:27:28)
IV	K		18	z36,z38	–	
II	L		21	b	1,5	
II	L		21	c	e,n,x	
IIIb	L		21	c	e,n,x,z_{15}	(Ar. 22:32:28)
II	L		21	g,[m],[s],t	–	
IIIa	L		21	g,z_{51}	–	(Ar. 22:13,14:-)
IV	L		21	g,z_{51}	–	
IIIb	L		21	i	1,5,7	(Ar. 22:33:30)
IIIb	L		21	i	e,n,x,z_{15}	(Ar. 22:33:28)
IIIb	L		21	k	e,n,x,z_{15}	(Ar. 22:29:28)
IIIb	L		21	k	z	(Ar. 22:29:31)
IIIb	L		21	l,v	z	(Ar. 22:23:31)
IIIb	L		21	l,v	z_{57}	(Ar. 22:23:40)
II	L		21	m,t	–	
IIIb	L		21	r	z	(Ar. 22:24:31)
II	L		21	z	–	CDC does not have this.
IIIa	L		21	z_4,z_{23}	–	(Ar. 22:1,2,5:- and 22:1,2,6:-)
IIIa	L		21	z_4,z_{24}	–	(Ar. 22:1,3,11:-)
IV	L		21	z_4,z_{32}	–	
IIIb	L		21	z_{10}	e,n,x,z_{15}	(Ar. 22:27:28)
IIIb	L		21	z_{10}	z	(Ar. 22:27:31)
IIIb	L		21	z_{10}	z_{53}	(Ar. 22:27:25)
IIIa	L		21	z_{29}	–	(Ar. 22:16,17,18:-)
IV	L		21	z_{36}	–	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	L		21	z_{65}	e,n,x,z_{15}	(Ar. 22:32:28)
II	M		28	a	e,n,x	
II	M		28	b	e,n,x	
II	M		28	e,n,x	1,7	
II	M		28	g,m,t	e,n,x	
II	M		28	g,m,t	z_{39}	
II	M		28	g,s,t	e,n,x	
II	M		28	l,z_{28}	1,5	
II	M		28	m,t	[e,n,x]	
II	M		28	z	1,5	
IIIb	M		28	z_{10}	z	(Ar. 35:27:31)
IIIb	M		28	z_{10}	z:[z_{57}]	(Ar. 35:27:31:[40])
II	M		28	z_{29}	1,5	
II	M		28	z_{29}	e,n,x	
II	N		30	b	z_6	
II	N		30	c	z_{39}	
II	N		30	g,m,s	e,n,x	
II	N		30	k	e,n,x,z_{15}	
II	N		30	l,z_{28}	z_6	
II	N		30	m,t	–	
II	N		30	z_6	1,6	
II	N		30	z_{39}	1,7	
II	O		35	d	1,5	
II	O		35	g,m,s,t	–	
II	O		35	g,t	1,5	
II	O		35	g,t	z_{42}	
IIIa	O		35	g,z_{51}	–	(Ar. 20:13,14:-)
IIIb	O		35	i	e,n,x,z_{15}	(Ar. 20:33:28)
IIIb	O		35	i	z	(Ar. 20:33:31)
IIIb	O		35	i	z_{35}	(Ar. 20:33:21)
IIIb	O		35	i	z_{53}	(Ar. 20:33:25)
IIIb	O		35	k	e,n,x,z_{15}	(Ar. 20:29:28)
IIIb	O		35	k	z	(Ar. 20:29:31)
IIIb	O		35	k	z_{53}	(Ar. 20:29:25). May possess H phase Rz_{50} (Ar.42).
IIIb	O		35	(k)	z	(Ar. 20:22:31)
IIIb	O		35	(k)	z_{35}	(Ar. 20:22:21)
IIIb	O		35	l,v	1,5,7	(Ar. 20:23:30)
IIIb	O		35	l,v	e,n,x,z_{15}	(Ar. 20:23:28)
IIIb	O		35	l,v	z_{35}	(Ar. 20:23:21)
II	O		35	l,z_{28}	–	
II	O		35	m,t	–	
IIIb	O		35	r	e,n,x,z_{15}	(Ar. 20:24:28)
IIIb	O		35	r	z	(Ar. 20:24:31)
IIIb	O		35	r	z_{35}	(Ar. 20:24:21)
IIIb	O		35	r	z_{61}	(Ar. 20:24:41)
IIIa	O		35	z_4,z_{23}	–	(Ar. 20:1,2,6:-)
IIIa	O		35	z_4,z_{32}	–	(Ar. 20:1,7,8:-)
IIIb	O		35	z_{10}	z_{35}	(Ar. 20:27:21)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIa	O		35	z_{29}	–	(Ar. 20:16,17,18:-)
IIIa	O		35	z_{36}	–	(Ar. 20:17,20:-)
IIIb	O		35	z_{52}	1,5,7	(Ar. 20:26:30)
IIIb	O		35	z_{52}	e,n,x,z_{15}	(Ar. 20:26:28)
IIIb	O		35	z_{52}	z	(Ar. 20:26:31)
IIIb	O		35	z_{52}	z_{35}	(Ar. 20:26:21)
II	P		38	b	1,2	
IIIa	P		38	g,z_{51}	–	(Ar. 16:13,14:-)
IV	P		38	g,z_{51}	–	
IIIb	P		38	i	z	(Ar. 16:33:31)
IIIb	P		38	i	z_{53}	(Ar. 16:33:25)
IIIb	P		38	k	e,n,x,z_{15}	(Ar. 16:29:28)
IIIb	P		38	k	z	(Ar. 16:29:31)
IIIb	P		38	k	z_{53}	(Ar. 16:29:25)
IIIb	P		38	(k)	1,5,7	(Ar. 16:22:30)
IIIb	P		38	(k)	z	(Ar. 16:22:31)
IIIb	P		38	(k)	z_{35}	(Ar. 16:22:21). May possess H phase Rz_{56} (Ar. 38).
IIIb	P		38	(k)	z_{54}	(Ar. 16:22:34)
IIIb	P		38	(k)	z_{55}	(Ar. 16:22:37)
IIIb	P		38	l,v	z	(Ar. 16:23:31)
IIIb	P		38	l,v	z_{35}	(Ar. 16:23:21)
IIIb	P		38	l,v	z_{53}:[z_{54}]	(Ar. 16:23:25:[34])
IIIb	P		38	r	1,5,7	(Ar. 16:24:30)
IIIb	P		38	r	e,n,x,z_{15}	(Ar. 16:24:28)
IIIb	P		38	r	z:[z_{57}]	(Ar. 16:24:31:[40])
IIIb	P		38	r	z_{35}	(Ar. 16:24:21)
IIIa	P		38	z_4,z_{23}	–	(Ar. 16:1,2,6:-)
IV	P		38	z_4,z_{23}	–	
IIIb	P		38	z_{10}	z	(Ar. 16:27:31)
IIIb	P		38	z_{10}	z_{53}	(Ar. 16:27:25)
IIIb	P		38	z_{47}	z_{53}	(Ar. 16:39:25)
IIIb	P		38	z_{52}	z_{35}	(Ar. 16:26:21)
IIIb	P		38	z_{52}	z_{53}	(Ar. 16:26:25)
IIIb	P		38	z_{53}	–	(Ar. 16:25:-). May possess H phase Rz_{50} (Ar. 42) or Rz_{76} (Ar. Rz_{76}). CDC does not have monophasic.
IIIa	P		38	z_{61}	–	(Ar. 16:41:-)
IIIb	P		38	z_{61}	z_{53}	(Ar. 16:41:25)
II	Q		39	a	z_{39}	
II	Q		39	c	e,n,x	
II	Q		39	e,n,x	1,7	
II	Q		39	g,m,t	–	
II	Q		39	l,v	1,5	
II	Q		39	l,z_{28}	z_{39}	
II	Q		39	m,t	e,n,x	
II	Q		39	–	1,7	
II	R		1,40	a	1,5	
II	R		1,40	a	z_6	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	R		40	b	–	
II	R		1,40	c	z_{39}	
II	R		1,40	e,n,x	1,[5],7	
II	R		1,40	e,n,x,z_{15}	1,6	
II	R		1,40	g,t	1,5	
II	R		1,40	g,t	[e,n,x]	
II	R		1,40	g,t	e,n,x,z_{15}	
II	R		40	g,t	z_{39}	
II	R		1,40	g,[m],[s],t	z_{42}	
IIIb	R		40	g,z_{51}	[e,n,x,z_{15}]	(Ar. 10a,10b:13,14:[28])
IIIb	R		40	i	1,5,7	(Ar. 10a,10b:33:30)
IIIb	R		40	k	z:z_{57}	(Ar. 10a,10b:29:31:40)
II	R		40	k	z_6	
IIIb	R		40	k	z_{53}	(Ar. 10a,10b:29:25)
IIIb	R		40	l,v	z	(Ar. 10a,10b,(10c):23:31)
IIIb	R		40	l,v	z_{53}	(Ar. 10a,10b:23:25)
II	R		1,40	l,z_{28}	1,5:z_{42}	
II	R		1,40	l,z_{28}	z_{39}	
II	R		40	m,t	z_{39}	
II	R		1,40	m,t	z_{42}	
IV	R		40	m,t	-	
II	R		1,40	z	z_6	
II	R		1,40	z	z_{39}	
II	R		40	z	z_{42}	
IIIa	R		40	z_4,z_{23}	–	(Ar. 10a,10b:1,2,5:-; 10a,10b:1,2,5,6:-; and 10a,10b:1,2,6:-)
IIIa	R		40	z_4,z_{24}	–	(Ar. 10a,10b:1,3,11:-)
IV	R		40	z_4,z_{24}	–	Also called Degania var. subsp. IV.
IIIa	R		40	z_4,z_{32}	–	(Ar. 10a,10b:1,2,10:-; 10a,10c:1,2,10:-; and 10a,10b:1,7,8:-)
IIIa	R		40	z_4,z_{32}	–	
II	R		1,40	z_6	1,5	
IIIb	R		40	z_{10}	z_{35}	(Ar. 10a,10b:27:21)
IIIa	R		40	z_{29}	–	(Ar. 10a,10b:16,18:-)
V	R		1,40	z_{35}	–	
IIIa	R		40	z_{35}	–	(Ar. 10a,10b:17,20:-)
II	R		40	z_{39}	1,5:z_{42}	
II	R		40	z_{39}	1,7	
II	R		1,40	z_{42}	1,6	
II	R		1,40	[z_{42}]	1,(5),7	
V	R		40	z_{81}	–	H z_{81} was formerly H a in *S. bongori*.
II	S		41	b	[1,5]	
VI	S		41	b	1,7	
IIIb	S		41	c	e,n,x,z_{15}	(Ar. 13:32:28)
II	S		41	c	[z6]	
II	S		41	g,m,s,t	z_6	
IIIa	S		41	g,z_{51}	–	(Ar. 13:13,14:-)
II	S		41	k	1,6	
II	S		41	k	[z_6]	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	S		41	(k)	[z_{35}]	(Ar. 13:22:[21])
II	S		41	l,z_{13},z_{28}	e,n,x,z_{15}	
IIIa	S		41	z_4,z_{23}	–	(Ar. 13:1,2,5:- and 13:1,2,6:-)
IV	S		41	z_4,z_{23}	–	Also called Waycross var. subsp. IV.
IIIa	S		41	z_4,z_{23},z_{32}	–	(Ar. 13:1,6,7,9:-)
IIIa	S		41	z_4,z_{24}	–	(Ar. 13:1,3,11:-)
IIIa	S		41	z_4,z_{32}	–	(Ar. 13:1,6,7:- and 13:1,7,8:-)
IIIa	S		41	z_{29}	–	(Ar. 13:16,17,18:-)
IV	S		41	z_{29}	–	
IIIa	S		41	z_{36}	–	(Ar. 13:17,20:-)
IV	S		41	z_{52}	–	
II	S		41	–	1,6	
II	T		42	b	z_6	
II	T		42	d	z_6	
II	T		42	[e,n,x]	1,6	
IIIa	T		42	g,z_{51}	–	(Ar. 15:13,14:-)
IV	T		1,42	g,z_{51}	–	
IIIb	T		42	k	–	(Ar. 15:29:-)
IIIb	T		42	k	e,n,x,z_{15}	(Ar. 15:29:28)
IIIb	T		42	k	z	(Ar. 15:29:31)
IIIb	T		42	k	z_{35}	(Ar. 15:29:21)
IIIb	T		42	(k)	z_{35}	(Ar. 15:22:21)
IIIb	T		42	l,v	1,5,7	(Ar. 15:23:30)
IIIb	T		42	l,v	e,n,x,z_{15}	(Ar. 15:23:28)
IIIb	T		42	l,v	z	(Ar. 15:23:31)
IIIb	T		42	l,v	z_{53}	(Ar. 15:23:25)
II	T		1,42	l,w	e,n,x	
II	T		42	l,[z_{13}],z_{28}	[z_6]	
II	T		42	m,t	[e,n,x,z_{15}]	
IIIb	T		42	r	–	(Ar. 15:24:-). May possess H phase Rz_{50} (Ar. 42).
IIIb	T		42	r	z	(Ar. 15:24:31)
IIIb	T		42	r	z_{53}	(Ar. 15:24:25)
IIIa	T		42	z_4,z_{23}	–	(Ar. 15:1,2,5:- and 15:1,2,6:-)
IIIa	T		42	z_4,z_{24}	–	(Ar. 15:1,3,11:-)
IV	T		1,42	z_4,z_{24}	–	
II	T		42	z_6	1,6	
IIIb	T		42	z_{10}	–	(Ar. 15:27:-). May possess H phase Rz_{56} (Ar. 38) and Rz_{50} (Ar. 42).
II	T		42	z_{10}	1,2	
II	T		42	z_{10}	e,n,x,z_{15}	
IIIb	T		42	z_{10}	e,n,x,z_{15}	(Ar. 15:27:28)
IIIb	T		42	z_{10}	z	(Ar. 15:27:31)
II	T		42	z_{10}	z_6	
IIIb	T		42	z_{10}	z_{35}	(Ar. 15:27:21)
IIIb	T		42	z_{10}	z_{67}	(Ar. 15:27:46)
IV	T		42	z_{36}	–	
IIIb	T		42	z_{52}	z	(Ar. 15:26:31)
II	U		43	a	1,5	

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	U		43	a	z_6	
II	U		43	d	e,n,x,z_{15}	
II	U		43	d	z_{39}	
II	U		43	d	z_{42}	
II	U		43	e,n,x,z_{15}	1,(5),7	
II	U		43	e,n,x,z_{15}	1,6	
II	U		43	g,t	1,5	
IIIa	U		43	g,z_{51}	–	(Ar. 21:13,14:-)
IV	U		43	g,z_{51}	–	
II	U		43	g,z_{62}	e,n,x	
IIIb	U		43	k	z	(Ar. 21:29:31)
IIIb	U		43	l,v	z_{53}:[Rz_{56}]	(Ar. 21:23:25:[38])
II	U		43	l,z_{13},z_{28}	1,5	
IIIb	U		43	r	e,n,x,z_{15}	(Ar. 21:24:28)
IIIb	U		43	r	z	(Ar. 21:24:31)
IIIb	U		43	r	z_{53}	(Ar. 21:24:25)
II	U		43	z	1,5	
IV	U		43	z_4,z_{23}	–	
IIIa	U		43	z_4,z_{23}	–	(Ar. 21:1,2,5:- and 21:1,2,6:-)
IIIa	U		43	z_4,z_{24}	–	(Ar. 21:1,3,11:-)
IV	U		43	z_4,z_{24}	–	
IV	U		43	z_{29}	–	
II	U		43	z_{29}	e,n,x	
II	U		43	z_{29}	z_{42}	
IIIa	U		43	z_{36}	–	(Ar. 21:17,20:-)
IIIb	U		43	z_{52}	z_{53}	(Ar. 21:26:25)
II	V		1,44	e,n,x	1,6	
II	V		44	g,t	z_{42}	
IV	V		44	g,z_{51}	–	
II	V		44	z_4,z_{23}	–	
IIIa	V		44	z_4,z_{23}	–	(Ar. 1,3:1,2,5:- and 1,3:1,2,6:-)
IV	V		44	z_4,z_{23}	–	
IIIa	V		44	z_4,z_{23},z_{32}	–	(Ar. 1,3:1,6,7,9:-)
IIIa	V		44	z_4,z_{24}	–	(Ar. 1,3:1,3,11:-)
IV	V		44	z_4,z_{24}	–	
IIIa	V		44	z_4,z_{32}	–	(Ar. 1,3:1,2,10:- and 1,3:1,7,8:-). IP calls z_4,z_{23},z_{32}, Ar. 1,2,10.
IV	V		44	z_{29}	–	
II	V		44	z_{29}	e,n,x:z_{42}	
IV	V		44	z_{36},[z_{38}]	–	
V	V		44	z_{39}	–	
IIIa	W		45	g,z_{51}	–	(Ar. 11:13,14:-)
IV	W		45	g,z_{51}	–	
II	W		45	m,t	1,5	
II	W		45	z	1,5	
IIIa	W		45	z_4,z_{23}	–	(Ar. 11:1,2,5:-)
IV	W		45	z_4,z_{23}	–	
IIIa	W		45	z_4,z_{24}	–	(Ar. 11:1,3,11:-)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIa	W		45	z_4,z_{32}	–	(Ar. 11:1,7,8:-)
IIIa	W		45	z_{29}	–	(Ar. 11:16,18:-)
II	W		45	z_{29}	1,5	
II	W		45	z_{29}	e,n,x	
II	W		45	z_{29}	z_{42}	
IV	W		45	z_{36},z_{38}	–	
II	X		47	a	e,n,x,z_{15}	
II	X		47	b	z_6	
IIIb	X		47	c	1,5,7	(Ar. 28:32:30)
IIIb	X		47	c	e,n,x,z_{15}:[z_{57}]	(Ar. 23:32:28 and 28:32:28:[40])
IIIb	X		47	c	z	(Ar. 28:32:31)
IIIb	X		47	c	z_{35}	(Ar. 28:32:21)
II	X		47	d	e,n,x,z_{15}	
II	X		47	e,n,x,z_{15}	1,6	
II	X		47	g,t	e,n,x	
IIIa	X		47	g,z_{51}	–	(Ar. 28:13,14)
IIIb	X		47	i	e,n,x,z_{15}	(Ar. 23:33:28). May possess H phase Rz_{50} (Ar. 42).
IIIb	X		47	i	z	(Ar. 28:33:31)
IIIb	X		47	i	z_{35}	(Ar. 23:33:21 and 28:33:21)
IIIb	X		47	i	z_{53}:[z_{57}]	(Ar. 23:33:25 and 28:33:25:[40])
IIIb	X		47	k	1,5,7	(Ar. 28:29:30)
IIIb	X		47	k	e,n,x,z_{15}	(Ar. 28:29:28)
IIIb	X		47	k	z	(Ar. 28:29:31)
IIIb	X		47	k	z_{35}	(Ar. 23:29:21)
IIIb	X		47	k	z_{53}	(Ar. 23:29:25)
IV	X		47	l,v	–	
IIIb	X		47	l,v	1,5,(7)	(Ar. 23:23:30). May possess H phase Rz_{50} (Ar. 42).
IIIa	X		47	l,v	e,n,x,z_{15}	(Ar. 28:23:28)
IIIb	X		47	l,v	z	(Ar. 23:23:31)
IIIb	X		47	l,v	z_{35}	(Ar. 28:23:21)
IIIb	X		47	l,v	z_{53}	(Ar. 28:23:25)
IIIb	X		47	l,v	z_{57}	(Ar. 28:23:40)
IIIa	X		47	r	–	(Ar. 23:24:-). CDC does not have this.
IIIb	X		47	r	1,5,7	(Ar. 23:24:30)
IIIb	X		47	r	z	(Ar. 23:24:31)
IIIb	X		47	r	z_{35}	(Ar. 23:24:21 and 28:24:21)
IIIb	X		47	r	z_{53}	(Ar. 23:24:25). May possess H phase Rz_{74} (Ar. Rz74)
IIIb	X		47	r	z_{53}:[z_{60}]	(Ar. 23:24:25:[44]). May possess H phase Rz_{70} and Rz_{72} (Ar. Rz_{70} or Rz_{72}).
IIIb	X		47	r	z_{53}:Rz_{50}:z_{60}	(Ar. 28:24:25:42:44). Not in IP book.
II	X		47	z	e,n,x,z_{15}	
IIIa	X		47	z_4,z_{23}	–	(Ar. 28:1,2,5:-)
II	X		47	z_6	1,6	
IIIb	X		47	z_{10}	1,5,7	(Ar. 28:27:30)
IIIb	X		47	z_{10}	z	(Ar. 28:27:31)
IIIb	X		47	z_{10}	z_{35}	(Ar. 28:27:21)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIa	X		47	z_{29}	–	(Ar. 28:16,18:-)
II	X		47	z_{29}	e,n,x,z_{15}	
IV	X		47	z_{36}	–	
IIIb	X		47	z_{52}	1,5,7	(Ar. 28:26:30)
IIIb	X		47	z_{52}	e,n,x,z_{15}	(Ar. 28:26:28)
IIIb	X		47	z_{52}	z	(Ar. 28:26:31)
IIIb	X		47	z_{52}	z_{35}	(Ar. 28:26:21)
II	Y		48	a	z_6	
IIIb	Y		48	a	z_{35}	(Ar. 5:35:21). Not in 1992 IP, but is in Bergey.
II	Y		48	a	z_{39}	
V	Y		48	b	–	
II	Y		48	b	[z_6]	
IIIb	Y		48	c	z	(Ar. 29:32:31)
II	Y		48	d	1,2	
IIIa	Y		48	g,z_{51}	–	(Ar. 5:13,14:-)
IIIb	Y		48	i	z:[z_{72}]	(Ar. 5,29:33:31:[z_{72}]). CDC does not have z_{72} strain.
IIIb	Y		48	i	z_{35}:[z_{57}]	(Ar. 29:33:21:[40])
IIIb	Y		48	i	z_{53}	(Ar. 5:33:25)
IIIb	Y		48	i	z_{61}	(Ar. 5,29:33:41)
IIIb	Y		48	k	1,5,(7)	(Ar. 5:29:30)
II	Y		48	k	e,n,x,z_{15}	
IIIb	Y		48	k	e,n,x,z_{15}	(Ar. 5:29:28)
IIIb	Y		48	k	z	(Ar. 5,29:29:31)
IIIb	Y		48	k	z_{35}:[Rz_{75}]	(Ar. [5:29:21:Rz_{75}]). CDC does not have Rz_{75}.
IIIb	Y		48	k	z_{53}	(Ar. 5,29:29:25)
IIIb	Y		48	(k)	z_{53}	(Ar. 5:22:25 and Ar. 5,29:22:25). Called 5:22:25 by IP.
IIIb	Y		48	l,v	1,5,(7)	(Ar. 5:23:30). May possess H phase Rz_{47} or Rz_{50} (Ar. 39 or 42).
IIIb	Y		48	l,v	z	(Ar. 5,29:23:31)
IIIb	Y		48	r	e,n,x,z_{15}	(Ar. 5:24:28)
IIIb	Y		48	r	z	(Ar. 5,29:24:31)
II	Y		48	z	1,5	
IIIa	Y		48	z_4,z_{23}	–	(Ar. 5:1,2,5:-; 5:1,2,5,6:-; and 5:1,6:-)
IV	Y		48	z_4,z_{23}	–	
IIIa	Y		48	z_4,z_{23},z_{32}	–	(Ar. 5:1,6,7,9:-). IP calls this 5:1,6,7:-.
IIIa	Y		48	z_4,z_{24}	–	(Ar. 5:1,3,11:-)
IIIa	Y		48	z_4,z_{32}	–	(Ar. 5:1,6,7:-; 5:1,7,8:-; and Ar. 5:1,2,10:-). IP calls z_4,z_{32}, Ar. 1,7,8; and would call z_4,z_{23},z_{32}, Ar. 1,2,10.
IV	Y		48	z_4,z_{32}	–	
VI	Y		48	z_{10}	1,5	
IIIb	Y		48	z_{10}	e,n,x,z_{15}	(Ar. 5:27:28)
IIIb	Y		48	z_{10}	z	(Ar. 5,29:27:31)
II	Y		48	z_{29}	–	
IIIa	Y		48	z_{29}	–	(Ar. 5:16,18). This is not in IP book, but is on Rohde's list.
IV	Y		48	z_{29}	–	
IIIb	Y		48	z_{35}	z_{52}	(Ar. 5:21:26)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIa	Y		48	z_{36}	–	(Ar. 5,29:17,20:-)
IV	Y		48	z_{36},[z_{38}]	–	
V	Y		48	z_{39}	-	
IIIb	Y		48	z_{52}	e,n,x,z15	(Ar. 29:26:28)
IIIb	Y		48	z_{52}	z	(Ar. 5:26:31)
V	Y		48	z_{65}	-	
V	Y		48	z_{81}	-	
IV	Z		50	a	-	
IV	Z		50	b	-	
II	Z		50	b	z_6	
IV	Z		50	d	-	
II	Z		50	g,z_{62}	e,n,x	
IIIb	Z		50	i	1,5,7	(Ar. 9a,9c:33:30)
IIIb	Z		50	i	e,n,x,z_{15}	(Ar. 9a,9c:33:28)
IIIb	Z		50	i	z	(Ar. 9a,9c:33:31)
IIIb	Z		50	k	1,5,7	(Ar. 9a,9c:29:30)
IIIb	Z		50	k	e,n,x,z_{15}	(Ar. 9a,9c:29:28)
II	Z		50	k	e,n,x:z_{42}	
IIIb	Z		50	k	z	(Ar. 9a,9b:29:31 and 9a,9c:29:31). Ar. 9a,9b may possess H phase Rz_{50} (Ar. 42).
IIIb	Z		50	k	z_{35}	(Ar. 9a,9b:29:21)
IIIb	Z		50	k	z_{53}	(Ar. 9a,9b:29:25 and 9a,9c:29:25). IP and Rohde only list the 9a,9c.
IIIb	Z		50	(k)	z	(Ar. 9a,9b:22:31)
IIIb	Z		50	(k)	z_{35}	(Ar. 9a,9b:22:21)
IIIb	Z		50	l,v	e,n,x,z_{15}	(Ar. 9a,9b:23:28)
IIIb	Z		50	l,v	z	(Ar. 9a,9b:23:31 and 9a,9c:23:31). IP only lists 9a,9c.
IIIb	Z		50	l,v	z_{35}	(Ar. 9a,9c:23:21)
II	Z		50	l,w	e,n,x,z_{15}:z_{42}	
II	Z		50	l,z_{28}	z_{42}	
IIIb	Z		50	r	1,5,(7)	(Ar. 9a,9b:24:30)
IIIb	Z		50	r	e,n,x,z_{15}	(Ar. 9a,9c:24:28)
IIIb	Z		50	r	z	(Ar. 9a,9b:24:31 and 9a,9c:24:31).
IIIb	Z		50	r	z_{35}	(Ar. 9a,9b:24:21). May possess H phase Rz_{58} (Ar. Rz58). This is not in IP book, but is on Rohde's list.
IIIb	Z		50	r	z_{53}	(Ar. 9a,9b:24:25). May possess H phase Rz_{50} (Ar. 42). This is not in IP book, but is on Rohde's list.
IIIa	Z		50	z_4,z_{23}	–	(Ar. 9a,9b:1,2,5:- and 9a,9b:1,2,6:-)
IIIa	Z		50	z_4,z_{23},z_{32}	–	(Ar. 9a,9b:1,2,10:-). Called 9a,9b:1,6,7:- by IP and Rohde.
IIIa	Z		50	z_4,z_{24}	–	(Ar. 9a,9b:1,3,11:-)
IV	Z		50	z_4,z_{24}	–	
IIIa	Z		50	z_4,z_{32}	–	(Ar. 9a,9b:1,2,10; 9a,9b:1,6,7:-; and 9a,9b:1,7,8:-). 9a,9b:1,2,10:- and 9a,9b:1,7,8:- used by IP and Rohde.
IIIb	Z		50	z_{10}	z	(Ar. 9a,9c:27:31). May possess H phase Rz_{56} (Ar. 38).
IIIb	Z		50	z_{10}	z_{53}	(Ar. 9a,9c:27:25)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIa	Z		50	z_{29}	–	(Ar. 9a,9b:16,18:-)
IIIa	Z		50	z_{36}	–	(Ar. 9a,9b:17,20:-)
IIIb	Z		50	z_{52}	1,5,7	(Ar. 9a,9b:26:30 and 9a,9c:26:30)
IIIb	Z		50	z_{52}	z	(Ar. 9a,9b:26:31 and 9a,9c:26:31)
IIIb	Z		50	z_{52}	z_{35}	(Ar. 9a,9b:26:21 and 9a,9c:26:21)
IIIb	Z		50	z_{52}	z_{53}	(Ar. 9a,9b:26:25 and 9a,9c:26:25)
IV	51		51	b	–	
II	51		51	c	–	
II	51		51	g,s,t	e,n,x	
IIIa	51		51	g,z_{51}	–	(Ar. 1,2:13,14:-)
IIIb	51		51	k	z_{35}	(Ar. 1,2:29:21)
IIIb	51		51	l,v	z	(Ar. 1,2:23:31)
IIIa	51		51	z_4,z_{23}	–	(Ar. 1,2:1,2,5:- and 1,2:1,2,6:-)
IIIa	51		51	z_4,z_{24}	–	(Ar. 1,2:1,3,11:-)
IIIa	51		51	z_4,z_{32}	–	(Ar. 1,2:1,7,8:-)
II	51		51	z_{29}	e,n,x,z_{15}	
II	52		52	c	k	
IIIb	52		52	c	k	(Ar. 31:32:29). This is not in IP book, but is on Rohde's list.
II	52		52	d	e,n,x,z_{15}	
II	52		52	d	z_{39}	CDC does not have this.
II	52		52	g,t	–	
IIIb	52		52	k	z_{35}	(Ar. 31:29:21)
IIIb	52		52	k	z_{53}	(Ar. 31:29:25)
IIIb	52		52	(k)	z_{35}	(Ar. 31:22:21)
IIIb	52		52	l,v	z_{53}	(Ar. 31:23:25)
II	52		52	z	z_{39}	
IIIb	52		52	z_{52}	z	(Ar. 31:26:31)
II	53		53	c	1,5	
II	53		53	d	1,5	
II	53		1,53	d	z39	
II	53		53	d	z42	
IIIa	53		53	g,z_{51}	–	(Ar. 1,4:13,14:-)
IV	53		1,53	g,z_{51}	–	
IIIb	53		53	i	z	(Ar. 1,4:33:31)
IIIb	53		53	k	e,n,x,z_{15}	(Ar. 1,4:29:28)
IIIb	53		53	k	z	(Ar. 1,4:29:31)
IIIb	53		53	(k)	z	(Ar. 1,4:22:31)
IIIb	53		53	(k)	z_{35}	(Ar. 1,4:22:21)
IIIb	53		53	l,v	e,n,x,z_{15}	(Ar. 1,4:23:28)
IIIb	53		53	l,v	z_{35}	(Ar. 1,4:23:21)
II	53		53	l,z_{28}	e,n,x	
II	53		53	l,z_{28}	z_6	
IIIb	53		53	r	z	(Ar. 1,4:24:31)
IIIb	53		53	r	z_{35}	(Ar. 1,4:24:21)
IIIb	53		53	r	z_{68}	(Ar. 1,4:24:47). This was formerly called z_{56} (Ar. 38), but was changed to z_{68} (Ar. 47).
II	53		53	z	1,5	
IIIb	53		53	z	1,5,(7)	(Ar. 1,4:30:31)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	53		53	z	z_6	
IIIa	53		53	z_4,z_{23}	–	(Ar. 1,4:1,2,5:- and 1,4:1,2,6:-)
IV	53		53	z_4,z_{23}	–	
IIIa	53		53	z_4,z_{23},z_{32}	–	(Ar. 1,4:1,6,7,9:-)
IIIa	53		53	z_4,z_{24}	–	(Ar. 1,4:1,3,11:-)
IIIa	53		53	z_4,z_{32}	–	(Ar. 1,4:1,6,7:-). IP combined this with 53:z_4,z_{23},z_{32}:- (Ar. 1,4:1,6,7,9:-).
IIIb	53		53	z_{10}	z_{35}	(Ar. 1,4:27:21)
IIIa	53		53	z_{29}	–	(Ar. 1,4:16,18:-)
IIIb	53		53	z_{52}	z_{35}	(Ar. 1,4:26:21)
IIIb	53		53	z_{52}	z_{53}	(Ar. 1,4:26:25)
II	56		56	d	–	
II	56		56	e,n,x	1,7	
II	56		56	l,v	z_{39}	
II	56		56	l,z_{28}	–	
II	56		56	z	z_6	
IIIa	56		56	z_4,z_{23}	–	(Ar. 14:1,2,5:- and 14:1,2,6:-)
IIIa	56		56	z_4,z_{23},z_{32}	–	(Ar. 14:1,6,7,9:-)
II	56		56	z_{10}	e,n,x	
IIIa	56		56	z_{29}	–	(Ar. 14:16,18:-)
II	57		57	a	z_{42}	
IIIb	57		57	c	z:[z_{60}]	(Ar. 34:32:31:[44])
II	57		57	d	1,5	
II	57		57	g,[m],s,t	z_{42}	
II	57		57	g,t	–	
IIIb	57		57	i	e,n,x,z_{15}	(Ar. 34:33:28)
IIIb	57		57	i	z	(Ar. 34:33:31)
IIIb	57		57	k	e,n,x,z_{15}	(Ar. 34:29:28). CDC does not have this and not on Rohde's list.
IV	57		57	z_4,z_{23}	–	
IIIb	57		57	z_{10}	z	(Ar. 34:27:31)
II	58		58	a	z6	
II	58		58	b	1,5	
II	58		58	c	z_6	
II	58		58	d	z_6	
IIIb	58		58	i	e,n,x,z_{15}	(Ar. 1,33:33:28)
IIIb	58		58	k	z	(Ar. 1,33:29:31)
IIIb	58		58	l,v	e,n,x,z_{15}	(Ar. 1,33:23:28)
IIIb	58		58	l,v	z_{35}	(Ar. 1,33:23:21)
II	58		58	l,z_{13},z_{28}	z_6	
IIIb	58		58	r	e,n,x,z_{15}	(Ar. 1,33:24:28)
IIIb	58		58	r	z	(Ar. 1,33:24:31)
IIIb	58		58	r	z_{53}	(Ar. 1,33:24:25). May possess H phase Rz_{47} (Ar. 39) or Rz_{57} (Ar. 40) or Rz_{70} (Ar. Rz_{70}).
II	58		58	z_6	1,6	
II	58		58	z_{10}	1,6	
IIIb	58		58	z_{10}	e,n,x,z_{15}	(Ar. 1,33:27:28)
II	58		58	z_{10}	z_6	
IIIb	58		58	z_{10}	z_{53}	(Ar. 1,33:27:25). May possess H phase Rz_{50} (Ar. 42).

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
II	58		58	z_{39}	e,n,x,z_{15}	
IIIb	58		58	z_{52}	z	(Ar. 1,33:26:31)
IIIb	58		58	z_{52}	z_{35}	(Ar. 1,33:26:21)
IIIb	59		59	c	e,n,x,z_{15}	(Ar. 19:32:28)
IIIb	59		59	i	e,n,x,z_{15}	(Ar. 19:33:28)
IIIb	59		59	i	z	(Ar. 19:33:31)
IIIb	59		59	i	z_{35}	(Ar. 19:33:21)
IIIb	59		59	k	z_{53}	(Ar. 19:29:25)
IIIb	59		59	(k)	e,n,x,z_{15}	(Ar. 19:22:28)
IIIb	59		59	(k)	z	(Ar. 19:22:31)
IIIb	59		59	(k)	z_{35}	(Ar. 19:22:21)
IIIb	59		59	l,v	z	(Ar. 19:23:31)
IIIb	59		59	l,v	z_{53}	(Ar. 19:23:25)
IIIb	59		59	r	z_{35}	(Ar. 19:24:21)
II	59		1,59	z	z_6	
IIIa	59		59	z_4,z_{23}	–	(Ar. 19:1,2,5:- and 19:1,2,6:-)
IIIb	59		59	z_{10}	z_{53}	(Ar. 19:27:25)
IIIb	59		59	z_{10}	z_{57}	(Ar. 19:27:40)
IIIa	59		59	z_{29}	–	(Ar. 19:16,18:-)
IIIa	59		59	z_{36}	–	(Ar. 19:17,20:-)
IIIb	59		59	z_{52}	[z_{53}]	(Ar. 19:26:[25])
II	60		60	b	[1,16]	
IIIb	60		60	i	–	(Ar. 24:33:-). May possess H phase Rz_{50} (Ar. 42).
IIIb	60		60	i	e,n,x,z_{15}	(Ar. 24:33:28)
IIIb	60		60	i	z_{35}	(Ar. 24:33:21)
IIIb	60		60	k	z	(Ar. 24:29:31)
IIIb	60		60	k	z_{35}	(Ar. 24:29:21)
IIIb	60		60	(k)	z_{53}	(Ar. 24:22:25)
IIIb	60		60	l,v	z	(Ar. 24:23:31)
IIIb	60		60	r	e,n,x,z_{15}	(Ar. 24:24:28)
IIIb	60		60	r	z	(Ar. 24:24:31)
IIIb	60		60	r	z_{35}	(Ar. 24:24:21)
IIIb	60		60	r	z_{53}	(Ar. 24:24:25)
IIIb	60		60	z_{10}	z	(Ar. 24:27:31)
IIIb	60		60	z_{10}	z_{35}	(Ar. 24:27:21)
IIIb	60		60	z_{10}	z_{53}	(Ar. 24:27:25)
II	60		60	z_{29}	e,n,x	
V	60		60	z_{41}	–	
IIIb	60		60	z_{52}	1,5,[7]	(Ar. 24:26:30)
IIIb	60		60	z_{52}	z	(Ar. 24:26:31)
IIIb	60		60	z_{52}	z_{35}	(Ar. 24:26:21)
IIIb	60		60	z_{52}	z_{53}	(Ar. 24:26:25)
IIIb	61		61	c	1,5,(7)	(Ar. 26:32:30)
IIIb	61		61	c	z_{35}	(Ar. 26:32:21)
IIIb	61		61	i	e,n,x,z_{15}	(Ar. 26:33:28)
IIIb	61		61	i	z	(Ar. 26:33:31)
IIIb	61		61	i	z_{35}	(Ar. 26:33:21)
IIIb	61		61	i	z_{53}	(Ar. 26:33:25)

SUBSPECIES	O ANTIGEN GROUP	SEROTYPE	O ANTIGENS	PHASE 1	PHASE 2	NOTE
IIIb	61		61	k	1,5,(7)	(Ar. 26:29:30)
IIIb	61		61	k	z_{35}	(Ar. 26:29:21). CDC does not have this.
IIIb	61		61	(k)	z_{53}	(Ar. 26:22:25)
IIIb	61		61	l,v	1,5,7:[z_{57}]	(Ar. 26:23:30:[40])
IIIb	61		61	l,v	z	(Ar. 26:23:31)
IIIb	61		61	l,v	z_{35}	(Ar. 26:23:21)
IIIb	61		61	r	1,5,7	(Ar. 26:24:30)
IIIb	61		61	r	z	(Ar. 26:24:31)
IIIb	61		61	r	z_{35}	(Ar. 26:24:21)
IIIb	61		61	r	z_{53}	(Ar. 26:24:25). May possess H phase Rz_{47} (Ar. 39).
IIIb	61		61	z_{10}	z_{35}	(Ar. 26:27:21)
V	61		61	z_{35}	-	
IIIb	61		61	z_{52}	1,5,7	(Ar. 26:26:30)
IIIb	61		61	z_{52}	z	(Ar. 26:26:31)
IIIb	61		61	z_{52}	z_{35}	(Ar. 26:26:21)
IIIb	61		61	z_{52}	z_{53}	(Ar. 26:26:25)
IIIa	62		62	g,z_{51}	–	(Ar. 6:13,14:-)
IIIa	62		62	z_4,z_{23}	–	(Ar. 6:1,2,5:-)
IIIa	62		62	z_4,z_{32}	–	(Ar. 6:1,7,8:-)
IIIa	62		62	z_{29}	–	(Ar. 6:17,18:-)
IIIa	62		62	z_{36}	–	(Ar. 6:17,20:-)
IIIa	63		63	g,z_{51}	–	(Ar. 8:13,14:-)
IIIa	63		63	z_4,z_{23}	–	(Ar. 8:1,2,5:-)
IIIa	63		63	z_4,z_{32}	–	(Ar. 8:1,7,8:-)
IIIa	63		63	z_{36}	–	(Ar. 8:17,20:-)
IIIb	65		65	c	1,5,7	(Ar. 30:32:30)
IIIb	65		65	c	z	(Ar. 30:32:31)
IIIb	65		65	c	z_{53}	(Ar. 30:32:25)
II	65		65	g,t	–	
IIIb	65		65	i	e,n,x,z_{15}	(Ar. 30:33:28)
IIIb	65		65	(k)	z	(Ar. 30:22:31)
IIIb	65		65	(k)	z_{35}	(Ar. 30:22:21)
IIIb	65		65	(k)	z_{53}	(Ar. 30:22:25)
IIIb	65		65	l,v	e,n,x,z_{15}	(Ar. 30:23:28)
IIIb	65		65	l,v	z	(Ar. 30:23:31)
IIIb	65		65	l,v	z_{35}	(Ar. 30:23:21)
IIIb	65		65	l,v	z_{53}	(Ar. 30:23:25)
IIIb	65		65	r	z_{35}	(Ar. 30:24:21)
IIIb	65		65	z_{10}	e,n,x,z_{15}	(Ar. 30:27:28)
IIIb	65		65	z_{10}	z	(Ar. 30:27:31)
IIIb	65		65	z_{52}	e,n,x,z_{15}	(Ar. 30:26:28)
IIIb	65		65	z_{52}	z	(Ar. 30:26:31)
IIIb	65		65	z_{52}	z_{35}	(Ar. 30:26:21)
IIIb	65		65	z_{52}	z_{53}	(Ar. 30:26:25)
II	65		65	–	1,6	
V	66		66	z_{39}	–	
V	66		66	z_{81}	–	

Bacto® Shigella Antisera

Shigella Antiserum Poly Group A · Shigella Antiserum Poly Group A_1 · Shigella Antiserum Poly Group B · Shigella Antiserum Poly Group C · Shigella Antiserum Poly Group C_1 Shigella Antiserum Poly Group C_2 · Shigella Antiserum Poly Group D · Alkalescens-Dispar Antiserum Poly

Intended Use

Bacto Shigella Antisera are used for identifying *Shigella* species by the slide agglutination test. Bacto Alkalescens-Dispar Antiserum Poly is used for identifying the Alkalescens-Dispar Group of microorganisms by the slide agglutination test.

Summary and Explanation

Shigella species cause the human diarrheal disease shigellosis (classic bacillary dysentery). The range of illness is from mild diarrhea to severe dysentery characterized by abdominal cramps and frequent passage of bloody, mucoid stools. While the disease is usually self-limiting, it can be life threatening to the young, the elderly and malnourished persons. *Shigella* species are carried primarily in humans and are not generally distributed in nature. While transmission is usually direct person-to-person and through contaminated water supplies, foodborne outbreaks do occur.

The genus *Shigella* belongs to the family Enterobacteriaceae. *Shigella* species are facultatively anaerobic, gram-negative bacilli that typically are oxidase negative, lactose negative, H_2S negative and non-gas producing. *Shigella* and *Escherichia* are genetically related. Certain strains of *E. coli* may resemble *Shigella* biochemically because both can be lactose-negative, nonmotile or non-gas-producing. These anaerogenic, nonmotile types have historically been called the Alkalescens-Dispar group and are presently classified as *E. coli*.

Serological testing with polyvalent and group specific antisera should be used to confirm the identification of isolates that are morphologically and biochemically identified as *Shigella* species. *Shigella* species are nonmotile, so serological identification is based on somatic ("O") antigens. However, some strains have envelope antigens that prevent agglutination in somatic antisera. Heating the suspension at 100°C for 15-60 minutes destroys these interfering antigens. The four named species or serotypes of *Shigella* are *S. dysenteriae* (10 serovars), *S. flexneri* (six serovars), *S. boydii* (15 serovars) and *S. sonnei*. For a complete and current explanation of the classification of *Shigella*, consult appropriate references.[1]

The Alkalescens-Dispar group of microorganisms is currently recognized as anaerogenic, nonmotile biotypes of *E. coli*. Consult appropriate references for biochemical tests specific for differentiating these strains from *Shigella*.[1-6]

User Quality Control

Identity Specifications

Shigella Poly Antisera Group A-D

Lyophilized appearance: Light gold to amber, button to powdered cake.

Rehydrated appearance: Light gold to amber, clear liquid.

Alkalescens-Dispar Antiserum Poly

Lyophilized appearance: Light gold to amber, button to powdered cake.

Rehydrated appearance: Light gold to amber, clear liquid.

Culture Response

Rehydrate Shigella Antiserum Poly Groups A-D and Alkalescens-Dispar Antiserum Poly per label directions. Perform the slide agglutination test using appropriate QC Antigens Shigella Group A-D or Alkalescens-Dispar.

SHIGELLA ANTISERUM	QC ANTIGEN	REACTION
Poly Group A	Shigella Group A	3+
Poly Group A_1	Shigella Group A_1	3+
Poly Group B	Shigella Group B	3+
Poly Group C	Shigella Group C	3+
Poly Group C_1	Shigella Group C_1	3+
Poly Group C_2	Shigella Group C_2	3+
Poly Group D	Shigella Group D	3+
Alkalescens-Dispar Antiserum Poly	Alkalescens-Dispar Group 1	3+

Principles of the Procedure

Identification of *Shigella* species includes the isolation of the microorganism, biochemical identification and serological confirmation. Serological confirmation involves the reaction in which the microorganism (antigen) reacts with its corresponding antibody. This *in vitro* reaction produces macroscopic clumping called agglutination. The desired homologous reaction is rapid, does not dissociate (high avidity) and binds strongly (high affinity).

Because a microorganism (antigen) may agglutinate with antibodies produced in response to other species, heterologous reactions are possible. These are characterized as weak in strength or slow in formation.

Such unexpected and, perhaps, unpredictable reactions may lead to some confusion in serological identification. Therefore, a positive homologous agglutination reaction should support the morphological and biochemical identification of the microorganism. Homologous reactions occur rapidly and are strong. Heterologous reactions form slowly and are weak.

Reagents

Shigella Antisera Poly and Alkalescens-Dispar Antiserum Poly are lyophilized, polyclonal rabbit antisera containing approximately 0.04% Thimerosal as a preservative.

Shigella Antisera Poly are absorbed when necessary to render each lot of serum as specific as practical. Antisera are absorbed to a certain point without reducing homologous reactions to an unsatisfactory level. They have been absorbed inter- and intra-specifically except that *Shigella* antisera are not prepared from or tested for:

S. dysenteriae provisional serotypes,

S. flexneri X and Y variants, or

Alkalescens-Dispar Groups other than types 1-4.

ANTISERUM	REACTS WITH
Shigella Antiserum Poly Group A	*S. dysenteriae* types 1-7
Shigella Antiserum Poly Group A_1	*S. dysenteriae* types 8ab, 8ac, 9, 10
Shigella Antiserum Poly Group B	*S. flexneri* types 1-6
Shigella Antiserum Poly Group C	*S. boydii* types 1-7
Shigella Antiserum Poly Group C_1	*S. boydii* types 8-11
Shigella Antiserum Poly Group C_2	*S. boydii* types 12-15
Shigella Antiserum Poly Group D	*S. sonnei* I and II
Alkalescens-Dispar Antiserum Poly	Alkalescens-Dispar Groups 1,2,3 and 4

When rehydrated and used as described, each vial of Shigella Antisera Poly and Alkalescens-Dispar Antiserum Poly contains sufficient reagent for 60 slide tests.

Precautions

1. For In Vitro Diagnostic Use.
2. **Shigella Antiserum Poly Group A**
   Shigella Antiserum Poly Group A_1
   Shigella Antiserum Poly Group B
   Shigella Antiserum Poly Group C
   Shigella Antiserum Poly Group C_1
   Shigella Antiserum Poly Group C_2
   Shigella Antiserum Poly Group D
   Alkalescens-Dispar Antiserum Poly

   The Packaging of This Product Contains Dry Natural Rubber.
3. Follow proper established laboratory procedure in handling and disposing of infectious materials.

Storage

Store lyophilized and rehydrated Shigella Antisera Poly and Alkalescens-Dispar Antiserum Poly at 2-8°C. Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Lyophilized Shigella Antisera Poly and Alkalescens-Dispar Poly are stable through the expiration date on the label when stored as described.

Rehydrated Shigella Antisera Poly and Alkalescens-Dispar Antiserum Poly that are cloudy or have a precipitate at any time during the period of use should be discarded.

Procedure

Materials Provided

Shigella Antisera Poly Group A
Shigella Antisera Poly Group A_1
Shigella Antisera Poly Group B
Shigella Antisera Poly Group C
Shigella Antisera Poly Group C_1
Shigella Antisera Poly Group C_2
Shigella Antisera Poly Group D
Alkalescens-Dispar Antiserum Poly

Materials Required But Not Provided

Agglutination slides with 1 inch squares
Applicator sticks
Waterbath, boiling
Sterile 0.85% NaCl solution
QC Antigen Shigella Groups
QC Antigen Alkalescens-Dispar Group 1

Reagent Preparation

Equilibrate all materials to room temperature before performing the tests. Ensure that all glassware and pipettes are clean and free of residues such as detergents.

Shigella Antisera Poly and Alkalescens-Dispar Antiserum Poly: To rehydrate, add 3 ml of sterile 0.85% NaCl solution and rotate gently to completely dissolve the contents. The rehydrated antiserum is considered a 1:2 working dilution. Subsequent dilutions are based on this as a starting dilution.

Specimen Collection and Preparation

From clinical specimens, *Shigella* can be recovered on selective differential media such as Hektoen Enteric Agar or XLD Agar. For specific recommendations, consult appropriate references.[2,3,4] Determine that a pure culture of the microorganism has been obtained and that biochemical test reactions are consistent with the identification of the organism as a *Shigella* species. After these criteria are met, serological identification can be performed.

Shigella can be recovered from various types of foods when samples are processed to recover injured microorganisms and to prevent overgrowth of competing microorganisms. Consult appropriate references for recommended procedures when testing food samples.[5,6] After following an established protocol, determine that a pure culture of the microorganism has been obtained. Biochemical test reactions

should be consistent with the identification of the organism as a *Shigella* species. After these criteria are met, serological identification can be performed.

Test Procedure

Use this procedure to test the isolate with each selected Shigella Antisera Poly or Alkalescens-Dispar Antiserum Poly.

1. **Shigella Antiserum**: Dispense 1 drop (35 µl) of the antiserum to be tested on an agglutination slide.
2. **Negative control**: Dispense 1 drop of sterile 0.85% NaCl solution on an agglutination slide.
3. **Test isolate**: Transfer a loopful of growth of the test organism to the drops of antisera and NaCl solution and mix thoroughly.
4. **Positive control**: Dispense 1 drop of the Shigella Antiserum to be tested on an agglutination slide. Add 1 drop of the appropriate QC Antigen.
5. Mix each reaction area with a separate applicator stick and rock for 1 minute. Read for agglutination.

Results

1. Read and record results as follows:
   - 4+ 100% agglutination; background is clear to slightly hazy.
   - 3+ 75% agglutination; background is slightly cloudy.
   - 2+ 50% agglutination; background is moderately cloudy.
   - 1+ 25% agglutination; background is cloudy.
   - – No agglutination.
2. **Positive control**: Should show 3+ or greater agglutination.
3. **Negative control**: Should show no agglutination. If autoagglutination occurs, tests results cannot be reported. To test for autoagglutination, transfer the isolate to selective medium.
4. **Test isolates**: 3+ or greater agglutination within 1-2 minutes is a positive result.
5. If no agglutination occurs or agglutination is weak, follow this procedure to remove blocking envelope antigens:
   - Prepare a dense suspension of the isolate from an agar medium in 3-5 ml of sterile 0.85% NaCl solution.
   - Heat in a boiling waterbath for 30-60 minutes and cool. The suspension should not show precipitation after heating. If this occurs, select another colony for testing.
   - Centrifuge at 1,000 rpm for 10-15 minutes.
   - Aspirate and discard the supernatant.
   - Resuspend the sediment in 0.5 ml sterile 0.85% NaCl solution.
   - Use a drop of the suspension and perform the slide agglutination test as outlined above.
6. A partial (less than 3+) or delayed agglutination reaction should be considered negative.
7. If test results for either the positive control or negative control are not as described, the test is invalid and results cannot be reported.

Limitations of the Procedure

1. Correct interpretation of serological reactions depends on culture purity, morphological characteristics and biochemical reactions that are consistent with identification of the microorganism as a *Shigella* species.
2. Serological methods alone cannot identify the isolate as a *Shigella* species.
3. Excessive heat from external sources (hot bacteriological loop, burner flame, light source, etc.) may prevent making a smooth suspension of the microorganism or cause evaporation or precipitation of the test mixture. False-positive reactions may occur.
4. Rough culture isolates do occur and will agglutinate spontaneously, causing agglutination of the negative control (autoagglutination). Smooth colonies must be selected and tested in serological procedures.
5. Shigella Antisera Poly and Alkalescens-Dispar Poly have been tested using cultures taken directly from agar media. These antisera have not been tested using antigen suspensions in NaCl solution or other diluents. If the user applies variations in the recommended steps, each lot of antiserum must be tested with known control cultures to verify expected reactions under the modified procedure.

References

1. **Ewing, W.H. (ed.).** 1986. Edwards and Ewing's identification of Enterobacteriaceae, 4th ed. Elsevier Science Publishing Co., Inc., New York, NY.
2. **Gray, L. D.** 1995. *Escherichia, Salmonella, Shigella and Yersinia*, p. 450-456. *In* P. R. Murray, E. J. Baron, M. A. Pfaller, F. C. Tenover, and R. H. Yolken (ed.), Manual of clinical microbiology, 6th ed. American Society for Microbiology, Washington, D.C.
3. **Baron, E. J., L. R. Peterson, and S. M. Finegold.** 1994. Bailey & Scott's diagnostic microbiology, 9th ed. Mosby-Year Book, Inc., St. Louis, MO.
4. **Pezzlo, M. (ed.).** 1992. Aerobic bacteriology, p. 1.0.1-1.20.47. *In* H. D. Isenberg (ed.), Clinical microbiology procedures handbook, vol. 1. American Society for Microbiology, Washington, D.C.
5. **Andrews, W. H., G. A. June, and P. S. Sherrod.** 1995. Shigella, p. 6.01-6.06. *In* FDA Bacteriological Analytical Manual, 8th ed. AOAC International, Gaithersburg, MD.
6. **Vanderzant, C., and D. F. Splittstoesser (eds.).** 1992. Compendium of methods for the microbiological examination of foods, 3rd edition. American Public Health Association, Washington, D.C.

Packaging

Shigella Antiserum Poly Group A	3 ml	2834-47
Shigella Antiserum Poly Group A_1	3 ml	2776-47
Shigella Antiserum Poly Group B	3 ml	2835-47
Shigella Antiserum Poly Group C	3 ml	2836-47
Shigella Antiserum Poly Group C_1	3 ml	2777-47
Shigella Antiserum Poly Group C_2	3 ml	2778-47
Shigella Antiserum Poly Group D	3 ml	2837-47
Alkalescens-Dispar Antiserum Poly	3 ml	2838-47

Bacto® Streptococcus Antigens and Antisera

Streptococcus Antiserum Group A · Streptococcus Antiserum Group B · Streptococcus Antigen Group A · Streptococcus Antigen Group B

Intended Use

Bacto Streptococcus Antisera are used in the serological grouping of Group A and Group B streptococci by the capillary tube precipitin technique.

Bacto Streptococcus Antigens are used in the quality control testing of Bacto Streptococcus Antisera Groups A and B.

Summary and Explanation

Streptococci are gram-positive cocci that are facultative anaerobes. They are catalase negative and may be alpha-, beta- or non-hemolytic.

Streptococcus pyogenes (Group A) is the most common cause of bacterial pharyngitis in children. Symptoms include fever, pharyngeal erythema and edema, tonsillar exudate and enlarged cervical lymph nodes. Physical findings alone cannot distinguish between Group A streptococcal pharyngitis and pharyngitis caused by other agents such as viruses or mycoplasma. Other infections caused by Group A streptococci include scarlet fever, impetigo and skin infections that range from mild to severe with toxic shock symptoms and tissue necrosis.

User Quality Control

Identity Specifications

Streptococcus Antisera Groups A and B

Lyophilized Appearance: Light gold to amber, button to powdered cake.

Rehydrated Appearance: Light gold to amber, clear liquid.

Streptococcus Antigens Groups A and B

Solution Appearance: Colorless to light yellow, clear liquid.

Quality Control Results

Rehydrate Streptococcus Antisera per label directions. Perform the capillary tube precipitin technique using appropriate Streptococcus Antigens.

ANTISERUM	ANTIGEN	REACTION
Streptococcus Antiserum Group A	Streptococcus Antigen Group A	Positive
Streptococcus Antiserum Group A	Streptococcus Antigen Group B	Negative
Streptococcus Antiserum Group B	Streptococcus Antigen Group B	Positive
Streptococcus Antiserum Group B	Streptococcus Antigen Group A	Negative

Streptococcus agalactiae (Group B streptococci) causes neonatal sepsis and meningitis. Other infections in children and adults include bacteremia, endocarditis and pneumonia.

Identification of Group A and Group B streptococci includes isolation of the microorganism and biochemical and serological identification. Serological identification involves the reaction in which the microorganism (antigen) reacts with its corresponding antibody. This *in vitro* reaction produces fine particles called precipitation.

Principles of the Procedure

Beta-hemolytic streptococci Group A and Group B have carbohydrate group-specific antigens that can be extracted. Streptococcus Antisera and Streptococcus Antigens are used together in the capillary precipitin test to serologically identify the microorganisms.

Reagents

Streptococcus Antisera Groups A and B are lyophilized, polyclonal rabbit antisera containing approximately 0.02% Thimerosal as a preservative. When rehydrated and used as described, each vial of Streptococcus Antisera contains sufficient reagent for 50 precipitin tests.

Streptococcus Antigens Groups A and B are ready-to-use cellular extracts of *S. pyogenes* and *S. agalactiae*, respectively, containing Thimerosal as a preservative. When used as described, each vial of Streptococcus Antigens contains sufficient reagent for 50 precipitin tests.

Precautions

1. For In Vitro Diagnostic Use.
2. **Streptococcus Antiserum Group A**
   Streptococcus Antiserum Group B
   Streptococcus Antigen Group A
   Streptococcus Antigen Group B
   The Packaging of This Product Contains Dry Natural Rubber.
3. Follow proper established laboratory procedures in handling and disposing of infectious materials.
4. Streptococcus Antigens are not intended for use in the immunization of humans or animals.

Storage

Store lyophilized and rehydrated Streptococcus Antisera at 2-8°C.

Store Streptococcus Antigens at 2-8°C.

Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications Rehydrated Streptococcus Antiserum that is cloudy or has a precipitate anytime during use should be discarded.

Antigens must be smooth uniform suspensions. Examine antigen vials for precipitation before use. Suspensions with precipitation are not usable and should be discarded.

Procedure

Materials Provided

Streptococcus Antiserum Group A
Streptococcus Antiserum Group B
Streptococcus Antigen Group A
Streptococcus Antigen Group B

Materials Required but not Provided

Capillary tubes
Sterile distilled or deionized water
Plasticine block

Reagent Preparation

Equilibrate all materials to room temperature before performing the tests. Ensure that glassware and pipettes are clean and free of residues such as detergent.

Streptococcus Antisera: To rehydrate, add 1 ml sterile distilled or deionized water and rotate gently to completely dissolve the contents.

Streptococcus Antigens are ready to use.

Specimen Collection and Preparation

Group A and Group B streptococci can be recovered on routine culture media such as sheep blood agar. For specific recommendations on isolation and presumptive identification, consult appropriate references.[1,2] Determine that a pure culture of the microorganism has been obtained and that biochemical test reactions are consistent with the identification of the organism as a Group A or Group B *Streptococcus*. After these criteria are met, serological identification can be performed.

Test antigen extract: To prepare, extract the carbohydrate, group-specific antigen from a pure culture of the microorganism by the Lancefield hot HCl, autoclave, enzyme or other such method. For specific information on these methods, consult appropriate references.[1,2]

Test Procedure

Add the antiserum to the capillary tube first so that it will be layered above the extract.

1. **Streptococcus Antiserum**: Dip a capillary tube into the antiserum and allow a column of 2-3 cm to rise into the tube.
2. Holding the forefinger on the top end of the capillary tube, remove the tube from the antiserum vial. Clean the tip with a lint-free tissue to remove excess antiserum. Do not allow air into the tube. If this occurs, discard the tube and begin again.
3. **Test antigen extract**: Dip the capillary tube into the prepared extract until the antiserum and the antigen come in contact with each other. If an air bubble separates them, discard the tube and repeat steps 1-3.
4. Remove the tube from the extract and invert slightly to allow the column to move to the center of the tube.
5. Wipe excess fluid from the tube and insert in a plasticine block, antiserum end upward. Wipe the capillary tube so that it is free of fingerprints or any material that might interfere with a clear reading.
6. **Positive control**: Repeat steps 1-5, using (in step 3) a Streptococcus Antigen (Group A or B) that is *homologous* to the antiserum used in step 1.
7. **Negative control**: Repeat steps 1-5, using (in step 3) a Streptococcus Antigen (Group A or B) that is *not homologous* to the antiserum used in step 1.
8. Incubate all capillary tubes at 22 ± 2°C for 5 minutes. Examine for the formation of a white precipitate at the interface of the antiserum and the antigen. Observe at 5 minute intervals for up to 30 minutes.

Results

1. A strongly positive reaction develops within 5 minutes, a weaker reaction develops within 30 minutes.
2. Disregard any precipitate that appears after 30 minutes.
3. Precipitation in a tube indicates that the test antigen extract is homologous to the Streptococcus Antiserum Group A or Group B used.
4. Observe at 5 minute intervals within the 30 minute period because the precipitate may dissolve (prozone phenomenon).

Limitations of the Procedure

1. Correct interpretation of serological reactions depends on culture purity as well as on morphological characteristics and biochemical reactions that are consistent with identification of the microorganism as *S. pyogenes* or *S. agalactiae*.
2. Serological methods alone cannot identify the isolate as *S. pyogenes* or *S. agalactiae*.

References

1. **Murray, P. R., E. J. Baron, M. A. Pfaller, F. C. Tenover, and R. H. Yolken (ed.).** 1995. Manual of clinical microbiology, 6th ed. American Society for Microbiology, Washington, D.C.
2. **Isenberg, H. D. (ed.).** 1992. Clinical microbiology procedures handbook, vol. 2. American Society for Microbiology, Washington, D.C.

Packaging

Streptococcus Antiserum Group A	1 ml	2672-50
Streptococcus Antiserum Group B	1 ml	2741-50
Streptococcus Antigen Group A	1 ml	2978-50
Streptococcus Antigen Group B	1 ml	2979-50

Bacto® USR Antigen
Bacto USR Test Control Serum Set

Intended Use

Bacto USR Antigen is nontreponemal antigen used in the Unheated Serum Reagin (USR) Test.[1]

Bacto USR Test Control Serum Set is standardized human sera used for controlling the USR Test.

Summary and Explanation

Treponema pallidum is the causative agent of syphilis. Syphilis is a chronic infection with clinical manifestations that occur in distinct stages. Specific laboratory tests are recommended for the detection of each stage of the disease.

During the primary stage, treponemes present in the characteristic lesion, a chancre, are detectable by dark-field microscopy[2] or by the Direct Fluorescent Antibody Test for *T. pallidum* (DFA-TP). During the secondary stage, most serological tests for syphilis are reactive and treponemes may be found in the lesions by using dark-field microscopy. The latent period, which is asymptomatic, may last for years. Serological tests are usually reactive in the early latent period, but the reactivity of non-treponemal tests decreases during the late latent period. Symptoms of the tertiary or late stage of syphilis may occur 10-20 years after initial infection. Approximately 71% of patients in the tertiary stage of syphilis have reactive non-treponemal tests.[3,4] In the tertiary stage, treponemal tests will usually be reactive and are the only basis for diagnosis. The lesions in tertiary syphilis will have few treponemes. Neurosyphilis and late cardiovascular syphilis are complications of tertiary syphilis.

Since the clinical manifestations of syphilis can be confused with other infectious or noninfectious conditions, proper diagnosis must include microscopic examination of lesion material and serological results.[3]

The USR Antigen is a nontreponemal antigen composed of cardiolipin, cholesterol and lecithin. The antigen is a modification of the VDRL Antigen emulsion in a USR suspending solution. The antigen suspension contains choline chloride, which enhances the reactivity of reagin in unheated serum.[5] The USR Test is suitable for qualitative as well as quantitative determinations.

Nontreponemal tests measure reagin, an antibody-like substance that can be detected in syphilitic serum. Reagin is also occasionally found in the serum of persons with other acute or chronic diseases. Reactive nontreponemal tests aid in the diagnosis of latent subclinical syphilis and are effective tools for detecting cases in epidemiological investigations. Nontreponemal tests are superior to treponemal tests for following the response to therapy.[3]

Nontreponemal antigen tests are not entirely specific for syphilis, nor do they have satisfactory sensitivity in all stages of syphilis. Whenever the results of a nontreponemal antigen test disagree with the clinical impression, a treponemal antigen test such as the Fluorescent Treponemal Antibody-Absorption (FTA-ABS)[2,3] should be performed. Nontreponemal tests such as the USR, RPR and VDRL tests are used to screen patient serum. Treponemal tests such as the FTA-ABS are used for confirmation.

The likelihood of obtaining a reactive USR Test result in various stages of untreated syphilis has been reported as follows:[3]

STAGES OF UNTREATED SYPHILIS	% REACTIVE
Primary	80
Secondary	100
Latent	95

User Quality Control

Identity Specifications

USR Antigen

Appearance: Milky white, opaque suspension after gentle mixing.

Nontreponemal Antigen Reactive Serum

Lyophilized Appearance: White to cream colored, button to powdered cake.

Rehydrated Appearance: Light gold to light amber, clear to slightly opalescent.

USR Weakly Reactive Serum

Lyophilized Appearance: White to cream colored, button to powdered cake.

Rehydrated Appearance: Light gold to light amber, clear to slightly opalescent.

Nontreponemal Antigen Nonreactive Serum

Lyophilized Appearance: White to cream colored, button to powdered cake.

Rehydrated Appearance: Light gold to light amber, clear to slightly opalescent.

Performance Response

Rehydrate the sera contained in the USR Test Control Serum Set per label directions. Perform the USR Test according to the Test Procedure. Each serum in the USR Test Control Serum Set should yield appropriate reactions when tested with the USR Antigen.

Use the USR Antigen suspension only if it produces the expected reactivity with the control sera.

Principles of the Procedure

In the USR Test procedure, the patient's unheated serum is mixed with a buffered saline suspension of USR Antigen containing cardiolipin, lecithin and cholesterol. The combination of reagin and USR Antigen forms microscopic clumping called flocculation.

Reagents

USR Antigen is 0.03% cardiolipin and 0.9% cholesterol dissolved in absolute alcohol with sufficient lecithin (approximately 0.2%) to produce standard reactivity. The antigen is suspended in a solution

containing EDTA, choline chloride and phosphate with 0.2% Thimerosal as a preservative.[7,8]

USR Test Control Serum Set contains 3 ml, each, of the following lyophilized human sera: Nontreponemal Antigen Reactive Serum, USR Weakly Reactive Serum and Nontreponemal Antigen Nonreactive Serum. These reagents are standardized to provide reactive, weakly reactive and nonreactive readings, respectively, when tested according to the USR Test procedure.

Precautions

1. For In Vitro Diagnostic Use.
2. WARNING! POTENTIAL BIOHAZARDOUS REAGENTS. Each donor unit used in preparation of USR Antigen and USR Test Control Serum Set was tested by an FDA approved method for the presence of the antibody to human immunodeficiency virus (HIV) and for hepatitis B surface antigen and found negative (were not repeatedly reactive).

   Because no test method can offer complete assurance that HIV, hepatitis B virus or other infectious agents are absent, these reagents should be handled at the Biosafety Level 2 as recommended for any potentially infectious human serum or blood specimen.[9]
3. **USR Test Control Serum Set**

   The Packaging of This Product Contains Dry Natural Rubber.
4. Observe universal blood and body fluid precautions in handling and disposing of specimens.[10,11]
5. Follow proper established laboratory procedure in handling and disposing of infectious materials.

Storage

Store USR Antigen at 2-8°C. If the original 3 ml quantity exceeds what is needed for one testing period, transfer the remainder from the first day's use to one or more aliquot vials and store at 2-8°C.

Store the lyophilized sera in the USR Test Control Serum Set at 2-8°C. Store the rehydrated control sera at 2-8°C or divide into aliquots sufficient for one day of testing and store at -20°C. Do not thaw and refreeze.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

USR Antigen
USR Test Control Serum Set

Materials Required But Not Provided

0.9% saline
Nondisposable glass syringe, 1-2 cc
Nondisposable calibrated 18-gauge needles without bevel
Micropipettor, 50 µl
Pipettes, serological, graduated to tip:
1.0 ml, graduated in 1/100 ml
5.0 ml, graduated in 1/10 ml
10.0 ml, graduated in 1/10 ml
Slides, 2 x 3 inches with paraffin or ceramic rings approximately 14 mm in diameter and high enough to prevent spillage during rotation.
Slide holder for 2 x 3 inch slides
Mechanical rotator, adjustable to 180 ± 2 rpm circumscribing a circle 19 mm in diameter on a horizontal plane.
Light microscope with 10X ocular and 10X objective
Sterile distilled or deionized water
Absolute alcohol
Acetone
Timer

Reagent Preparation

USR Antigen is ready to use.

Equilibrate all materials to room temperature (23-29°C) before performing the tests. Ensure that all glassware and pipettes are clean and free of detergent residues.

USR Test Control Serum Set: To rehydrate the control sera, add 3 ml sterile distilled or deionized water and rotate gently to completely dissolve the contents.

Specimen Collection and Preparation

Collect a blood specimen by aseptic venipuncture into a clean, dry tube without anticoagulant. After the specimen has clotted, centrifuge the specimen at 1,500-2,000 rpm for five minutes to obtain test serum. Store serum specimens at room temperature for no longer than 4 hours; for prolonged storage, keep at 2-8°C for up to 5 days or maintain below -20°C. Serum specimens must be clear, free of hemolysis and show no visible evidence of bacterial contamination, such as turbidity or particulate matter. Refer to appropriate references for more information on collection of specimens.[1,3,12]

Test Procedure

Preparation of Specific Glassware

Syringes with needles:

1. Prerinse with tap water.
2. Soak and hand wash thoroughly in a glassware detergent solution.
3. Rinse with tap water 6-8 times.
4. Rinse with unused distilled or deionized water.
5. Rinse with absolute alcohol.
6. Rinse with acetone.
7. Air dry until the acetone odor is completely eliminated.
8. Remove needles from syringes for storage.

Ceramic-ringed slides:

1. Prerinse with tap water.
2. Wash with a glassware detergent solution. Avoid prolonged soaking of ceramic-ringed slides in detergent solution because the ceramic rings will become brittle and flake off.
3. Rinse with tap water 3-4 times.
4. Rinse with unused distilled or deionized water.
5. Wipe dry with a clean lint-free cloth. If cleaned slides do not allow serum to spread evenly within the inner surface of the circle, proceed as follows.
6. Scrub the slides with a nonscratching cleanser.
7. Rinse, dry and polish with a clean, lint-free cloth.

Testing the Accuracy of the Antigen Suspension Needle

1. The accuracy of the test depends on the amount of antigen suspension used. Check the calibration of the needle periodically to ensure delivery of the correct volume of USR Antigen suspension.
2. For the qualitative and quantitative tests on serum, dispense the antigen suspension from a syringe fitted with an 18-gauge needle without bevel that will deliver 45 ± 1 drops (22 ml) of antigen suspension per ml when held vertically.
3. Place the needle on a 1-2 ml syringe. Fill the syringe with 1 ml of USR Antigen suspension. Holding the syringe in a vertical position, count the number of drops delivered in 1.0 ml. The needle is correctly calibrated if 45 ± 1 drops are delivered in 1.0 ml.
4. Adjust or replace the needle if it does not meet this specification. Repeat calibration on the new or adjusted needle.

Testing and Storing the USR Antigen Suspension

1. Store the antigen suspension at 2-8°C.
2. For daily use, withdraw a sufficient amount of suspension for 1 day's testing and store the remainder at 2-8°C. Antigen suspensions must be at room temperature (23-29°C) before use.
2. Test antigen suspension reactivity with the Reactive, Weakly Reactive and Nonreactive control sera. Use the antigen suspension only if it produces the expected reactivity with the control sera.
3. After each day of use, clean the dispensing needle, bottle and syringe by rinsing with water, alcohol and acetone, in that order. Remove the needle from the syringe after cleaning.

USR Qualitative Slide Test on Serum[1,13]

For reliable and reproducible test results, the USR Antigen suspension, controls and test specimens must be at 23-29°C when tests are performed.

1. Pipette 50 µl of unheated serum into one ring of a paraffin- or ceramic-ringed slide using a safety pipetting device. Do not use a glass slide with concavities, wells or glass rings. Spread the serum with a circular motion of the pipette tip so that the serum covers the entire inner surface of the paraffin or ceramic ring. Include control sera when performing the test.
2. Gently resuspend the USR Antigen and withdraw the desired quantity with a syringe and needle.
3. Hold the syringe and needle containing the USR Antigen suspension in a vertical position. Dispense several drops to clear the needle of air. Add exactly 1 free-falling drop (22 µl) of antigen suspension to each circle containing serum. Do not allow the needle to touch the serum.
4. Place the slide on the mechanical rotator. Rotate the slide for 4 minutes at 180 ± 2 rpm. If the environment is dry, cover the slides with a moist, humidifying cover during rotation to prevent excessive evaporation.
5. Immediately after rotating the slide, remove the slide from the rotator and read the test results microscopically, using a 10X ocular and a 10X objective.

Results – Qualitative Test

1. Read and record results as follows:
   Medium to large clumps - Reactive (R)
   Small clumps - Weakly reactive (WR)
   No clumping or very slight roughness - Nonreactive (N)
2. Verify that the control sera results are as expected. If reactions are not as expected, the test is invalid and results cannot be reported.
3. Perform a quantitative test on all serum specimens that produce Reactive, Weakly Reactive or "rough" Nonreactive results, since prozone reactions are occasionally encountered.

USR Quantitative Test[1,13] on Serum

1. To quantitate serum samples to an endpoint titer, prepare serum dilutions on the slide at 1:1, 1:2, 1:4 and 1:8, as follows.
2. Dispense 50 µl of 0.9% saline in circles 2-4. Do not spread the saline.
3. Dispense 50 µl of serum in circles 1 and 2.
4. Mix the saline and the serum in circle 2 by drawing the mixture up and down in the pipette 8 times. Mix gently to prevent bubbles.
5. Transfer 50 µl from circle 2 (1:2) to circle 3 and mix.
6. Transfer 50 µl from circle 3 (1:4) to circle 4 (1:8), mix, and then discard 50 µl from circle 4.
7. Holding the syringe and needle containing the USR Antigen suspension in a vertical position, dispense several drops to clear the needle of air. Then, add exactly 1 free-falling drop (22 µl) of antigen suspension to each circle containing serum. Do not allow the needle to touch the serum.
8. Place the slide on the mechanical rotator. Rotate the slide for 4 minutes at 180 ± 2 rpm. If the environment is dry, cover the slides with a moist, humidifying cover during rotation to prevent excessive evaporation.
9. Immediately after rotating the slide, remove the slide from the rotator and read the test results microscopically using a 10X ocular and a 10X objective.
10. If the highest dilution tested (1:8) is reactive, prepare a 1:8 dilution of the test specimen by adding 0.1 ml of serum to 0.7 ml of 0.9% saline. Mix thoroughly. Retest as in steps 1-9, above.

Results – Quantitative Test

Report the titer as the highest dilution that produces a Reactive result.

Table 1. Sample quantitative USR Test results.

Undiluted (1:1)	1:2	1:4	1:8	1:16	1:32	
R	W	N	N	N	N	Reactive, undiluted
R	R	W	N	N	N	Reactive, 1:2 dilution
R	R	R	W	N	N	Reactive, 1:4 dilution
W	W	R	R	W	N	Reactive, 1:8 dilution
N (rough)	W	R	R	R	N	Reactive, 1:16 dilution
W	N	N	N	N	N	Weakly reactive, undiluted

If reactive results are obtained through dilution 1:32, prepare further twofold serial dilutions in 0.9% saline (1:64, 1:128 and 1:256) and retest using the quantitative test procedure.

Interpretation

1. The results of the serum USR Test must be confirmed by a treponemal test.
2. The diagnosis of syphilis depends on the results of the USR Test, treponemal confirmatory test, clinical signs and symptoms, and risk factors.
3. A Reactive USR Test may indicate past or present infection with a pathogenic treponeme. However, it may be a false-positive reaction. A false positive is determined if the confirmatory treponemal test is negative.
4. A Nonreactive USR Test with clinical evidence of syphilis may indicate early, primary syphilis, a prozone reaction in secondary syphilis, or late syphilis.
5. A Nonreactive USR Test with no clinical evidence of syphilis indicates no current infection or an effectively treated infection.
6. A quantitative USR Test detects changes in reagin titer. Therefore, a serum specimen showing a fourfold increase in titer on a repeat specimen may indicate an infection, a reinfection or a treatment failure. Likewise, a fourfold decrease during treatment indicates adequate syphilis therapy.

Limitations of the Procedure

1. A prozone reaction may occur in which reactivity with true positive undiluted serum is inhibited. The prozone phenomenon often gives Weakly Reactive or "rough" Nonreactive results in the qualitative test. Specimens with such nonreactive results must be quantitatively tested.
2. Biological false-positive reactions can occur with nontreponemal tests in persons who abuse drugs, have diseases such as lupus erythematosus, mononucleosis, malaria, leprosy or viral pneumonia, or who have recently been immunized.[1]
3. Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.
4. If the temperature of the testing area, specimens, or reagents is less than 23°C, test, reactivity is decreased. If the temperature is greater than 29°C, test reactivity is increased.[1]
5. Test results are unpredictable when testing hemolyzed, contaminated or extremely turbid serum specimens.
6. Test results may be erroneous if the speed and time of rotation are not correct.
7. Positive results obtained by using USR Antigen should not be considered as conclusive evidence that the patient is syphilitic. Conversely, a nonreactive USR Test, by itself, does not rule out the diagnosis of syphilis.

References

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Packaging

USR Antigen	6 x 3 ml	2405-46
USR Test Control Serum Set	1 set	3516-32
Contains:		
Nontreponemal Antigen Reactive Serum	3 ml	
USR Weakly Reactive Serum	3 ml	
Nontreponemal Antigen Nonreactive Serum	3 ml	
Aliquant Vials	3 vials	

Bacto® VDRL Antigen
Bacto VDRL Test Control Serum Set

Intended Use

Bacto VDRL Antigen with Bacto VDRL Buffered Saline is used in the Venereal Disease Research Laboratory (VDRL)[1] Test for detecting reagin, an antibody-like substance, by the qualitative and quantitative slide procedures.

Bacto VDRL Test Control Serum Set is used for controlling the VDRL Test.

Summary and Explanation

Treponema pallidum is the causative agent of syphilis. Syphilis is a chronic infection with many clinical manifestations which occur in distinct stages. Specific laboratory tests are recommended for the detection of each stage of the disease.[2-4]

The VDRL Antigen is a nontreponemal antigen composed of cardiolipin, cholesterol, and lecithin. The nontreponemal tests measure antilipid antibodies (IgG and IgM, which are formed by the host in response to lipoidal material released from damaged host cells early in infection with *T. pallidum*) and lipid like material from the treponemal cell surface.[5] During infection with syphilis, an antibody-like substance called reagin can be detected in the patient's serum. In syphilis infection of the central nervous system, reagin can be detected in the cerebrospinal fluid (CSF).

Reactive nontreponemal tests confirm the diagnosis in the presence of early or late lesion syphilis. They offer a clue in latent subclinical syphilis, and are effective tools for detecting cases in epidemiological investigations. Nontreponemal tests are superior to the treponemal test for following the response to therapy.[3]

Nontreponemal antigen tests are not entirely specific for syphilis, nor do they have satisfactory sensitivity in all stages of syphilis. Whenever the results of a nontreponemal antigen test disagree with the clinical impression, a treponemal antigen test such as the FTA-ABS[2,3] should be performed. Nontreponemal tests such as the VDRL are used to screen patient serum, while treponemal tests such as the FTA-ABS are used for confirmation. The likelihood of obtaining a reactive VDRL test result in various stages of untreated syphilis has been reported as follows[3]:

STAGES OF UNTREATED SYPHILIS	% REACTIVE VDRL TEST
Primary	78
Secondary	100
Latent	96
Late	71

User Quality Control

Identity Specifications

VDRL Antigen
Appearance: Clear, colorless solution.

VDRL Buffered Saline
Appearance: Clear, colorless solution.

Nontreponemal Antigen Reactive Serum
Lyophilized Appearance: White to cream colored, button to powdered cake.
Rehydrated Appearance: Light gold to light amber, clear to slightly opalescent.

VDRL Weakly Reactive Serum
Lyophilized Appearance: White to cream colored, button to powdered cake.
Rehydrated Appearance: Light gold to light amber, clear to slightly opalescent.

Nontreponemal Antigen Nonreactive Serum
Lyophilized Appearance: White to cream colored, button to powdered cake.
Rehydrated Appearance: Light gold to light amber, clear to slightly opalescent.

Performance Response

Rehydrate the sera contained in the VDRL Test Control Serum Set per label directions. Perform the VDRL Slide Test according to the Test Procedure. Each serum in the VDRL Test Control Serum Set should yield appropriate reactions when tested with the VDRL Antigen.

Use an antigen suspension only if it produces the expected reactivity with the control sera.

Principles of the Procedure

In the VDRL Test procedure, the patient's serum is heat-inactivated and then mixed with a buffered saline suspension of VDRL Antigen containing cardiolipin, lecithin and cholesterol. The combination of reagin and VDRL Antigen forms microscopic clumping called flocculation. With certain modification, the serum test procedure can be used for testing CSF.

Reagents

VDRL Antigen is 0.03% cardiolipin and 0.9% cholesterol dissolved in absolute alcohol with sufficient lecithin (approximately 0.18-0.2%) to produce standard reactivity.

It is prepared according to the modifications of Harris, Rosenberg and Riedel.[6] Cardiolipin and lecithin are prepared according to the directions of Pangborn.[7,8,9]

VDRL Buffered Saline is a 1% NaCl solution at pH 6.0 ± 0.1. It is packaged with VDRL Antigen and used to prepare the VDRL Antigen suspension.

Nontreponemal Antigen Reactive Serum is a lyophilized human serum standardized to provide a reactive reading when tested according to the USR or VDRL test procedure.

VDRL Weakly Reactive Serum is a lyophilized human serum standardized to provide a weakly reactive reading when tested according to the VDRL test procedure.

Nontreponemal Antigen Nonreactive Serum is a lyophilized human serum standardized to provide a nonreactive reading when tested according to the USR or VDRL test procedure.

Precautions

1. For In Vitro Diagnostic Use.
2. **WARNING!** POTENTIALLY BIOHAZARDOUS REAGENTS. Each donor unit used in preparation of VDRL Antigen and VDRL Test Control Serum Set was tested by an FDA approved method for the presence of the antibody to human immunodeficiency virus (HIV) and for hepatitis B surface antigen and found negative (were not repeatedly reactive).

   Because no test method can offer complete assurance that HIV, hepatitis B virus or other infectious agents are absent, these reagents should be handled at the Biosafety Level 2 as recommended for any potentially infectious human serum or blood specimen.[10]
3. Observe universal blood and body fluid precautions in handling and disposing of specimens.[11,12]
4. **VDRL Antigen**

   HIGHLY FLAMMABLE. IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.[us] POSSIBLE RISK OF IRREVERSIBLE EFFECTS.[us] POSSIBLE RISK OF HARM TO THE UNBORN CHILD.[us] Avoid contact with skin and eyes. Do not breathe mist. Wear suitable protective clothing. Keep container tightly closed. Keep away from sources of ignition. No smoking. Target Organs: Blood, Intestines, Liver, Muscles, Nerves.

   FIRST AID: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice. If swallowed seek medical advice immediately and show this container or label.
5. **VDRL Test Control Serum Set**

   The Packaging of This Product Contains Dry Natural Rubber.
6. Follow proper established laboratory procedure in handling and disposing of infectious materials.

Storage

Store VDRL Antigen at 15-30°C in the dark.

Store VDRL Buffered Saline at 15-30°C. After the bottle is opened, store at 2-8°C.

Store the lyophilized control sera in the VDRL Test Control Serum Set at 2-8°C. Store the rehydrated control sera at 2-8°C or divide into aliquots sufficient for one day of testing and store at -20°C. Do not thaw and refreeze.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

VDRL Antigen with VDRL Buffered Saline
VDRL Test Control Serum Set

Materials Required But Not Provided

0.9% saline
Nondisposable syringe, 1 cc
Nondisposable calibrated needles without bevel:
  Serum test: 18 gauge
  CSF test: 21 or 22 gauge
Bottles, 30 ml, round, narrow-mouthed, 35 mm in diameter with glass stoppers and a flat inner-bottom surface
Micropipettor, 50 µl
Pipettes, serological, graduated to tip:
  1.0 ml, graduated in 1/100 ml
  5.0 ml, graduated in 1/10 ml
  10.0 ml, graduated in 1/10 ml
Slides:
  Serum test: 2 x 3 inches with paraffin or ceramic rings approximately 14 mm in diameter and high enough to prevent spillage during rotation
  CSF test: Kline concavity slides, 3 x 2 3 inches x 3 mm thick, 12 concavities measuring 16 mm in diameter and 1.75 mm in depth
Slide holder for 2 x 4 inch slides
Mechanical rotator adjustable to 180 ± 2 rpm, circumscribing a circle 19 mm in diameter on a horizontal plane
Waterbath, 56°C
Light microscope with 10X ocular and 10X objective
Sterile distilled or deionized water
Absolute alcohol
Acetone
Timer

Reagent Preparation

VDRL Antigen and VDRL Buffered Saline are ready to use in preparing VDRL Antigen suspension.

Equilibrate all materials to room temperature before performing the tests. Ensure that all glassware and pipettes are clean and free of detergent residues.

VDRL Test Control Serum Set: To rehydrate the control sera, add 3 ml sterile distilled or deionized water each and rotate gently to completely dissolve the contents.

Specimen Collection and Preparation

Collect a blood specimen by aseptic venipuncture. After the specimen has clotted, centrifuge to obtain serum. Store serum specimens at room temperature for no longer than 4 hours; for prolonged storage, keep at 2-8°C for up to 5 days or maintain below -20°C. Serum specimens must be clear, free of hemolysis and show no visible evidence of bacterial contamination such as turbidity, hemolysis or particulate matter. Consult appropriate references for more information on collection of specimens.[1,3,13]

Before testing, heat the test sera at 56°C for 30 minutes. Specimens that are not tested within four hours must be reheated for 10 minutes at 56°C.

Preparation of Specific Glassware

Syringes with needles and emulsion bottles:

1. Pre-rinse with tap water.
2. Soak and hand wash thoroughly in a glassware detergent solution.
3. Rinse with tap water 6-8 times.
4. Rinse with unused distilled or deionized water.
5. Rinse with absolute alcohol.
6. Rinse with acetone.

7. Air dry until the acetone odor is completely eliminated.
8. Remove needles from syringes for storage.

Ceramic-ringed slides:

1. Pre-rinse with tap water.
2. Wash with a glassware detergent solution. Avoid prolonged soaking in detergent solution because the ceramic rings will become brittle and flake off.
3. Rinse with tap water 3-4 times.
4. Rinse with unused distilled or deionized water.
5. Wipe dry with a clean lint-free cloth. If, after cleaning, the slides do not allow serum to spread evenly within the inner surface of the circle, proceed as follows.
6. Scrub the slides with a nonscratching cleanser.
7. Rinse, dry and polish with a clean lint-free cloth.

Prepare the Antigen Suspension

Check the pH of VDRL Buffered Saline before preparing the VDRL Antigen emulsion. VDRL Buffered Saline outside the range of pH 6.0 ± 0.1 should be discarded.

Allow VDRL Antigen and VDR Buffered Saline to reach 23-29°C before preparing the VDRL Antigen emulsion.

Use only emulsion bottles with flat inner-bottom surfaces that allow the initial VDR Buffered Saline to evenly cover the inner-bottom surface of the bottle. If the VDRL Buffered Saline beads or does not spread evenly to cover the bottom of the bottle, rewash the bottle.

For reproducible results, the VDRL Antigen emulsion must be checked daily for proper reactivity by testing with VDRL Test Control Serum Set. Only those VDRL emulsions producing the established reactivity pattern of the control serum should be used.

1. Prepare a fresh VDRL Antigen suspension each testing day. The temperature of the VDRL Buffered Saline, VDRL Antigen and equipment should be between 23-29°C at the time the antigen suspension is prepared.
2. Pipette 0.4 ml of VDRL Buffered Saline to the bottom of a round, 30 ml glass-stoppered bottle with a flat inner-bottom surface. Gently tilt the bottle so that the VDR Buffered Saline will cover the entire inner-bottom surface of the bottle.
3. Add 0.5 ml of VDRL Antigen (from the lower half of a 1.0 ml pipette graduated to the tip) directly into the saline while continuously but gently rotating the bottle on a flat surface. Add antigen drop by drop at a rate allowing approximately 6 seconds for each 0.5 ml of antigen. Keep the pipette tip in the upper third of the bottle. Do not splash saline onto the pipette. The proper speed of rotation is obtained when the center of the bottle circumscribes a 2-inch diameter circle approximately three times per second.
4. Expel the last drop of antigen from the pipette without touching the pipette to the saline and continue rotating the bottle for 10 seconds.
5. Add 4.1 ml of buffered saline from a 5 ml pipette. Do not drop the saline directly onto the antigen; allow it to flow down the side of the bottle.
6. Cap the bottle and shake it from bottom to top and back approximately 30 times in 10 seconds. Let the VDRL Antigen emulsion stand without further disturbance for 10 minutes. The antigen suspension is ready for use and may be used during 1 day (8 hours).
7. Mix the VDRL Antigen suspension by gently swirling it each time it is used. Do not mix the suspension by forcing it back and forth through the syringe and needle, since this may cause breakdown of particles and loss of reactivity.

Testing the Accuracy of the Antigen Suspension Needle

1. The accuracy of the test depends on the amount of antigen suspension used. Check the calibration of the needle periodically to ensure delivery of the correct volume of VDRL Antigen suspension.
2. For the qualitative and quantitative tests on serum, dispense the antigen suspension from a syringe fitted with an 18-gauge needle without bevel that will deliver 60 ± 2 drops of antigen suspension per ml when held vertically.
3. Place the needle on a 1 ml syringe. Fill the syringe with VDRL Antigen suspension. Holding the syringe in a vertical position, count the number of drops delivered in 0.5 ml. The needle is correctly calibrated if 30 ± 1 drops are delivered in 0.5 ml.
4. Adjust or replace the needle if it does not meet this specification. Repeat calibration of the new needle.

Testing and Storing the VDRL Antigen Suspension

1. Prepare a fresh antigen suspension each testing day. Once prepared, it should be used within 8 hours.
2. Store the antigen suspension at 23-29°C.
3. Test the reactivity of the antigen suspension with the Reactive, Weakly Reactive and Nonreactive control sera. Test the serum dilutions within 1 hour after inactivation.
4. Use the antigen suspension only if it produces the expected reactivity with the control sera (Reactive, Weakly Reactive and Nonreactive).
5. After each day of use, clean the dispensing needle, bottle and syringe by rinsing with water, alcohol and acetone, as described above. Remove the needle from the syringe after cleaning.

VDRL Qualitative Slide Test on Serum

1. Slide flocculation tests for syphilis are affected by the temperature of the room. For reliable and reproducible test results, the VDRL Antigen suspension, controls and test specimens must be at 23-29°C when tests are performed.
2. Pipette 50 µl of serum into one ring of a paraffin or ceramic-ringed slide using a safety pipetting device. Do not use a glass slide with concavities, wells or glass rings. Spread the serum with a circular motion of the pipette tip so that the serum covers the entire inner surface of the paraffin or ceramic ring. Use only clean slides that allow the serum to evenly cover the entire surface within the ceramic or paraffin ring.
3. Gently Resuspend the VDRL Antigen suspension.
4. Holding the VDRL Antigen suspension dispensing needle and syringe in a vertical position, dispense several drops to clear the needle of air. Then add exactly 1 free-falling drop (17 µl) of antigen suspension to each circle containing serum. Do not allow the needle to touch the serum.
5. Place the slide on the mechanical rotator. Rotate the slide for 4 minutes at 180 ± 2 rpm. When performing the test in a dry climate, cover the slides with a moist, humidifying cover during rotation to prevent excessive evaporation.
6. Immediately after rotating the slide, remove it from the rotator and read the test results microscopically using a 10X ocular and a 10X objective.

Results - Qualitative Slide Test

1. Read and record results as follows:
   Reactive (R) - Medium to large clumps
   Weakly reactive (WR) - Small clumps
   Nonreactive (N) - No clumping or very slight roughness
2. Verify that the control sera results are as expected. If reactions are not as expected, the test is invalid and results cannot be reported.
3. Perform a quantitative test on all serum specimens that produce Reactive, Weakly Reactive or "rough" Nonreactive results, since prozone reactions are encountered occasionally.

VDRL Quantitative Test on Serum

1. To quantitate serum samples to an endpoint titer, prepare serum dilutions on the slide at 1:1, 1:2, 1:4 and 1:8, as follows.
2. Dispense 50 µl of 0.9% saline in circles 2-4. Do not spread the saline.
3. Dispense 50 µl of serum in circles 1 and 2.
4. Mix the saline and the serum in circle 2 by drawing the mixture up and down in the pipette 8 times. Avoid forming bubbles.
5. Transfer 50 µl from circle 2 (1:2) to circle 3 (1:4) and mix.
6. Transfer 50 µl from circle 3 (1:4) to circle 4 (1:8), mix, and then discard 50 µl from circle 4.
7. Gently resuspend the antigen suspension.
8. Holding the antigen suspension dispensing needle and syringe in a vertical position, dispense several drops to clear the needle of air. Then add exactly 1 free-falling drop (17 µl) of antigen suspension to each circle.
9. Place the slide on the mechanical rotator. Rotate the slide for 4 minutes at 180 ±2 rpm. When performing the test in a dry climate, place the slides under a moist, humidifying cover during rotation to prevent excessive evaporation.
10. Immediately after rotation, read the test results microscopically using a 10X ocular and a 10X objective.
11. If the highest dilution tested (1:8) is reactive, prepare a 1:8 dilution of the test specimen by adding 0.1 ml of serum to 0.7 ml of 0.9% saline. Mix thoroughly. Retest as in steps 1-10, above.

Results - Quantitative Test

Report the titer as the highest dilution that produces a Reactive (not Weakly Reactive) result.

Table 1. Sample quantitative VDRL Test results.

	SERUM DILUTIONS					REPORT
Undiluted (1:1)	1:2	1:4	1:8	1:16	1:32	
R	W	N	N	N	N	Reactive, undiluted
R	R	W	N	N	N	Reactive, 1:2 dilution
R	R	R	W	N	N	Reactive, 1:4 dilution
W	W	R	R	W	N	Reactive, 1:8 dilution
N (rough)	W	R	R	R	N	Reactive, 1:16 dilution
W	N	N	N	N	N	Weakly reactive, undiluted

If reactive results are obtained through dilution 1:32, prepare further twofold serial dilutions in 0.9% saline (1:64, 1:128 and 1:256) and retest using the quantitative test procedure.

Interpretation

1. The results of the serum VDRL Test must be confirmed by a treponemal test.
2. The diagnosis of syphilis depends on the results of the VDRL test, the treponemal confirmatory test, clinical signs and symptoms, and risk factors.
3. A reactive VDRL Test may indicate past or present infection with a pathogenic treponeme. However, it may be a false-positive reaction. A false positive is determined if the confirmatory treponemal test is negative.
4. A nonreactive VDRL Test with clinical evidence of syphilis may indicate early, primary syphilis, a prozone reaction in secondary syphilis, or late syphilis.
5. A nonreactive VDRL Test with no clinical evidence of syphilis indicates no current infection or an effectively treated infection.
6. A quantitative VDRL Test detects changes in reagin titer. Therefore a serum specimen showing a fourfold increase in titer on a repeat specimen may indicate an infection, a reinfection or a treatment failure. Likewise, a fourfold decrease during treatment indicates adequate syphilis therapy.

VDRL Test on Spinal Fluid

Consult an appropriate reference for the procedure to use when testing spinal fluids by the VDRL Test.[1]

Limitations of the Procedure

1. A prozone reaction may occur in which reactivity with undiluted serum is inhibited. The prozone phenomenon often gives Weakly Reactive or "rough" Nonreactive results in the qualitative test. Specimens with such results must be quantitatively tested.
2. Biological false-positive reactions can occur with nontreponemal tests in persons who abuse drugs, have diseases such as lupus erythematosus, mononucleosis, malaria, leprosy or viral pneumonia, or who have recently been immunized.[1]
3. During manufacturing, VDRL Antigen with VDRL Buffered Saline is tested only with serum. To modify the serum test products and procedures for testing CSF, consult the appropriate reference.[1] The user is responsible for modifying the products and procedures and for the required quality control standards according to this manual.
4. Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.
5. VDRL Buffered Saline showing turbidity or mold growth should be discarded.
6. If the temperature of the testing area, specimens or reagents is less than 23°C, test reactivity is decreased. If the temperature is greater than 29°C, test reactivity is increased.[1]
7. Test results are unpredictable when testing hemolyzed, contaminated or extremely turbid serum specimens.
8. For correct test results, adhere strictly to the correct speed and length of time for rotating the specimens and antigen.

References

1. **Larsen, S. A., E. F. Hunter, and S. J. Kraus.** 1990. A manual of tests for syphilis. American Public Health Association.
2. **Creighton, E. T**. 1990. Dark field microscopy for the detection and identification of *Treponema pallidum*, p. 49-61. *In* S. A. Larsen, E. F. Hunter, and S. J. Kraus (ed.), Manual of tests for syphilis, 8th ed. American Public Health Association, Washington, D.C.
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Packaging

VDRL Antigen w/Buffered Saline	5 ml	0388-56
	10 x 0.5 ml	0388-49
VDRL Test Control Serum Set	1 set	3520-32
Contains:		
Nontreponemal Antigen Reactive Serum	3 ml	
VDRL Weakly Reactive Serum	3 ml	
Nontreponemal Antigen Nonreactive Serum	3 ml	
Aliquant Vials	3 vials	

Bacto® Vibrio Cholerae Antisera

Vibrio Cholerae Antiserum Inaba · Vibrio Cholerae Antiserum Ogawa · Vibrio Cholerae Antiserum Poly

User Quality Control

Identity Specifications

Vibrio Cholerae Antiserum Inaba
Vibrio Cholerae Antiserum Ogawa
Vibrio Cholerae Antiserum Poly

Lyophilized appearance: Light gold to amber button to powdered cake

Rehydrated appearance: Light gold to amber, clear liquid

Performance Response

Rehydrate Vibrio Cholerae Antisera per label directions. Perform the slide agglutination test using appropriate known cultures of *Vibrio cholerae* as positive and negative controls.

Intended Use

Bacto Vibrio Cholerae Antisera are used for serotyping *Vibrio cholerae* in slide agglutination tests.

Summary and Explanation

V. cholerae are facultative anaerobes that in microscopic morphology are gram-negative, curved or straight bacilli. The microorganisms either require sodium chloride or grow best in its presence. Various media designed to select and cultivate the growth of this microorganism are used in the clinical laboratory, the food industry and environmental testing.

V. cholerae is the causative agent of a secretory diarrhea known as cholera. Two biotypes, El Tor and Classical, are associated with human disease.[1] These two biotypes cannot be differentiated serologically. The spread of the disease is primarily through contaminated

water and by the fecal-oral route. Infections with *V. cholerae* may be asymptomatic, mild or severe. If not treated, patients with severe cholera may die within five hours from massive fluid and electrolyte loss.[1] Because *Vibrio* species are natural inhabitants of aquatic environments, food products such as uncooked or incorrectly handled seafood can spread infection.

Gastrointestinal symptoms of cholera include "rice water stools" caused by a potent enterotoxin. The primary human specimen is feces. Seafood products are frequently tested as vehicles of human infection.

In 1935, Gardner and Ventkatraman[2] published a classification scheme for *Vibrio cholerae*. *V. cholerae* isolated from cholera patients was classified as O1. All other strains were designated non-O1. Non-O1 *V. cholerae* causes both gastroenteritis and systemic infections. Some strains produce cholera enterotoxin. Non-O1 *V. cholerae* has been isolated from blood, wounds, ears, sputum, cerebro-spinal fluid and urine.[3,4]

V. cholerae of the O1 serogroup are divided into the serotypes Ogawa, Inaba and Hikojima.[5,6] The antigenic factors are:

SEROTYPE	O ANTIGEN FACTORS
Ogawa	AB
Inaba	AC
Hikojima	ABC

Cholera can be diagnosed retrospectively. A fourfold rise in titer between acute-phase serum and that collected 10-14 days later is considered diagnostic.[7]

Principles of the Procedure

Identification of *V. cholerae* includes the isolation of the microorganism as well as biochemical identification and serological confirmation.

Serological confirmation requires that the microorganism (antigen) react with its corresponding antibody. This *in vitro* reaction produces macroscopic clumping called agglutination. The desired homologous reaction is rapid, does not dissociate (high avidity) and binds (high affinity).

Because a microorganism may agglutinate with an antibody produced in response to another species, heterologous reactions are possible. These are characterized as weak in strength or slow in formation. Such unexpected and unpredictable reactions may lead to some confusion in serological identification. A positive homologous agglutination reaction should support the morphological and biochemical identification of the microorganism.

Homologous reactions occur rapidly and are strong. Heterologous reactions form slowly and are weak.

Reagents

Vibrio Cholerae Antisera are lyophilized, polyclonal rabbit *Vibrio cholerae* O1 antisera containing approximately 0.04%Thimerosal as a preservative. Vibrio Cholerae Antisera Inaba and Ogawa are monospecific absorbed antisera.

Vibrio Cholerae Antisera possess the following antibodies:

ANTISERUM	O ANTIBODIES
Vibrio Cholerae Antiserum Inaba	C
Vibrio Cholerae Antiserum Ogawa	B
Vibrio Cholerae Antiserum Poly	ABC

Each vial of Vibrio Cholerae Antiserum contains sufficient reagent for 20 slide tests.

Precautions

1. For In Vitro Diagnostic Use.
2. **Vibrio Cholerae Antiserum Inaba**
   Vibrio Cholerae Antiserum Ogawa
   Vibrio Cholerae Antiserum Poly
   The Packaging of This Product Contains Dry Natural Rubber.
3. Follow proper established laboratory procedure in handling and disposing of infectious materials.

Storage

Store lyophilized and rehydrated Vibrio Cholerae Antisera at 2-8°C.

Expiration Date

The expiration date applies to product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

Vibrio Cholerae Antiserum Inaba
Vibrio Cholerae Antiserum Ogawa
Vibrio Cholerae Antiserum Poly

Materials Required But Not Provided

Agglutination slides
Applicator sticks
Sterile 0.85% NaCl solution

Reagent Preparation

Equilibrate all materials to room temperature before performing the tests. Ensure that all glassware and pipettes are clean and free of residues such as detergent.

Vibrio Cholerae Antisera: To rehydrate, add 3 ml sterile 0.85% NaCl solution and rotate gently to completely dissolve the contents. The rehydrated antiserum is considered a 1:2 working dilution.

Specimen Collection and Preparation

V. cholerae can be recovered from clinical specimens on selective media such as thiosulfate-citrate-bile salts-sucrose (TCBS) agar. For specific recommendations, consult appropriate references.[1,8,9]

V. cholerae can be recovered from various types of foods, particularly seafood. Samples are processed to prevent overgrowth of competing microorganisms and selective media are used to enhance the growth of the microorganism. Some isolation media have been specifically developed for the food industry. Consult appropriate references for recommended procedures for isolating *V. cholerae* from food.[10,11]

The isolate for serological testing should be subcultured from selective media to a nonselective agar such as Nutrient Agar. Consult standard protocols in appropriate references for the type of specimen and the appropriate medium.[1, 8-11]

Having followed an established protocol, determine that a pure culture of the microorganism has been obtained and that biochemical test reactions are consistent with the identification of the organism as *V. cholerae*. After these criteria are met, serological identification can be performed.

Testing the isolate for autoagglutination:

1. From the test culture, transfer a loopful of growth to a drop (35 µl) of sterile 0.85% NaCl solution on a clean slide and emulsify the organism.
2. Rotate the slide for one minute, then observe for agglutination.
3. If autoagglutination occurs, the culture is rough and cannot be tested. Subculture to a nonselective medium, incubate and test the organism again as described in steps 1 and 2.

   If no agglutination occurs, proceed with testing the organism as described below.

Test Procedure

Use Vibrio Cholerae Antiserum Poly to screen possible *V. cholerae* isolates. Continue testing with Vibrio Cholerae Antisera Inaba and Ogawa. Include known positive and negative control cultures.

1. **Vibrio Cholerae Antiserum**: Dispense a drop of the antiserum to be tested on an agglutination slide.
2. **Test organism**: Transfer a loopful of growth to the drop of antiserum and mix thoroughly.
3. Rotate the slide for one minute and read for agglutination.

Results

1. Read and record results as follows:

   4+ 100% agglutination; background is clear to slightly hazy.
   3+ 75% agglutination; background is slightly cloudy.
   2+ 50% agglutination; background is moderately cloudy.
   1+ 25% agglutination; background is cloudy.
   – No agglutination.

1. **Positive control**: Should produce 3+ or greater agglutination.
2. **Negative control**: Should show no agglutination.
3. Test isolates: 3+ or greater agglutination within one minute is a positive result.

Interpretation

Agglutination of the monospecific antiserum, when used, provides preliminary presumptive identification of the serotype.

0.85% NACL SOLUTION CONTROL	POLY	OGAWA	INABA	INTERPRETATION
–	–			Not *V. cholerae*
–	+			Presumptively *V. cholerae*
–	+	+	–	*V. cholerae* serotype Ogawa
–	+	–	+	*V. cholerae* serotype Inaba
–	+	+	+	*V. cholerae* serotype Hikojima
+	Any	Any	Any	Autoagglutination. Unsuitable test culture.

+ agglutination
– no agglutination

1. Positive agglutination using Vibrio Cholerae Antiserum Poly with typical biochemical test results gives presumptive identification of *V. cholerae* O1.
2. Cultures with positive agglutination in Vibrio Cholerae Antiserum Poly may be serotyped using the Vibrio Cholerae Antiserum Ogawa and Vibrio Cholerae Antiserum Inaba. Positive agglutination in both antisera is rare and, when it occurs, is usually interpreted as identifying *V. cholerae* serotype Hikojima.[6] *V. cholerae* serotype Hikojima is a rare serotype and should be sent to a reference laboratory for further study.
3. Positive agglutination will be immediate and strong. The strongest and most rapid reaction should be used to identify the serotype. *V. cholerae* O1 strains frequently cross-react slowly or weakly in monospecific antiserum for the other serotype.
4. Isolates that weakly or slowly agglutinate with Vibrio Cholerae Antiserum Poly and not with Vibrio Cholerae Antiserum Inaba or Vibrio Cholerae Antiserum Ogawa are usually considered *V. cholerae* non-O1. The isolate may be sent to a reference laboratory for further study.

Limitations of the Procedure

1. Correct interpretation of serological reactions depends on culture purity as well as morphological characteristics and biochemical reactions that are consistent with identification of the microorganism as *V. cholerae*.
2. Serological methods alone cannot identify the isolate as *V. cholerae*.
3. Excessive heat from external sources (hot bacteriological loop, burner flame, light source, etc.) may prevent a smooth suspension of the microorganism or cause evaporation or precipitation of the test mixture. False-positive reactions may occur.
4. Rough culture isolates do occur and will agglutinate spontaneously, causing agglutination of the negative control reaction (autoagglutination). Smooth colonies must be selected and tested in serological procedures.
5. Vibrio Cholerae Antisera have been tested using undiluted cultures taken from agar media. These antisera have not been tested using antigen suspensions in NaCl solution or other diluents. If the user applies variations to the recommended procedure, each lot of antiserum must be tested with known control cultures to verify expected reactions under the modified procedure.
6. Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.
7. Rehydrated Vibrio Cholerae Antiserum that is cloudy or has a precipitate at any time during its use should be discarded.

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Packaging

Vibrio Cholera Antiserum Inaba	3 ml	2430-47
Vibrio Cholera Antiserum Ogawa	3 ml	2431-47
Vibrio Cholera Antiserum Poly	3 ml	2432-47

Bacto® Widal Antigen Set

CONTAINS: Salmonella O Antigen · Salmonella H Antigens Salmonella Vi Antigen · Febrile Positive Control Polyvalent Febrile Negative Control

ALSO AVAILABLE: Salmonella O Antigens · Salmonella H Antigen

Intended Use

Bacto Widal Antigen Set, which contains four *Salmonella* antigens, is used in detecting *Salmonella* antibodies by slide and tube agglutination tests.

Bacto Salmonella H, O and Vi Antigens, available individually, are used in detecting *Salmonella* antibodies by slide and tube agglutination tests.

Summary and Explanation

Salmonellae represent many species of pathogenic microorganisms that, upon invasion, produce a fever in their host. Consequently, they are often called "Febrile Antigens". *Salmonella* species cause a variety of human diseases called salmonelloses. The range of disease is from mild self-limiting gastroenteritis to a more severe form, possibly with bacteremia or typhoid fever, which can be severe and life-threatening. Severe disease and bacteremia are associated primarily with *S.* Choleraesuis, *S.* Paratyphoid A and *S.* Typhi, while most of the other 2,300 or more strains are associated with gastroenteritis. The severity of the diarrheal disease depends on the virulence of the strain and the condition of the human host.

Salmonella is found in nature and occurs in the intestinal tract of many animals, both wild and domestic. The microorganism can spread to man from contact with the environment or from eating contaminated meat or vegetable food products.

The genus *Salmonella* is in the family *Enterobacteriaceae.* Salmonellae are facultatively anaerobic, gram-negative bacilli that typically are oxidase negative, non-lactose fermenting, H_2S positive and produce gas. Serotypes of *Salmonella* are defined based on antigenic structure, both somatic or cell wall (O) antigens and flagellar (H) antigens. The antigenic formula lists the O antigen(s) followed by the H antigen(s).

In 1896, Widal introduced techniques for testing patient serum for antibodies in cases of typhoid fever.[1] The Widal test was used diagnostically in two ways. First, it was considered diagnostic when a single high antibody titer occurred during the first week of illness. Further, it was diagnostic if a greater than fourfold rise in titer existed in serum samples taken 1 to 2 weeks apart.[2,3,4] The Widal test was developed to include *Salmonella* Typhi and other species of *Salmonella* detected by a variety of O and H antigens. *S.* Typhi and *S.* Paratyphi A and B are the major pathogens in this group that can produce clinically distinct systemic illness. In areas such as developing countries where typhoid is highly endemic, the diagnostic value of the Widal test has been well documented.[5,6,7] The Widal test for antibodies to the O antigens of *Salmonella* serotypes most likely to cause typhoid fever (usually *S.* Typhi and *S.* Paratyphi A and B) can be useful in helping diagnose typhoid fever when other methods have failed.[8]

Diagnosis of the cause of febrile disease cannot be based solely on the analysis of serum samples for antibody response. Many factors may affect measurable antibody levels. For example, the patient's immune response can be affected by age, immune status, general state of health and previous immunizations. Patients with known typhoid fever have developed diagnostic titers of antibodies that are low.[9,10] Also, patients treated with antibiotics early in their disease may not develop a significant titer rise.[2]

The various species of *Salmonella* contain multiple antigens that are cross-reactive. This prevents using increased antibody levels, alone, to identify infecting organisms by species or serotype. Other non-typhoidal febrile illness or unrelated immunological disorders may produce significant elevations of antibody titers.[2]

Certain organisms may share cross-reacting antigens leading to the production of heterologous antibodies. These heterologous antibodies may react with one or more antigens in an antibody test procedure, resulting in low-level antibody titers that may not, singly, suggest disease.

The rapid slide procedure is a screening test designed to detect agglutinins. The macroscopic tube test[11] is a confirmatory procedure designed to quantitate agglutinin compositions. Any positive results obtained in the screening (slide) test of specimens must be confirmed by a tube test.

The rapid slide test is the most widely used procedure employing the Widal antigens because of the simplicity with which the results may be reported. Negative slide test reactions can usually be reported as such if all five serum dilutions have been used. Although the slide test is not quantitative, running the series of dilutions is necessary to detect agglutinins that might be overlooked with a "prozone phenomenon". This often occurs in serum containing a high titer of typhoid agglutinins where higher concentrations of the serum may yield negative results but a dilution of the serum is positive.

Principles of The Procedure

Agglutination tests involving the use of *Salmonella* antigens determine the presence of antibodies that react with the test antigen. The serological procedure involves serially diluting the patient serum and then adding a standard volume of antigen. The end point of the test is the last dilution of the serum that shows a specific amount of agglutination. The end point, reported as a dilution of the serum, is called the patient's antibody "titer."

User Quality Control

Identity Specifications

Salmonella O Antigens
Salmonella H Antigens
Salmonella Vi Antigen

Appearance: Turquiose-blue-violet suspension.

Febrile Positive Control Polyvalent

Lyophilized Appearance: Light gold to amber, button to powdered cake.

Rehydrated Appearance: Light gold to amber, clear liquid.

Febrile Negative Control

Lyophilized Appearance: Colorless to light gold, button to powdered cake.

Rehydrated Appearance: Colorless to light gold, clear liquid.

Performance Response

Rehydrate Febrile Positive Control Polyvalent and Febrile Negative Control per label directions. Perform the slide or tube agglutination test using Salmonella O, H or Vi Antigens and positive and negative controls diluted in the same proportion as a patient serum.

A Salmonella Antigen is considered satisfactory if it does not agglutinate with the negative control and gives a 2+ or greater reaction at a 1:80 dilution with the positive control.

Reagents

Antigens

1. Salmonella Antigens are ready-to-use suspensions of the *Salmonella* organisms listed below. Salmonella O Antigens contain 20% glycerin.

   Widal Antigen Set contents:
   Salmonella O Antigen Group D - *Salmonella* Typhi O901, factors 9,12 (selected strain)
   Salmonella H Antigen a - *Salmonella* Paratyphi A.
   Salmonella H Antigen b - *Salmonella* Paratyphi B.
   Salmonella H Antigen d - *Salmonella* Typhi H901.

   Salmonella O and H Antigens, available individually, are prepared from selected strains containing the following group-specific antigens:
   Salmonella H Antigen c - flagellar antigen c
   Salmonella O Antigen Group A - factors 1, 2, 12
   Salmonella O Antigen Group B - factors 1, 4, 5, 12
   Salmonella O Antigen Group C - factors 6, 7, (8), 20
   Salmonella Vi Antigen

   When used as described, each vial contains sufficient reagent for 20 slide tests or 25 tube tests.
2. **Concentration of Antigen**: Salmonella O, H and Vi Antigens are used undiluted for the slide test and diluted 1:20 for the tube test.
3. **Antigen Density**: Salmonella O, H and Vi Antigens are adjusted to a density approximating 20 times a McFarland Barium Sulfate Standard No. 3 (1.8×10^{10} organisms per ml).

   Because antigen density may vary, it is adjusted for optimum performance when standardized with hyperimmune sera obtained from laboratory animals.

   Variation in color intensity of the antigen is normal and will not affect the outcome of the test.
4. Salmonella Antigens contain the following preservatives:

   Salmonella O Antigens: 0.5% phenol, and approximately 0.002% crystal violet and 0.005% brilliant green.

   Salmonella H Antigens: 0.5% formaldehyde, and approximately 0.002% crystal violet and 0.005% brilliant green.

   Salmonella Vi Antigen: 0.5% phenol, and approximately 0.002% crystal violet and 0.005% brilliant green.

Antisera:

1. **Febrile Positive Control Polyvalent** is lyophilized, polyclonal, polyvalent goat antisera containing approximately 0.04% Thimerosal as a preservative. This reagent contains antibodies at a titer of 1:80 or greater for the Salmonella O and H Antigens in the Widal Antigen Set.

   Each vial of Febrile Positive Control Polyvalent contains sufficient reagent for 32 slide tests or 50 tube tests using the four antigens contained in the Widal Antigen Set. When using the Salmonella O, H and Vi Antigens separately, there is sufficient reagent for 20 slide or 25 tube tests.

2. **Febrile Negative Control** is a lyophilized, standard protein solution containing approximately 0.02% Thimerosal as a preservative.

   Each vial of Febrile Negative Control contains sufficient reagent for 32 slide tests when using the four antigens contained in the Widal Antigen Set. When using the Salmonella O, H and Vi Antigens separately, there is sufficient reagent for 20 slide tests.

Precautions

1. For In Vitro Diagnostic Use.
2. Observe universal blood and body fluid precautions in the handling and disposing of specimens.[12,13]
3. **Salmonella H Antigen a**
   Salmonella H Antigen b
   Salmonella H Antigen c
   Salmonella H Antigen d

   POSSIBLE RISK OF IRREVERSIBLE EFFECTS. (US) Avoid contact with skin and eyes. Do not breathe mist. Wear suitable protective clothing. Keep container tightly closed. TARGET ORGAN(S): Eyes, Kidneys, Lungs, Skin.

   FIRST AID: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice. If swallowed seek medical advice immediately and show this container or label.
4. Follow proper established laboratory procedure in handling and disposing of infectious materials.
5. Salmonella O, H and Vi Antigens are not intended for use in the immunization of humans or animals.

Storage

Store Salmonella O, H and Vi Antigens at 2-8°C.

Store lyophilized and rehydrated Febrile Positive Control Polyvalent at 2-8°C.

Store lyophilized and rehydrated Febrile Negative Control at 2-8°C.

Expiration Date

The expiration date applies to the product in its intact container when stored as directed. Do not use a product if it fails to meet specifications for identity and performance.

Procedure

Materials Provided

Widal Antigen Set:
Salmonella O Antigen Group D
Salmonella H Antigen Group a
Salmonella H Antigen Group b
Salmonella H Antigen Group d
Febrile Positive Control Polyvalent
Febrile Negative Control

Available separately:
Salmonella O Antigens
Salmonella H Antigens
Salmonella Vi Antigen
Febrile Positive Control Polyvalent
Febrile Negative Control
Droppers, 0.03 ml per drop (supplied)

Materials Required but not Provided

Slide test

Agglutination slides, 5 squares, 1” each
Applicator sticks
Sterile distilled or deionized water
Serological pipettes, 0.2 ml

Tube Test

Culture tubes 12 x 75 mm and rack
Waterbath, 50 ± 2°C
Serological pipettes, 1 ml and 5 ml
Sterile 0.85% NaCl solution

Reagent Preparation

Salmonella O, H and Vi Antigens are ready to use in the slide test. Salmonella O and H antigens must be diluted 1:20 for the tube tests. (See Test Procedure for preparation instructions).

Equilibrate all materials to room temperature before performing the tests. Ensure that all glassware and pipettes are clean and free of residues such as detergent.

Febrile Positive Control Polyvalent: To rehydrate, add 5 ml sterile distilled or deionized water and rotate gently to completely dissolve the contents.

Febrile Negative Control: To rehydrate, add 5 ml sterile distilled or deionized water and rotate gently to completely dissolve the contents.

Specimen Collection and Preparation

Collect a blood specimen by aseptic venipuncture. Serum is required for the test. Store serum specimens at room temperature for no longer than 4 hours; for prolonged storage, keep at 2-8°C for up to 5 days or maintain at or below -20°C. Serum specimens must be clear, free of hemolysis and show no visible evidence of bacterial contamination (turbidity, hemolysis or particulate matter). Refer to appropriate references for more information on collection of specimens.[14,15] Serum specimens must not be heated. Heat may inactivate or destroy certain antibodies.

Because changes in titer over a period of time are the best indicators of active infection, and because the accuracy and precision of the tests can be affected not only by test conditions but also by the subjectivity of the person reading the endpoint, the following protocol is recommended.

A preliminary test using either the rapid slide test and/or the macroscopic tube test may be performed on the initial serum specimen and reported to the physician at that time. An aliquot of the serum should be transferred to a sterile test tube, sealed tightly, and kept in the freezer. When the second serum is obtained, it should be run in parallel with the original specimen. In this manner, the original serum will serve as a control. Any difference in titer will be more credible, since the bias associated with the performance of the test and determining the endpoint will be reduced.

Test Procedure

Rapid Slide Test

Use the slide test only as a screening test. Confirm positive results with the tube test.

1. **Test serum**: Using a 0.2 ml serological pipette, dispense 0.08, 0.04, 0.02, 0.01 and 0.005 ml of each test serum into a row of squares on an agglutination slide.
2. **Positive control**: Using a 0.2 ml serological pipette, dispense 0.08, 0.04, 0.02, 0.01 and 0.005 ml of Febrile Positive Control Polyvalent into a row of squares on the agglutination slide.
3. **Negative control**: Using a 0.2 ml serological pipette, dispense 0.08, 0.04, 0.02, 0.01 and 0.005 ml of Febrile Negative Control into a row of squares on the agglutination slide.
4. **Salmonella Antigen**: Shake the vial of antigen well to ensure a smooth, uniform suspension. Place one drop (35 µl) of antigen suspension in each drop of test serum, positive control and negative control.
5. Mix each row of test sera and control sera, using a separate applicator stick for each row. Start with the most dilute mixture (0.005 ml) and work to the most concentrated (0.08 ml).
6. Rotate the slide for 1 minute and read for agglutination.
7. The final dilutions in squares 1-5 correspond with tube dilutions of 1:20, 1:40, 1:80, 1:160, 1:320, respectively.

Results

1. Read and record results as follows:
   - 4+ 100% agglutination; background is clear to slightly hazy.
   - 3+ 75% agglutination; background is slightly cloudy.
   - 2+ 50% agglutination; background is moderately cloudy.
   - 1+ 25% agglutination; background is cloudy.
   - – No agglutination.
2. **Positive control**: Should show 2+ or greater agglutination at the 1:80 dilution.
3. **Negative control**: Should show no agglutination.
4. If results for either the positive or negative control are not as described, the test is invalid and results cannot be reported.
5. **Test specimens**: The serum titer is that dilution that shows a 2+ or greater agglutination. See Table 1.
6. The slide test is a screening test, only, and results must be confirmed with the tube test.

Table 1. Sample Rapid Slide Test reactions.

ml SERUM	CORRELATED DILUTION	REACTIONS		
		SPECIMEN 1	SPECIMEN 2	SPECIMEN 3
0.08	1:20	3+	4+	4+
0.04	1:40	2+	3+	3+
0.02	1:80	1+	3+	2+
0.01	1:160	–	2+	+
0.005	1:320	–	1+	–
Serum titer		**1:40**	**1:160**	**1:80**

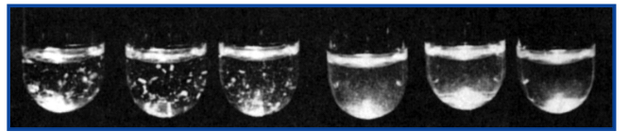
Macro Tube Test

Prepare a 1:20 dilution of the Salmonella O and H Antigens by adding 1 part of the antigen to 19 parts of sterile 0.85% NaCl solution.

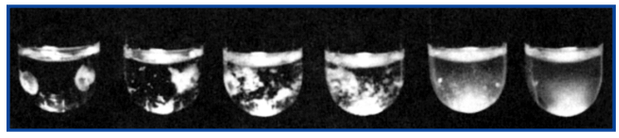
1. Prepare a row of eight culture tubes (12 x 75 ml) for each test serum, including a row for the Febrile Positive Control Polyvalent.
2. **Sterile 0.85% NaCl solution**: Dispense 0.9 ml in the first tube of each row and 0.5 ml in the remaining tubes.
3. **Test serum**: Using a 1 ml serological pipette, dispense 0.1 ml of test serum in the first tube in the row and mix thoroughly. Transfer 0.5 ml from tube 1 to tube 2 and mix thoroughly. Similarly, continue transferring 0.5 ml through tube 7, discarding 0.5 ml from tube 7 after mixing. Tube 8 is the antigen control tube and contains only sterile 0.85% NaCl solution.
4. **Positive control**: Using a 1 ml serological pipette, dispense 0.1 ml of Febrile Positive Control Polyvalent in the first tube in the row and mix thoroughly. Transfer 0.5 ml from tube 1 to tube 2 and mix thoroughly. Similarly, continue transferring 0.5 ml through tube 7, discarding 0.5 ml from tube 7 after mixing. Tube 8 is the antigen control tube and contains only sterile 0.85% NaCl solution.
5. **Salmonella Antigen**: Add 0.5 ml of the diluted antigen to all 8 tubes in each row and shake the rack to mix the suspensions.
6. The final dilutions in tubes 1-7 are 1:20, 1:40, 1:80, 1:160, 1:320, 1:640 and 1:1280, respectively.
7. **H antigen tests**: Incubate in a waterbath at 50 ± 2°C for 1 hour.
   O antigen tests: Incubate in a waterbath at 50 ± 2°C for 17 ± 1 hours.
8. Remove from the waterbath. Avoid excessive shaking before reading the reactions, either when the tubes are in the waterbath or when removing them from the waterbath.
9. Read and record the results.

Results

1. Tube agglutination reactions detect antibodies to either somatic (O) antigens or flagellar (H) antigens and these antibodies give two different reactions. An O antigen and the corresponding antibody give a coarse, compact agglutination which may be difficult to disperse. An H antigen and its corresponding antibody give a loose, flocculent agglutination. Do not vigorously shake tubes containing H antigens. Characteristic O and H agglutination is shown in the following diagrams.



Somatic "O" Agglutination



Flagellar "H" Agglutination

2. Read and record results as follows:
   - 4+ 100% agglutination; background is clear to slightly hazy.
   - 3+ 75% agglutination; background is slightly cloudy.
   - 2+ 50% agglutination; background is moderately cloudy.
   - 1+ 25% agglutination; background is cloudy.
   - – No agglutination.
3. **Positive control**: Should show 2+ or greater agglutination at the 1:80 dilution.

4. **Antigen control**: Tube #8 of each row should show no agglutination.
5. If results of the positive control and antigen control are not as described, the test is invalid and results cannot be reported.
6. **Test serum**: The serum titer is that dilution which shows 2+ or greater agglutination. See Table 2.

Table 2. Sample Macroscopic Tube Test reactions.

REACTIONS			
SERUM DILUTION	SPECIMEN 1	SPECIMEN 2	SPECIMEN 3
1:20	4+	3+	4+
1:40	4+	2+	4+
1:80	3+	1+	4+
1:160	2+	–	4+
1:320	1+	–	3+
1:640	–	–	2+
1:1280	–	–	1+
Serum Titer	**1:160**	**1:40**	**1:640**

Interpretation

For a single serum specimen, a titer of 1:80 suggests infection.

A pair of serum specimens (acute and convalescent) showing a two-dilution increase in titer is significant and suggests infection. A one dilution difference is within the limits of laboratory error.

Table 3 presents data that will be helpful in interpreting serological tests with the *Salmonella* antigens. The values tabulated will vary in certain cases.

Table 3. Disease states and associated Salmonella Antigens.

SALMONELLA ANTIGEN	SUGGESTED PATHOLOGY	TIME TO MAXIMUM TITER	SIGNIGICANT TITER
Salmonella H Antigen d (Typhoid H)	Typhoid Fever	4-5 weeks	1:80
Salmonella O Antigen Group D (Typhoid O)	Typhoid Fever	3-5 weeks	1:80
Salmonella H Antigen a (Paratyphoid A)	Paratyphoid Fever	3-5 weeks	1:80
Salmonella H Antigen b (Paratyphoid B)	Paratyphoid Fever	3-5 weeks	1:80

Limitations of the Procedure

1. The slide test is intended for screening only and should be confirmed by the tube test. Slide test dilutions are made to detect a prozone reaction and do not represent true quantitation of the antibody. A serum specimen with a prozone reaction shows no agglutination because of excessively high antibody concentrations. To avoid this occurrence, all five serum dilutions of the slide test should be run.
2. Detection of antibodies in serum specimens may complete the clinical picture of a patient having infection. However, isolation of the causative agent from patient specimens may be required. A definitive diagnosis must be made by a physician and must be based on patient history, physical examination and data from all laboratory tests.
3. In some cases of typhoid fever, sera may show a prozone reaction, the inability of an antigen to react in higher serum antibody concentrations. It is advised that all five serum dilutions be run in the rapid slide test, rather than just one dilution, to eliminate the possibility of missing positive reactions due to the prozone phenomenon.
4. Cross-reacting heterologous antibodies are responsible for many low titer reactions. Infections with other organisms, vaccinations and a history of disease may result in a low level of antibody titer. Antimicrobial therapy may suppress antibody production.
5. Previous immunization with typhoid vaccine or previous infection with *Salmonella* species sharing common antigens with *S.* Typhi can cause elevated antibody titers for prolonged periods. Other non-typhoid febrile illnesses may cause elevation of cross-reacting antibodies.
6. While a single serum specimen showing a titer of 1:80 suggests infection, it is not diagnostic.
7. Nonspecific agglutination has been noted with *Salmonella* O Group D antigen in the sera of patients with influenza.
8. Sera from narcotic addicts appear to contain broad nonspecific activity to the Widal antigen.[16]
9. Sera from patients with chronic active liver disease may show high agglutinin titers.[17]
10. To test for a significant rise in antibody titer, at least two specimens are necessary: an acute specimen (obtained at the time of initial symptoms) and a convalescent specimen (obtained 7 to 14 days later). A two-dilution difference in the titer is a significant increase in antibody level and suggests infection.
11. Antibody titers may be clinically useful in detecting chronic carriers of *S.* Typhi and in diagnosing typhoid fever in endemic areas. Detection of antibodies to heat-labile *Salmonella* envelope antigen (Vi) may be useful for the detection of a chronic carrier state for *S.* Typhi. The presence of capsular Vi antigen may mask somatic (O) antigen activity.
12. In *Salmonella* infections, the stage of the patient's disease is important and may affect test results. The optimum time for detecting peak titers may be missed if symptoms do not correlate with increased antibody levels. Antibodies to O antigens appear earlier and disappear earlier than antibodies to H antigens.
12. Prolonged exposure of reagents to temperatures other than those specified is detrimental to the products.
13. Exposure to temperatures below 2°C can cause autoagglutination. Antigens must be smooth uniform suspensions; before use, examine antigen vials for agglutination. Suspensions with agglutination are not usable and should be discarded.
14. Discard rehydrated Febrile Positive Control Polyvalent or Febrile Negative Control that is cloudy or has a precipitate anytime during its period of use.

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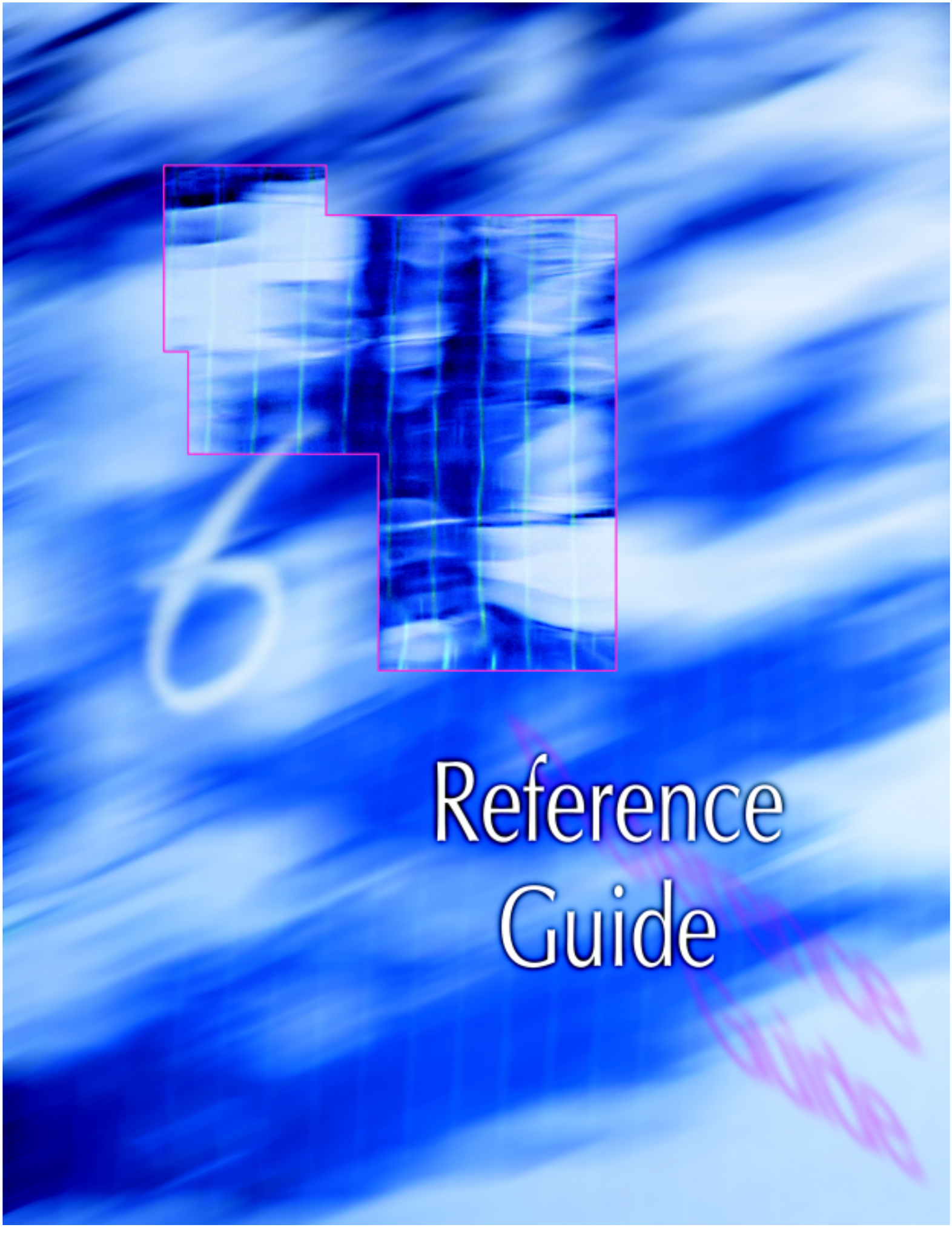
Packaging

Widal Antigen Set	6 x 5 ml	2642-32

Contains:
- Salmonella O Antigen Group D
- Salmonella H Antigen a
- Salmonella H Antigen b
- Salmonella H Antigen d
- Febrile Positive Control Polyvalent
- Febrile Negative Control

AVAILABLE SEPARATELY:

Salmonella H Antigen a	5 ml	2844-56
Salmonella H Antigen b	5 ml	2845-56
Salmonella H Antigen c	5 ml	2846-56
Salmonella H Antigen d	5 ml	2847-56
Salmonella O Antigen Group A	5 ml	2839-56
Salmonella O Antigen Group B	5 ml	2840-56
Salmonella O Antigen Group C	5 ml	2841-56
Salmonella O Antigen Group D	5 ml	2842-56
Salmonella Vi Antigen	5 ml	2953-56


Reference
Guide

Agar Selection Guide

APPLICATIONS	BACTERIOLOGICAL USES OF AGARS		
	Bacto® Agar	Agar, Granulated	Agar, Technical
Auxotrophic studies	++	+	
Bacteriology, research	++	+	
Bacteriology, general purpose	++	+	
Bacteriophage studies	++		
Biotechnology production	+	++	+/–
General microbial production	+	++	+/–
Growth of fastidious organisms	++		
Identification of pathogenic organisms	++	+	+/–
Microaerophilic studies	++		
Molecular genetics	++	+	
Prepared plate manufacture	+	++	+
Quality control, production	++	+	+/–
Quality control, environmental	+	++	+/–
Transformation of bacteria	++		
Transformation of yeast	++		

APPLICATIONS	NON-BACTERIOLOGICAL USES OF AGARS		
	Bacto® Agar	Agar, Granulated	Agar, Technical
Immunodiffusion		++	
Electrophoresis		++	
Tissue Culture, mammalian		++	
Tissue Culture, plant	++	+	
Histology, tissue embedding	+	++	
Histology, bone marrow embedding	++	+	
Insect growth substrate			++

Key

++ Recommended
+ Suitable
+/– Marginal

Anaerobes - General

ANAEROBES - GENERAL
Anaerobe Broth MIC
Anaerobic Agar
Blood Culture Bottles Columbia Broth w/CO_2
Blood Culture Bottles Columbia Broth w/SPS and CO_2
Blood Culture Bottles Fluid Thioglycollate Medium w/SPS and CO_2
Blood Culture Bottles Thioglycollate w/CO_2
Blood Culture Bottles Thioglycollate w/SPS and CO_2
Brain Heart Infusion Agar
Brewer Anaerobic Agar
Brewer Thioglycollate Medium
CHO Medium Base
Clostridium Difficile Antimicrobic Supplement CC
Cooked Meat Medium
ESP Anaerobic Broth
Differential Reinforced Clostridial Agar
Fluid Thioglycollate Medium
Liver Veal Agar
McClung Toabe Agar Base
NIH Thioglycollate Broth
Reinforced Clostridial Medium
Schaedler Agar
Schaedler Broth
SFP Agar Base
Sterility Bottles with Septum Fluid Thioglycollate Medium
Sterility Bottles with Screw Cap Fluid Thioglycollate Medium
SPS Agar
Sulfite Agar
Thioglycollate Medium USP Alternative
Thioglycollate Medium w/o Dextrose
Thioglycollate Medium w/o Dextrose or Indicator
Thioglycollate Medium w/o Indicator
Wilkens-Chalgren Agar

Antimicrobic Selective Agents For Culture Media

AGENT	CONCENTRATION PER VIAL	PRODUCT NAME
Cefsulodin-novobiocin	4 mg/2.5 mg	Yersinia Antimicrobic Supplement CN
Ceftozidime	40 mg	Palcam Antimicrobic Supplement
Chloramphenicol	0.05 g	Rose Bengal Antimicrobic Supplement C
Chlortetracycline (Aureomycin®)	25 mg	Antimicrobic Vial A
Colistin Sulfate - Nystatin - Vancomycin	7,500 mcg/12,500 units/ 3,000 mcg	Antimicrobic Vial CNV
Colistin Sulfate - Nystatin - Vancomycin Trimethoprim	7,500 mcg/12,500 units/ 3,000 mcg/5,000 mcg (10 ml vial)	Antimicrobic Vial CNVT
Cyclohexamide - Colistin Sulfate - Acriflavine - Cefotetan - Fosfomycin	400 mg/20 mg/5 mg/2 mg/ 10 mg	Oxford Antimicrobic Supplement
Cycloserine - Cefoxitin	125 mg/ 5 mg	Clostridium Difficile Antimicrobic Supplement CC
Kanamycin	25,000 mcg	Antimicrobic Vial K
Moxalactam	20 mg	Moxalactam Antimicrobic Supplement
Moxalactam - Colistin Sulfate	20 mg/10 mg	Modified Oxford Antimicrobic Supplement
Novobiocin	20 mg	Novobiocin Antimicrobic Supplement
Oxytetracycline	100 mg	Antimicrobic Vial Oxytetracycline
Polymyxin B	30,000 units	Antimicrobic Vial P
Potassium Tellurite Solution 1%	1%	Chapman Tellurite Solution
Potassium Tellurite Solution 3.5%	3.5%	Potassium Tellurite Solution 3.5%
Sodium 7- ethyl - 2 - methyl - 4 - undecyl sulfate		XLT4 Supplement

Cosmetic Testing

PRODUCTS	APPLICATIONS: Environmental (See also Environmental Sampling and Disinfectant Testing)	Gram-Negative Screening	Pseudomonas Isolation	Staphylococcus	Sterility Testing	Yeast & Mold Isolation
AC Broth					✔	
AC Broth Medium w/o Dextrose†					✔	
Cetrimide Agar Base/**PSEUDOSEL** Agar†			✔			
RODAC™ Plates	✔					
D/E Neutralizing Agar†	✔					
D/E Neutralizing Broth†	✔					
EMB Agar/Eosin Methylene Blue Agar Modified†		✔				
Fluid Thioglycollate Medium†					✔	
HC Agar Base†						✔
HYcheck	✔					
Letheen Agar†	✔					
Letheen Broth/Letheen Broth AOAC†	✔					
m Staphylococcus Broth				✔		
MacConkey Agar†		✔				
Malt Agar†						✔
Malt Extract Agar						✔
Malt Extract Broth†						✔
Mannitol Salt Agar†				✔		
Microbial Content Test Agar/ **TRYPTICASE**™ Soy w/Lec. poly.†	✔					
Modified Letheen Agar					✔	
Modified Letheen Broth					✔	
Mycological Agar/**MYCOPHIL**™ Agar†						✔
Mycobiotic Agar/**MYCOPHIL** Agar†						✔
Neutralizing Buffer†	✔					
Phenylethanol Agar/Phenylethyl Alcohol Agar†				✔		
Potato Dextrose Agar†						✔
Pseudomonas Agar F/Flo Agar†			✔			
Pseudomonas Agar P/Tech Agar†			✔			
Pseudomonas Isolation Agar/Pseudomonas ISO †			✔			
Sabouraud Dextrose Agar†						✔
Staph Latex Test Kit/**STAPHYLOSLIDE**™ Test Kit†				✔		
Staphylococcus Medium 110/Staphylococcus Agar #10†				✔		
Sterility Test Bottles, Prepared †					✔	
TAT Broth Base†					✔	
Tryptic Soy Broth/ **TRYPTICASE**™ Soy Broth†					✔	
VJ Agar/Vogel & Johnson Agar†				✔		

† Available from Difco & Becton Dickinson Microbiology Systems.

Dairy Product Testing - Products and Applications

PRODUCTS	APPLICATIONS								
	Beta-Lactams in Milk	*Clostridium*	Coliform Analysis	Environmental	Lipolytic Microorganisms	*Listeria* Analysis	Standard Plate Count	*Streptococcus* Detection	Yeast & Mold Analysis
Antibiotic Medium 1†	✔								
Antibiotic Medium 4†	✔								
Azide Blood Agar Base†								✔	
Brilliant Green Bile 2%/Brilliant Green Bile Broth†			✔						
Bryant and Burkey Medium		✔							
Concentration Disks 1/2" Penase	✔								
Concentration Disks 1/2" Penicillin 0.05 Unit/PM Discs, 0.05, 1/4" Taxo™†	✔								
Concentration Disks 1/2" Sterile Blanks, Antibiotic Detect Disc 1/2" Taxo†	✔								
Desoxycholate Lactose Agar†			✔						
D/E Neutralizing Agar†				✔					
D/E Neutralizing Broth†				✔					
EC Medium w/MUG/EC Broth w/ MUG†			✔						
m FC Agar/M-FC Agar†			✔						
Fraser Broth Base and/Fraser Broth Base Modified†						✔			
Fraser Broth Supplement/Fraser Broth Additive†						✔			
HYcheck™				✔					
LPM Agar Base†						✔			
Lactose Broth†			✔						
Lauryl Tryptose Broth w/MUG/ Lauryl Sulfate Broth w/ MUG†			✔						
Letheen Agar†				✔					
Letheen Broth/Letheen Broth AOAC†				✔					
Levine EMB Agar/Levine Eosin Methylene Blue Agar†			✔						
Listeria Antisera						✔			
M17 Broth†								✔	
Malt Extract Agar†									✔
Malt Extract Broth†									✔
McBride Listeria Agar†						✔			
Microbial Content Test Agar/ Trypticase™ Soy Agar w/Lec & Polysorbate†				✔					
Milk Agar IDF Formulation							✔		
Modified Listeria Enrichment Broth						✔			

† Available from Difco & Becton Dickinson Microbiology Systems.

Dairy Product Testing - Products and Applications

PRODUCTS	APPLICATIONS								
	Beta-Lactams in Milk	*Clostridium*	Coliform Analysis	Environmental	Lipolytic Microorganisms	*Listeria* Analysis	Standard Plate Count	*Streptococcus* Detection	Yeast & Mold Analysis
Modified Oxford Antimicrobic Supplement						✔			
Motility Test Medium†						✔			
Moxalactam Antimicrobic Supplement						✔			
Neutralizing Buffer†				✔					
Nutrient Agar†				✔					
Nutrient Broth†			✔						
Oxford Antimicrobic Supplement						✔			
Oxford Medium Base/ Oxford Agar Base Modified†						✔			
PALCAM Medium Base and PALCAM Antimicrobic Supplement						✔			
PM Indicator Agar	✔								
PM Negative Control	✔								
PM Positive Control	✔								
Penase Concentrate/Penicillinase Concentrate†	✔								
Phenylethanol Agar/Phenylethanol Alchol Agar†								✔	
Plate Count Agar/Standard Methods Agar†							✔		
Potato Dextrose Agar†									✔
Spirit Blue Agar w/Lipase Reagent					✔				
Strep Grouping Kit†								✔	
Subtilis Spore Suspension	✔								
Thermospore Suspension PM	✔								
Tryptic Soy Broth/**TRYPTICASE**™ Soy Broth†				✔					
Tryptone Glucose Extract Agar/ **TRYPTICASE** Glucose Extract Agar							✔		
UVM Modified Enrichment Broth/ UVM Mod. Listeria Enrichment Broth†						✔			
Universal Preenrichment Broth						✔			
Violet Red Bile Agar†			✔						
Violet Red Bile Agar w/MUG†			✔						
Yeast Extract Glucose Chloramphenicol Agar									✔

† Available from Difco & Becton Dickinson Microbiology Systems.

Environmental Sampling and Disinfectant Testing

CULTURE MEDIA	HYGIENE CONTACT SLIDES
Aseptic Commissioning Medium Bushnell-Haas Broth D/E Neutralizing Agar† D/E Neutralizing Broth† Disinfectant Test Broth AOAC Egg Meat Medium Letheen Agar† Letheen Broth/Letheen Broth AOAC† Microbial Content Test Agar /Trypticase™ Soy Agar w/ Lec. & Polysorbate† Neutralizing Buffer† Synthetic Broth AOAC	HYcheck™ D/E Neutralizing Agar HYcheck for Disinfection Control HYcheck for Enterobacteriaceae HYcheck for Plate Count Agar with TTC HYcheck for Total Count HYcheck for Yeasts and Molds HYcheck for Yeasts and Molds with TTC
CONTACT PLATES	**SETTLING PLATES (TRIPLE WRAPPED)**
DOUBLE WRAPPED (IRRADIATED) D/E Neutralizing Agar Sabouraud Dextrose Agar w/Lecithin and Polysorbate 80 Standard Methods Agar Tryptic Soy Agar w/Lecithin and Polysorbate 80	**STERILE 100mm OR 150mm** Sabouraud Dextrose Agar Tryptic Soy Agar Tryptic Soy Agar w/Lecithin and Polysorbate 80

Fermentation Products

FERMENTATION*		
Beef Extract, Desiccated†	Malt Extract†	Todd Hewitt Broth†
Brain Heart Infusion†	Neopeptone	Tryptic Soy Broth/**TRYPTICASE**™ Soy Broth
Brucella Broth†	Peptamin	Tryptic Soy Broth w/o Dextrose/ **TRYPTICASE** Soy Broth w/o Dextrose†
Casamino Acids/Select Casamino Acids†	Peptone, Bacto®	Tryptone/Select **TRYPTICASE** Peptone†
Casamino Acids, Technical†	Peptone Bacteriological, Technical	Tryptose/ **POLYPEPTONE**™ Peptone†
Casitone	Proteose Peptone/Meat Peptone†	Tryptose Phosphate Broth†
Eugon Broth/**EUGONBROTH**™	Proteose Peptone No. 2	Yeast Extract/Select Yeast Extract†
Gelatone/Gelysate Peptone†	Proteose Peptone No. 3	Yeast Extract, Technical†
Heart Infusion Broth†	Soytone/**PHYTONE**™ Peptone†	
M Broth†	TC Lactalbumin Hydrolysate	
	TC Yeastolate/Yeastolate, TC†	

*Custom formulations and packaging are also available.

† Available from Difco & Becton Dickinson Microbiology Systems.

Escherichia coli - Products and Applications

PRODUCTS	APPLICATIONS: Nonselective Media	Purity Plate	Selective-Differential Media	Serology	Specimen Collection and Shipment	Rapid Test
Brain Heart Infusion Agar†	✔					
BAGG Broth			✔			
Brilliant Green Bile Agar†			✔			
CULTURESWAB™ Transport System Amies Medium					✔	
CULTURESWAB Transport System Amies Medium w/o Charcoal/**CULTURETTE**™ Amies w/o Charcoal†					✔	
CULTURESWAB Transport System Cary-Blair Medium/ Anaerobic **CULTURETTE** Cary-Blair Single†					✔	
CULTURESWAB Transport System Stuart's Medium Modified/**CULTURETTE** Modified Stuart's Medium†					✔	
EC Medium w/MUG†			✔			
EMB Agar/Eosin Methylene Blue Agar Modified†			✔			
E. coli H Antiserum H7†				✔		
E. coli O Antiserum O157†				✔		
m Endo Agar LES/M-Enda Agar LES†			✔			
m Endo Broth MF®/M-Endo Broth			✔			
EZ Coli™ Rapid Detection System for *E. coli* 0157						✔
Lauryl Tryptose Broth w/MUG/Lauryl Sulfate Broth w/MUG†			✔			
MacConkey Agar†			✔			
MacConkey Sorbitol Agar/MacConkey II Agar w/Sorbitol†			✔			
Nutrient Agar†	✔					
Nutrient Agar w/MUG†	✔					
Transport Medium Amies					✔	
Transport Medium Stuart†					✔	
Transport Medium Amies w/o Charcoal					✔	
Tryptic Soy Agar/**TRYPTICASE**™ Soy Agar†	✔	✔				
TSA Blood Agar Base	✔	✔				
Veal Infusion Agar†	✔	✔				
Violet Red Bile Agar†			✔			
Violet Red Bile Agar w/MUG†			✔			

BIOCHEMICAL TESTS

Purple Agar/Broth Base		Ammonium Citrate	–	Tryptone Water	+
Adonitol	–	Gelatin	–	Urease	–
Dulcitol	V	H_2S	–	Voges-Proskauer	–
Glucose	+	Indole	+		
Inositol	–	KCN	–	**Key**	
Lactose	V	Methyl Red	+	– Negative	
Mannitol	+	Phenylalanine	–	+ Positive	
Salicin	V	Sodium Malonate	–	d Delayed	
Sucrose	V			V Variable +, d or –	

† Available from Difco & Becton Dickinson Microbiology Systems.

Food and Beverage Testing - Products and Applications

PRODUCTS	APPLICATIONS													
	Bacillus	Beverage Analysis	Campylobacter Analysis	Clostridium	Coliform Analysis	Environmental	Lactobacillus	Listeria Analysis	Salmonella/Shigella spp.	Staphylococcus	Total Plate Count	Vibrio	Yeast & Mold Analysis	Yersinia spp.
A-1 Medium/A-1 Broth†					✔									
APT Agar†							✔							
APT Broth†							✔							
Baird-Parker Agar Base w/EY Tellurite Enrichment†										✔				
Bismuth Sulfite Agar†									✔					
Brilliant Green Agar†									✔					
Brilliant Green Agar Modified (Edel-Kampelmacher)									✔					
Brilliant Green Bile 2%/Brilliant Green Bile Broth 2%†					✔									
Brucella Agar†			✔											
Brucella Broth†			✔											
Bryant and Burkey Medium				✔										
Buffered Peptone Water†									✔					
Campylobacter Agar Kit Blaser/Campylobacter Agar w/5 Antimicrobics and 10% Sheep Blood†			✔											
Campylobacter Agar Kit Skirrow			✔											
Campylobacter Agar Base			✔											
Coagulase Plasma (Rabbit)†										✔				
Coagulase Plasma EDTA (Rabbit)/ Coagulase Plasma, Rabbit w/ EDTA†										✔				
Cooke Rose Bengal Agar													✔	
Cooked Meat Medium†				✔										
D/E Neutralizing Agar†						✔								
D/E Neutralizing Broth†						✔								
DNAse Test Agar†										✔				
DNAse Test Agar w/Methyl Green/ DNAse Test Agar w/Toluidine Blue†										✔				
DRBC Agar													✔	
Demi-Fraser Broth Base								✔						
Desoxycholate Citrate Agar Hynes†									✔					
Differential Reinforced Clostridial Agar				✔										
EC Medium/EC Broth†					✔									
EC Medium with MUG/EC Broth w/MUG†					✔									
Elliker Broth†							✔							
m Endo Agar LES†					✔									
m Endo Broth MF®/ mEndo Broth, ALPHA†					✔									
EZ Coli™ Rapid Detection System					✔									
Fluid Thioglycollate Medium†				✔										
Fraser Broth Base/Fraser Broth Base Modified†								✔						
Fraser Broth Supplement/Fraser Broth Base Supplement†								✔						
Hektoen Enteric Agar†									✔					
HYcheck™ D/E Neutralizing Agar						✔								
HYcheck for Disinfection Control						✔								
HYcheck for Enterobacteriaceae						✔								
HYcheck for Total Count						✔								
HYcheck for Yeasts and Molds						✔								
HYcheck for Yeasts and Molds w/TTC						✔								
LPM Agar Base†								✔						

† Available from Difco & Becton Dickinson Microbiology Systems.

Food and Beverage Testing - Products and Applications

PRODUCTS	APPLICATIONS													
	Bacillus	Beverage Analysis	Campylobacter Analysis	Clostridium	Coliform Analysis	Environmental	Lactobacillus	Listeria Analysis	Salmonella/Shigella	Staphylococcus	Total Plate Count	Vibrio	Yeast & Mold Analysis	Yersinia sp.
Lactobacilli MRS Agar/MRS Agar†							✔							
Lactobacilli MRS Broth/MRS Broth†							✔							
Lactose Broth†									✔					
Lauryl Tryptose Broth/Lauryl Sulfate Broth†					✔									
Lauryl Tryptose Broth with MUG/Lauryl Sulfate Broth w/MUG†					✔									
Letheen Agar†						✔								
Letheen Broth/Letheen Broth AOAC†						✔								
Levine EMB Agar/Levine Eosin Methylene Blue Agar†					✔									
Listeria Enrichment Broth†								✔						
Listeria O Antisera								✔						
Liver Veal Agar†				✔										
Lysine Medium		✔											✔	
MYP Agar	✔													
M Broth†									✔					
MacConkey Agar†					✔				✔					
MacConkey Sorbitol Agar/MacConkey II Agar w/Sorbitol†					✔									
Malt Agar†													✔	
Malt Extract Agar†													✔	
Malt Extract Broth†													✔	
Mannitol Salt Agar†										✔				
McBride Listeria Agar†								✔						
McClung Toabe Agar Base†				✔										
Microbial Content Test Agar/ **TRYPTICASE**™ Soy Agar w/Lec. & Polysorbate 80†						✔								
Minerals Modified Glutamate Agar					✔									
Modified Listeria Enrichment Broth								✔						
Modified Oxford Antimicrobic Supplement								✔						
Modified EC Medium w/Indicator and Novobiocin Antimicrobic Supplement					✔									
Motility Test Medium†								✔						
Moxalactam Antimicrobic Supplement†								✔						
Muller Kauffmann Tetrathionate Broth Base									✔					
Mycological Agar/**MYCOPHIL**™ Agar†													✔	
Neutralizing Buffer†						✔								
OGYE Agar Base w/Antimicrobic Vial Oxytetracycline													✔	
Orange Serum Agar†		✔												
Orange Serum Broth Concentrate 10X		✔												
Oxford Antimicrobic Supplement								✔						
Oxford Medium Base/Oxford Agar Base Modified†								✔						
PALCAM Medium Base with PALCAM Antimicrobic Supplement								✔						
Plate Count Agar/Standard Methods Agar†											✔			
Potato Dextrose Agar†													✔	
Potato Dextrose Broth†													✔	
Rappaport-Vassiliadis (MSRV) Medium Semisolid Modification									✔					

† Available from Difco & Becton Dickinson Microbiology Systems.

Food and Beverage Testing - Products and Applications

PRODUCTS	APPLICATIONS													
	Bacillus	Beverage Analysis	Campylobacter Analysis	Clostridium	Coliform Analysis	Environmental	Lactobacillus	Listeria Analysis	Salmonella/Shigella sp.	Staphylococcus	Total Plate Count	Vibrio	Yeast & Mold Analysis	Yersinia sp.
Rappaport-Vassiliadis R10 Broth								✔						
Raka-Ray No. 3 Broth		✔					✔							
Raka-Ray No. 3 Medium		✔					✔							
Reinforced Clostridial Agar†				✔										
Rogosa SL Agar†							✔							
Rogosa SL Broth†							✔							
Rose Bengal Agar Base													✔	
Rose Bengal Antimicrobic Supplement C/ Chloramphenicol Selective†													✔	
SFP Agar Base/TSN Agar†				✔										
SS Agar/Salmonella Shigella Agar†								✔						
Sabouraud Dextrose Agar†													✔	
Sabouraud Dextrose Broth													✔	
Salmonella H Antiserum Poly a-z†								✔						
Salmonella O Antisera †								✔						
Selenite Broth/Selenite F Broth†								✔						
Selenite Cystine Broth†								✔						
Special Yeast and Mold Medium													✔	
m Staphylococcus Broth									✔					
Staphylococcus Medium 110/Staphylococcus Agar 110†									✔					
Staph Latex Test/**STAPHYLOSLIDE**™ Test†									✔					
Sulfite Agar				✔										
TCBS Agar†												✔		
TT Broth Base, Hajna/Tetrathionate H†								✔						
Tetrathionate Broth Base†								✔						
Tomato Juice Agar†						✔								
Tryptic Soy Broth/**TRYPTICASE**™ Soy Broth†					✔									
Tryptone Water					✔									
UBA Medium/Universal Beer Agar†		✔												
UVM Modified Listeria Enrichment Broth†							✔							
Universal Preenrichment Broth							✔	✔						
Vibrio Cholerae Antisera												✔		
Violet Red Bile Agar†					✔									
Violet Red Bile Agar w/MUG†					✔									
Violet Red Bile Glucose Agar					✔									
WL Differential Medium/WL Differential Agar†		✔												
WL Nutrient Broth		✔												
WL Nutrient Medium†		✔												
Wort Agar†		✔											✔	
XLD Agar †								✔						
XLT4 Agar Base and XLT4 Supplement								✔						
YM Agar													✔	
YM Broth													✔	
Yeast Extract Glucose Chloramphenicol Agar													✔	
Yersinia Selective Agar Base/CIN Agar Base†														✔
Yersinia Antimicrobic Supplement CN/CN Inhibitor†														✔

† Available from Difco & Becton Dickinson Microbiology Systems.

McFarland Standard Preparation

"MCFARLAND"	SULFURIC ACID, 1% AQUEOUS SOLUTION ML	BARIUM CHLORIDE, 1% AQUEOUS SOLUTION ML	CORRESPONDING DENSITY OF BACTERIA -10^6	INTERNATIONAL UNITS (IU) OF OPACITY
1	9.9	0.1	300	3
2	9.8	0.2	600	7
3	9.7	0.3	900	10
4	9.6	0.4	1200	12
5	9.5	0.5	1500	15
6	9.4	0.6	1800	–
7	9.3	0.7	2100	20
8	9.2	0.8	2400	–
9	9.1	0.9	2700	–
10	9.0	1.0	3000	30

1. Prepare the tubes by mixing 1% sulfuric acid with 1% barium chloride according to the table.
2. Make sure the tubes are uniform in size and made of chemically resistant glass.
3. Plug the tubes with rubber stoppers and carefully seal with paraffin. Store the tubes upright.
4. To estimate bacterial cell density, compare the bacterial suspension with the standards.
5. The above set is used to determine bacterial density in saline suspension. To estimate bacterial density in broth, make the set by dissolving the sulfuric acid and barium chloride in sterile broth.

REFERENCE IN: Gradwohl's Clinical Laboratory Methods and Diagnosis. In. A.C. Sonnenwirth and L. Jarett (ed.). C.V. Mosby Company, 1980 p. 1363.

Molecular Genetics - Media and Ingredients

LB MEDIA	NZ MEDIA AND INGREDIENTS	GENERAL MEDIA AND INGREDIENTS
LB Agar, Lennox/LB Agar (Lennox LAgar)†	Casein Digest/Casein Digest Peptone†	M9CA Medium
LB Agar, Miller (Luria-Bertani)/ Luria Agar†	NZCYM Broth†	M9 Minimal Salts, 5x/ M9 Minimal Salt†
LB Broth, Lennox/LB Broth†	NZM Broth	Minimal Agar Davis
LB Broth, Miller/Luria Broth†	NZYM Broth/NZY Broth†	Minimal Broth Davis w/o Dextrose
Luria Agar Base, Miller		SOB Medium
Luria Broth Base, Miller		Terrific Broth
		2xYT
		YPD Agar/YEPD Agar†
		YPD Broth/YEPD Broth†
		Yeast Nitrogen Base†
		Yeast Nitrogen Base w/o Amino Acids†
		Yeast Nitrogen Base w/o Amino Acids & Ammonium Sulfate

† Available from Difco & Becton Dickinson Microbiology Systems.

Mycobacteria

MYCOBACTERIA		
ATS Medium	ESP Myco GS	Middlebrook 7H9 Broth/Middlebrook 7H9 Broth Base†
Dubos Albumin Broth	ESP Myco PVNA	Middlebrook 7H10 Agar/Middlebrook & Cohn 7H10 Agar Base†
Dubos Broth Base	Lowenstein Medium Base/ Lowenstein Jensen Medium Base†	Middlebrook ADC Enrichment†
Dubos Medium Albumin	Lowenstein Medium Gruft	Middlebrook OADC Enrichment
Dubos Oleic Agar Base	Lowenstein Medium, Jensen	Middlebrook OADC Enrichment w/WR 1339
Dubos Oleic Albumin Complex/ Oleic Albumin Complex†	Lowenstein Medium, Jensen Deeps	Mycobacteria 7H11 Agar/Seven H11 Agar Base†
ESP Myco	Lowenstein Medium w/5% NaCl	Petragnani Medium

† Available from Difco & Becton Dickinson Microbiology Systems.

Mycology

CLINICAL REAGENTS FOR DETECTION OF *CANDIDA ALBICANS*

BiGGY Agar†
Candida Isolation Agar
Candida Albicans Antiserum

MEDIA FOR CLASSIFICATION OF YEASTS

Yeast Carbon Base
Yeast Morphology Agar
Yeast Nitrogen Base†
Yeast Nitrogen Base w/o Amino Acids†
Yeast Nitrogen Base w/o Amino Acids and Ammonium Sulfate

NON-INHIBITORY MEDIA FOR FUNGI

MEDIA	General Use	Vitamin Assay	*Candida* and/or Dermatophytes
Blood Agar Base†	✔		
Brain Heart Infusion†	✔		
Brain Heart Infusion Agar†	✔		
Brain Heart Infusion w/PAB†	✔		
Corn Meal Agar†			✔
Fluid Sabouraud Medium	✔		
Malt Agar†	✔		
Malt Extract Agar†	✔		
Malt Extract Broth†	✔		
Mycological Agar/**MYCOPHIL**™ Agar†	✔		
Mycological Agar w/Low pH/**MYCOPHIL**™ w/ Low pH†	✔		
Oatmeal Agar	✔		
Pagano Levin Base and TTC			✔
Potato Dextrose Agar†	✔		
Potato Dextrose Broth†	✔		
Rice Extract Agar†			✔
SABHI Agar Base/SABHI Agar†	✔		
Sabouraud Agar Modified/ Sabouraud Dextrose Agar Emmons†	✔		
Sabouraud Dextrose Agar†	✔		
Sabouraud Dextrose Broth	✔		
Sabouraud Maltose Agar†	✔		
Special Yeast and Mold Medium	✔		
YM Agar	✔		
YM Broth	✔		

† Available from Difco & Becton Dickinson Microbiology Systems.

Mycology

Reagents for Direct Microscopic Detection of Fungi

PRODUCT	USES
Gram Stain Sets and Reagents†	General screening
3-Step™ Gram Stain Sets and Reagents	General screening
SpotTest™ Calcofluor White Reagent/Calcofluor White Droppers† A nonspecific fluorochrome stain which allows the rapid examination of clinical specimens for the presence of fungi under an FA microscope	Screening of cultures for presence of fungi
SpotTest India Ink/India Ink Droppers† For use in the direct microscopic examination of clinical material for the presence of encapsulated yeast cells	Screening CSF for Cryptococcus neoformans Negative staining
SpotTest KOH 10%/Potassium Hydroxide 10% Droppers† A 10% solution of potassium hydroxide	Used in wet mounts of clinical specimens to examine for the presence of fungi
SpotTest Lactophenol Cotton Blue Stain/ Lactophenol Cotton Blue Droppers† For use in the direct mounting and staining of yeast and molds	Teased mount method Slide culture method

Selective and/or Differential Media for Fungi

GENERAL USE	*CANDIDA* AND/OR DERMATOPHYTES
Brain Heart CC Agar†	BiGGY Agar†
Cooke Rose Bengal Agar and Antimicrobic Vial A	Candida BCG Agar Base
DRBC Agar	Candida Isolation Agar
HC Agar Base†	DTM Agar
Mycobiotic Agar/Mycosel™ Agar†	Littman Oxgall Agar
Mycological Agar w/Low pH/Mycophil™ Agar w/Low pH†	Trichophyton Agars 1-7
Rose Bengal Agar Base and Rose Bengal Antimicrobic Supplement C	
Yeast Extract Glucose Chloramphenicol Agar	

† Available from Difco & Becton Dickinson Microbiology Systems.

Pasco® Panel Contents - Selection Guide

ANTIMICROBIAL AGENT (MCG/ML)		MIC GRAM-NEG.	MIC/ID GRAM-NEG.	MIC/ID GRAM-NEG. SPECIAL	BREAKPOINT/ID GRAM-NEG.	MIC ORAL	MIC SUPP.	MIC GRAM-POS.	MIC/ID GRAM-POS.
AK	Amikacin	32,24,16-1	32-4	32-4	32,24,16-4	———	———	———	———
A/C	Amoxicillin/ Clavulanic Acid	———	———	16-4/8-2	———	16-0.5/8-0.25	16-0.25/8-0.12	———	———
AM	Ampicillin	16-2	16-2	16-8	16-8	16-0.12	———	8-0.12	8-0.12
A/S	Ampicillin/ Sulbactam	16-2/8-1	16-8/8-4	16-8/8-4	16-8/8-4	———	———	16-2/8-1	16-2/8-1
AZT	Aztreonam	16-4	16-8	16-8	16-8	———	———	———	———
CB	Carbenicillin	———	———	———	———	256-128	256-128	———	———
CCL	Cefaclor	———	———	———	———	16-1	16-1	———	———
CFZ	Cefazolin	16-2	16-2	16-8	16-8	———	———	16-2	16-8
FIX	Cefixime	2-1	2-1	———	2-1	2-0.25	———	2-0.5	2-1
CPZ	Cefoperazone	32-4	32-16	32-16	32-16	———	———	———	———
CTX	Cefotaxime	32-8	———	32-8	32-8	———	16-0.12	32-4	32-8
CTN	Cefotetan	32-8	32-8	32-16	32-16	———	———	———	———
CX	Cefoxitin	16-2	16-4	16-8	16-8	———	———	———	———
TAZ	Ceftazidime	16-2	16-4	16-4	16-8	———	———	———	———
CTZ	Ceftizoxime	32-4	32-8	———	32-8	———	———	———	———
FRX	Ceftriaxone	32-4	32-8	32-8	32-8	———	8-0.25	32-4	32-8
CFX	Cefuroxime	16-2	16-2	16-8	16-8	16-0.5	4-0.25	16-4	16-8
CF	Cephalothin	———	———	16-8	16-8	16-1	16-8	———	———
C	Chloramphenicol	16-2	———	16-8	16-8	16-0.5	8-1	16-4	16-4
CIP	Ciprofloxacin	2-0.25	2-0.25	2-1	2-1	2-0.06	———	2-0.25	2-0.25
CLM	Clarithromycin	———	———	———	———	4-0.25	4-0.12	4-0.5	4-0.5
CD	Clindamycin	———	———	———	———	2-0.25	2-0.06	2-0.25	2-0.25
EN	Enoxacin	———	———	———	4-2	———	———	———	———
E	Erythromycin	———	———	———	———	4-0.25	4-0.25	4-0.5	4-0.5
GM	Gentamicin	8,6,4-0.25	8,6,4-0.5	8,6,4-0.5	8,6,4-1	———	———	500,8,6,4-0.25	500,8,6,4-1
IMI	Imipenem	———	———	8-4	———	———	8-0.06		
LOM	Lomefloxacin	4-2	4-2	———	4-2	4-2	———	4-2	4-2
MZ	Mezlocillin	64-8	64-8	64-16	———	———	———	———	———
NET	Netilmicin	16-8	———	———	———	———	———	———	———
FD	Nitrofurantoin	64-32	64-32	64-32	64-32	64-32	64-32	———	64-32
NOR	Norfloxacin	8-4	_____	8-4	8-4	8-4	8-2	———	———
OFX	Ofloxacin	4-0.5	4-0.5	4-2	4-2	4-0.12	8-1	4-0.25	4-1
OX	Oxacillin	———	———	———	———	6,4-0.5	———	6.4-0.5	6,4-1
P	Penicillin	———	———	———	———	8-0.03	2-0.03	8-0.03	8-0.03
PIP	Piperacillin	64-8	_____	64-16	64-8	———	———	———	———
P/T	Piperacillin/ Tazobactam	64-8/4	64-8/4	64-16/4	64-16/4	———	———	16-2/4	16-4/4
RI	Rifampin	———	———	———	———	2-1	4-0.5	2-1	2-1
STR	Streptomycin	———	———	———	———	———		1000	1000
SFX	Sulfisoxasole	———	———	———	———	256	———	———	———
TE	Tetracycline	———	———	8-4	8-4	8-0.5	8-1	8-2	———
TC	Ticarcillin	———	———	———	64-8	———	———	———	———
T/C	Ticarcillin/ Clavulanic Acid	———	———	64-16/2	———	———	64-16/2	———	———
TO	Tobramycin	8,6,4-0.25	8,6,4,-0.5	8,6,4,-0.5	8,6,4-1	———	———	8,6,4-0.25	8,6,4-1
T/S	Trimethoprim/ Sulfamethoxazole	2-1/38-19	2-1/38-19	2-38	2/38	2-0.5/38-9.5	2-0.5/38-9.5	2-0.5/38-9.5	2/38
VA	Vancomycin	———	———	———	———	16-4	4-0.5	16-1	16-2
Biochemical Substrates			30*	30*	30*				18**

* Gram-Negative Panels
** Gram-Positive Panels

Peptones & Hydrolysates Selection Guide

Typical Analyses

PRODUCT	AMINO ACIDS - %																	
	Alanine	Arginine	Aspartic Acid	Cystine	Glutamic Acid	Glycine	Histidine	Isoleucine	Leucine	Lysine	Methionine	Phenylalanine	Proline	Serine	Threonine	Tryptophan	Tyrosine	Valine
Beef Extract	2.54	1.39	1.67	0.18	6.01	4.14	4.94	0.53	1.00	1.45	0.30	<0.01	2.16	0.90	0.67	0.05	1.99	0.86
Beef Extract, Dessicated	8.96	5.66	4.30	0.17	12.55	16.25	2.50	1.45	3.63	3.27	1.08	2.00	9.58	2.10	1.42	0.32	1.03	2.62
Casamino Acids	3.26	2.20	4.76	0.16	15.30	1.31	1.66	3.34	5.47	5.71	1.28	2.11	6.17	2.19	2.41	<0.01	0.47	4.30
Casamino Acids, Technical	1.64	1.77	3.42	0.34	10.97	1.09	1.31	0.13	2.54	2.14	1.19	5.23	4.44	2.64	1.99	0.01	1.33	3.24
Casein Digest	2.92	3.02	6.75	0.17	23.10	1.93	2.52	4.66	8.29	7.70	2.66	4.27	11.04	5.55	4.33	1.16	2.54	6.51
Casitone	3.01	3.76	6.61	0.02	20.03	1.97	2.17	4.16	8.74	13.62	1.71	4.02	8.57	4.82	3.74	0.14	2.09	4.06
Neopeptone	4.03	4.14	6.19	0.26	13.22	7.02	<0.01	0.36	3.65	5.16	2.00	8.67	6.73	4.22	3.69	0.96	4.21	4.96
Bacto Peptone	8.67	6.76	5.60	0.20	10.21	15.59	0.58	1.45	3.01	3.42	1.19	1.81	8.80	2.87	1.81	0.36	0.64	2.35
Proteose Peptone	6.50	5.12	7.28	0.87	11.95	9.68	2.01	3.04	5.66	5.33	1.97	2.86	5.93	3.49	3.14	0.60	2.35	3.76
Proteose Peptone No. 2	6.08	5.47	7.45	0.40	10.57	10.84	<0.01	1.00	3.57	5.22	1.51	7.94	5.31	4.64	3.90	0.94	1.92	4.73
Proteose Peptone No. 3	5.99	5.49	6.92	1.12	12.38	9.26	1.74	2.65	5.70	5.02	1.86	2.72	4.94	3.65	3.32	0.59	1.96	3.62
Soytone	2.46	3.82	7.27	1.45	12.76	2.51	1.24	2.37	4.03	3.45	0.86	2.46	2.92	2.87	2.17	0.47	1.93	2.65
TC Lactalbumin Hydrolysate	3.70	2.67	7.13	0.55	16.30	2.02	1.83	1.18	5.43	4.11	2.11	10.81	6.62	4.62	4.76	1.75	1.22	5.82
TC Yeastolate	4.84	2.99	5.58	0.45	10.53	4.02	<0.01	0.56	3.23	3.82	0.96	5.59	2.59	2.81	2.80	0.79	1.21	3.80
Tryptone	2.86	3.03	6.11	0.42	17.05	1.75	2.02	4.40	7.11	6.70	2.57	3.71	7.45	4.29	3.58	0.71	1.42	5.00
Tryptose	4.45	4.65	6.34	0.44	13.92	2.84	<0.01	0.34	3.67	4.64	1.92	7.52	6.33	4.09	3.55	0.62	2.21	1.93
Yeast Extract	5.36	3.02	6.69	0.74	14.20	3.25	1.20	3.23	4.69	5.15	1.05	2.53	2.60	2.84	2.95	1.36	1.20	3.79

PRODUCT	INORGANICS - %															CARBOHYDRATE
	Calcium	Chloride	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Phosphate	Potassium	Sodium	Sulfate	Sulfur	Tin	Zinc	Total (%)
Beef Extract	0.068	1.284	<0.001	<0.001	<0.001	<0.001	0.239	<0.001	5.458	5.477	2.315	0.629	0.707	<0.001	<0.001	0.2
Beef Extract, Dessicated	0.018	1.576	<0.001	0.001	0.011	<0.001	0.022	<0.001	0.345	1.994	2.774	0.829	0.661	<0.001	0.002	<0.1
Casamino Acids	<0.001	7.400	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	3.325	0.410	8.710	0.045	0.420	<0.001	<0.001	
Casamino Acids, Technical	0.019	21.212	<0.001	<0.001	<0.001	<0.001	0.008	<0.001	1.358	0.273	13.721	0.167	0.424	<0.001	0.002	3.4
Casein Digest	0.019	0.059	<0.001	<0.001	0.002	<0.001	0.018	<0.001	2.670	0.078	2.937	0.167	0.621	<0.001	0.002	4.2
Casitone	0.010	0.110	<0.001	<0.001	0.003	<0.001	0.019	<0.001	2.604	0.162	3.073	0.339	0.676	<0.001	0.004	0.2
Neopeptone	0.012	0.344	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	2.209	0.149	2.057	0.340	0.657	<0.001	<0.001	0.8
Bacto Peptone	0.008	1.086	<0.001	<0.001	0.004	<0.001	0.007	<0.001	0.445	0.203	1.759	0.244	0.410	<0.001	0.001	6.9
Proteose Peptone	0.021	4.510	<0.001	<0.001	0.002	<0.001	0.027	<0.001	0.872	0.685	3.677	0.162	0.812	<0.001	0.002	<0.1
Proteose Peptone No. 2	0.024	3.644	<0.001	<0.001	<0.001	<0.001	0.024	<0.001	1.674	0.815	3.956	0.232	0.698	<0.001	0.003	1.3
Proteose Peptone No. 3	0.023	3.581	<0.001	<0.001	0.002	<0.001	0.027	<0.001	1.447	0.982	3.815	0.232	0.975	<0.001	0.007	1.4
Soytone	0.055	0.165	<0.001	<0.001	0.008	<0.001	0.161	<0.001	0.820	2.220	3.404	2.334	1.660	<0.001	0.001	24.0
TC Lactalbumin Hydrolysate	0.095	<0.010	<0.001	<0.001	0.002	<0.001	0.026	<0.001	1.309	0.932	1.357	0.379	0.750	<0.001	0.002	9.2
TC Yeastolate	0.002	0.299	<0.001	<0.001	<0.001	<0.001	0.025	<0.001	2.633	5.085	0.819	0.488	0.528	<0.001	0.007	10.3
Tryptone	0.013	0.186	<0.001	<0.001	<0.001	<0.001	0.017	<0.001	2.669	0.229	2.631	0.241	0.740	<0.001	0.003	7.7
Tryptose	0.001	1.886	<0.001	<0.001	0.002	<0.001	0.022	<0.001	2.144	0.679	3.410	0.308	0.737	<0.001	0.005	7.1
Yeast Extract	0.013	0.380	<0.001	<0.001	<0.001	<0.001	0.075	<0.001	3.270	3.195	1.490	0.091	0.634	<0.001	0.011	17.5

Peptones & Hydrolysates Selection Guide

Typical Analyses

PRODUCT	PHYSICAL CHARACTERISTICS						BIOLOGICAL TESTING - CFU/g						NITROGEN CONTENT		
	Ash (%)	Clarity 1% Soln (NTU)	Filterability (g/cm²)	Loss on Drying (%)	pH, 1% Soln		Coliform	Salmonella	Spore Count	Standard Plate Count	Thermophile Count		Total Nitrogen (%)	Amino Nitrogen	AN/TN (%)
Beef Extract	24.1	116.8	0.1	77.2*	5.4		neg	neg	299	117	33		11.2	3.8	33.8
Beef Extract, Dessicated	10.2	1.7	0.6	2.5	6.9		neg	neg	585	690	28		14.0	2.2	15.7
Casamino Acids	24.4	0.5	2.9	4.5	6.4		neg	neg	390	950	25		10.5	8.8	83.8
Casamino Acids, Technical	38.3	0.3	2.6	4.5	6.7		neg	neg	2375	2250	<50		8.1	6.4	79.0
Casein Digest	6.4	0.4	2.6	4.7	7.2		neg	neg	235	250	178		13.4	7.2	53.9
Casitone	7.0	0.6	1.7	3.7	7.2		neg	neg	300	1850	100		13.3	4.7	35.3
Neopeptone	7.0	1.2	0.3	3.2	7.4		neg	neg	175	400	75		13.7	3.3	23.8
Bacto Peptone	4.4	0.5	0.5	3.0	7.0		neg	neg	90	273	13		15.5	3.1	20.0
Proteose Peptone	11.1	1.4	0.9	3.1	7.2		neg	neg	393	443	73		14.0	2.9	20.7
Proteose Peptone No. 2	12.7	1.5	0.6	3.5	7.2		neg	neg	75	1450	<50		12.6	5.0	39.7
Proteose Peptone No. 3	11.4	2.2	0.5	4.0	7.2		neg	neg	890	915	25		13.2	3.5	26.5
Soytone	12.0	1.0	1.2	4.6	7.2		neg	neg	10	38	<3		9.4	3.1	33.0
TC Lactalbumin Hydrolysate	7.2	0.4	7.3	4.6	7.1		neg	neg	<50	300	<50		13.0	6.3	48.3
TC Yeastolate	13.0	1.4	4.5	3.6	6.9		neg	neg	175	175	<50		10.8	6.5	59.8
Tryptone	6.8	0.5	1.3	3.7	7.2		neg	neg	73	870	8		13.0	5.2	40.0
Tryptose	9.7	0.8	2.3	3.2	7.4		neg	neg	875	825	100		13.4	4.4	32.5
Yeast Extract	11.2	1.5	2.7	3.1	6.7		neg	neg	9	60	<5		10.9	6.0	55.0

PRODUCT	VITAMINS - µg/g											
	Biotin	Choline	Cyanocobalamin	Folic Acid	Inositol	Nicotinic Acid	PABA	Pantothenic Acid	Pyridoxine	Riboflavin	Thiamine	Thymidine
Beef Extract	0.1	1171.5	0.5	3.3	4113.2	774.7	20.0	91.0	7.3	0.4	<0.1	1093.4
Beef Extract, Dessicated	0.1	1300.0	<0.1	0.6	2100.0	138.1	40.5	8.7	2.8	<0.1	<0.1	111.3
Casamino Acids	<0.1	160.0	<0.1	<0.1	<100.0	<20.0	<5.0	<0.1	<0.1	1.8	1.2	<30.0
Casamino Acids, Technical	<0.1	<50.0	<0.1	<0.1	<38.0	<0.1	9.8	<0.6	<0.1	0.2	0.2	<14.0
Casein Digest	0.1	<40.0	<0.1	1.0	490.0	14.1	6.1	6.7	0.4	<0.1	1.5	8297.0
Casitone	0.2	550.0	<0.1	0.8	980.0	20.3	15.9	7.7	1.3	0.4	<0.1	342.9
Neopeptone	0.2	3100.0	<0.1	0.4	3600.0	52.2	2.9	16.0	2.3	1.3	<0.1	<14.0
Bacto Peptone	0.2	2000.0	<0.1	0.3	2400.0	21.9	<0.5	5.9	1.7	3.9	<0.1	413.0
Proteose Peptone	0.1	2300.0	<0.1	0.4	5000.0	79.9	4.2	20.0	1.1	<0.1	1.2	99.7
Proteose Peptone No. 2	0.3	4500.0	<0.1	0.5	4700.0	157.1	1.2	47.0	4.0	6.4	1.6	1319.0
Proteose Peptone No. 3	0.4	3700.0	<0.1	0.3	8900.0	124.2	<0.5	20.0	1.3	6.8	0.1	659.6
Soytone	0.2	2200.0	<0.1	3.0	2100.0	19.1	9.0	13.0	11.0	<0.1	1.2	113.2
TC Lactalbumin Hydrolysate	<0.1	280.0	<0.1	0.2	360.0	<0.1	11.3	4.3	1.0	8.5	0.5	<14.0
TC Yeastolate	6.7	3400.0	<0.1	25.2	1900.0	945.0	96.6	300.0	77.5	21.8	54.3	2975.0
Tryptone	0.1	350.0	<0.1	0.3	1400.0	97.8	3.7	5.3	0.6	<0.1	0.4	93.4
Tryptose	0.2	2700.0	<0.1	0.4	5400.0	47.4	11.4	16.0	1.4	4.3	0.1	769.0
Yeast Extract	3.3	300.0	<0.1	1.5	1400.0	597.9	763.0	273.7	43.2	116.5	529.9	217.5

*Represents Total Solids value rather than loss on drying.

Pharmaceutical Testing - Products and Applications

PRODUCTS	APPLICATIONS: Sterility Testing	Antibiotic Assay	Vitamin/Amino Acid Assay
Agar Medium No. F	✔		
Antibiotic Medium 1†		✔	
Antibiotic Medium 2/Base Agar, Penicillin Assay†		✔	
Antibiotic Medium 3†		✔	
Antibiotic Medium 4/Yeast Beef Agar†		✔	
Antibiotic Medium 5/ Streptomycin Assay Agar w/YE†		✔	
Antibiotic Medium 8/Base Agr w/Low pH†		✔	
Antibiotic Medium 9/Polymixin Base Agar†		✔	
Antibiotic Medium 10/Polymixin Seed Agar†		✔	
Antibiotic Medium 11/Neomycin Assay Agar†		✔	
Antibiotic Medium 12		✔	
Antibiotic Medium 19/Nystatin Assay Agar†		✔	
APT Agar†			✔
APT Broth†			✔
Aseptic Commissioning Medium	✔		
B12 Assay Medium USP			✔
B12 Culture Agar USP			✔
B12 Inoculum Broth USP			✔
Biotin Assay Medium			✔
Cystine Assay Medium			✔
Fluid Thioglycollate Medium†	✔		
Fluid Thioglycollate Medium w/Beef Extract†	✔		
Fluid Thioglycollate Medium w/K Agar	✔		
Folic Acid Assay Medium			✔
Folic Acid Casei Medium			✔
Folic AOAC Medium			✔
Folic Buffer A, Dried			✔
Inositol Assay Medium			✔
Lactobacilli Agar AOAC			✔
Lactobacilli Broth AOAC			✔
Lysine Assay Medium			✔
Methionine Assay Medium			✔

† Available from Difco & Becton Dickinson Microbiology Systems.

Pharmaceutical Testing - Products and Applications

PRODUCTS	APPLICATIONS: Sterility Testing	Antibiotic Assay	Vitamin/Amino Acid Assay
Micro Assay Culture Agar			✔
Micro Inoculum Broth			✔
Neurospora Culture Agar			✔
Niacin Assay Medium			✔
NIH Thioglycollate Medium†	✔		
Panthenol Assay Medium			✔
Pantothenate Assay Medium			✔
Pantothenate Medium AOAC USP			✔
Pyridoxine Y Medium			✔
Riboflavin Assay Medium			✔
Sterility Bottles w/ Screw Cap Fluid Thioglycollate Medium/ Fluid Thioglycollate Medium†	✔		
Sterility Bottles w/ Screw Cap Tryptic Soy Broth/Trypticase™ Soy Broth†	✔		
Sterility Bottles w/ Septum Fluid A/ Peptone Water (0.1%)†	✔		
Sterility Bottles w/ Septum Fluid D/ Peptone Water (0.1%) w/Polysorbate†	✔		
Sterility Bottles w/ Septum Fluid Thioglycollate Medium†	✔		
Sterility Bottles w/ Septum Tryptic Soy Broth/ Septum Fluid Thioglycollate Medium†	✔		
Thiamine Assay Medium LV			✔
Tryptic Soy Broth/Trypticase™ Soy Broth†	✔		
Vitamin B12 Assay Medium			✔

† Available from Difco & Becton Dickinson Microbiology Systems.

Salmonella - Products and Applications

PRODUCTS	APPLICATIONS: Biochemical Tests	Differential Agar	Enrichment	Highly Selective Media	Primary Differential Media	Serological Identification	Streak lactose negative colonies on
Adonitol/Adonitol CP†	–						
Alginate	–						
Arginine	+ or (+)						
Bismuth Sulfite Agar†				✔			
BG Sulfa Agar				✔			
Brilliant Green Agar†				✔			
Brilliant Green Agar Modified (Edel-Kampelmacher)				✔			
Desoxycholate Agar†		✔					
Desoxycholate Citrate Agar†				✔			
Dulcitol	(+) d						
EMB Agar†		✔					✔
Erythritol	–						
Esculin	–						
Gelatin	–						
Glucose	+						
GN Broth Hajna†			✔				
Hektoen Enteric Agar†		✔					
H_2S	+(–)						
Individual O and H Antisera						✔	
Indole	–						
Inositol	d						
KCN	–						
Lactose	–						
Lysine	+						
Lysine Iron Agar†					✔		
MacConkey Agar†		✔					✔
MacConkey Agar CS		✔					
Methyl Red	+						

Key

– Negative
+ Positive
d Delayed
(+) Variable
(–) Variable

† Available from Difco & Becton Dickinson Microbiology Systems.

Salmonella - Products and Applications

PRODUCTS	APPLICATIONS						
	Biochemical Tests	Differential Agar	Enrichment	Highly Selective Media	Primary Differential Media	Serological Identification	Streak lactose negative colonies on
MIO Medium					✔		
Muller Kauffmann Tetrathionate Broth Base				✔			
Nitrate Reduction	+						
Ornithine	+ or (+)						
Oxidase	–						
Phenylalanine	–						
Polyvalent Antisera						✔	
Raffinose	–						
Salicin	–						
SBG Enrichment			✔				
SBG Sulfa Enrichment			✔				
Selenite Broth			✔				
Selenite Cystine Broth†			✔				
SIM Medium†					✔		
Simmons Citrate†	(+) d						
Sodium Malonate	–						
SS Agar†				✔			
Sucrose	–						
m Tetrathionate Broth Base			✔				
Tetrathionate Broth Base†			✔				
Triple Sugar Iron Agar†					✔		
Universal Preenrichment Broth			✔				
Urea Agar Base†					✔		
Urease	–						
VP	–						
XLD Agar†		✔					
XLT4 Agar Base and XLT4 Supplement		✔					

Key

– Negative
+ Positive
d Delayed
(+) Variable
(–) Variable

† Available from Difco & Becton Dickinson Microbiology Systems.

Shigella and *Alkalescens-Dispar* Group - Products and Applications

PRODUCTS	APPLICATIONS: Biochemical Tests: Shigella	Biochemical Tests: A-D Group	Enrichment	Primary Differential Media	Primary Plating Media	Streak lactose negative colonies on
Acetate Differential Agar				✔		
Adonitol	–	–				
Arabinose	d	+				
Arginine Dihydrolase	d	d				
Christensen Citrate	–	d				
Desoxycholate Agar					✔	
Desoxycholate Citrate Agar					✔	
Dulcitol	d	d				
EMB Agar†					✔	✔
Gas from Glucose	–(1)	–				
Gelatin (22°C)	–	–				
GN Broth Hajna†			✔			
Hektoen Enteric Agar†					✔	
H_2S	–	–				
Indole	– or+	+				
Inositol	–	–				
KCN	–	–				
Lactose	–(1)	d				
Lysine Decarboxylase	–	d				
Lysine Iron Agar†				✔		
MacConkey Agar†					✔	✔
MacConkey Agar CS					✔	
Malonate	–	–				
Maltose	d	+				
Mannitol	+ or–	+				
Methyl Red	+	+				
Motility	–	–				

Key

– Negative

\+ Positive

d Different reactions

(1) Certain biotypes of *S. flexneri* produce gas; cultures of *S. sonnei* ferment lactose and sucrose slowly and decarboxylate ornithine.

(–) Variable

† Available from Difco & Becton Dickinson Microbiology Systems.

Shigella and *Alkalescens-Dispar* Group - Products and Applications

PRODUCTS	APPLICATIONS: Biochemical Tests: *Shigella*	Biochemical Tests: A-D Group	Enrichment	Primary Differential Media	Primary Plating Media	Streak lactose negative colonies on
Mucate	–	d				
Ornithine Decarboxylase	d	d				
Phenylalanine	–	–				
Raffinose	d	d				
Rhamnose	d	d				
Salicin	–	–				
Simmons Citrate Agar†	–	–				
Sodium Acetate	–	+(+)				
Sucrose	–(1)	d				
Triple Sugar Iron Agar†				✔		
Urease	–	–				
Voges-Proskauer	–	–				
XLD Agar†					✔	
Xylose	d	+				

Key

– Negative
+ Positive
d Different reactions
(1) Certain biotypes of *S. flexneri* produce gas; cultures of *S. sonnei* ferment lactose and sucrose slowly and decarboxylate ornithine.
(–) Variable

† Available from Difco & Becton Dickinson Microbiology Systems.

Sterility Testing

STERILITY TESTING, MANUAL

AC Broth
AC Medium
Agar Medium No. F
Brewer Thioglycollate Medium
Fluid Thioglycollate Medium†
Fluid Thioglycollate Medium w/Beef Extract†
Fluid Thioglycollate Medium w/K Agar
NIH Thioglycollate Medium
Sterility Bottles w/Screw Cap Fluid Thioglycollate Medium
Sterility Bottles w/Screw Cap Tryptic Soy Broth
Sterility Bottles w/Septum Fluid A
Sterility Bottles w/Septum Fluid D
Sterility Bottles w/Septum Fluid Thioglycollate Medium
Sterility Bottles w/Septum Tryptic Soy Broth
Thioglycollate Medium w/o Dextrose
Thioglycollate Medium w/o Indicator
Thioglycollate Medium w/o Dextrose or Indicator
Tryptic Soy Broth

See also: Environmental Sampling Section of the Reference Guide

STERILITY TESTING, AUTOMATED

See ESP, Industrial Applications

† Available from Difco & Becton Dickinson Microbiology Systems.

Veterinary Testing - Products and Applications

PRODUCTS	APPLICATIONS								
	Collection/Transport Bacterial	Collection/Transport, Viral	General Purpose Bacterial Culture Media	*Brucella*	*Clostridium*	*Francisella*	Gram Negative Enteric Bacteria (General)	*Leptospira*	*Pseudomonas*
Brain Heart Infusion†			✔						
Brain Heart Infusion Agar†			✔						
Brain Heart Infusion Agar and Clostridium Difficile Antimicrobic Supplement CC†					✔				
Brucella Agar†				✔					
Brucella Broth†				✔					
Brucella Antisera				✔					
Cell*matics*™ Viral Transport Pack/ **CULTURETTE**™ Viral Single Swab†		✔							
Cetrimide Agar Base/**PSEUDOSEL**™ Agar†									✔
Cooked Meat Medium†					✔				
CULTURESWAB™ Amies Medium	✔								
CULTURESWAB Amies Mediumw/o Charcoal/ **CULTURETTE** Amies w/o Charcoal†	✔								
CULTURESWAB Cary-Blair Medium/Anaeno **CULTURETTE** Cary-Blair Single†	✔								
CULTURESWAB Perinasal Swab w/Amies Medium	✔								
CULTURESWAB Urethral Swab w/Amies Medium	✔								
CULTURESWAB Stuart's Medium Modified/ **CULTURETTE** Modified Stuart's Medium†	✔								
Cystine Heart Agar						✔			
EMB Agar/Eosin Methylene Blue Agar Modified†							✔		
Eugon Agar/**EUGONAGAR**™†				✔					
Eugon Broth/**EUGONBROTH**™†				✔					
Fletcher Medium Base								✔	
Fluid Thioglycollate Medium†			✔						
Francisella Tularensis Antigen						✔			
Francisella Tularensis Antiserum†						✔			
Leptospira Enrichment EMJH								✔	
Leptospira Medium Base EMJH								✔	
Levine EMB Agar/Levine Eosin Methylene Blue Agar†							✔		
MacConkey Agar							✔		
McClung Toabe Agar Base†					✔				
Pseudomonas Agar F/Flo Agar†									✔
Pseudomonas Agar P/Tech Agar†									✔
Pseudomonas Isolation Agar/Pseudomonas ISO†									✔
Reinforced Clostridium Medium/ Reinforced Clostridum Agar†					✔				

† Available from Difco & Becton Dickinson Microbiology Systems.

Veterinary Testing - Products and Applications

PRODUCTS	APPLICATIONS								
	Collection/Transport Bacterial	Collection/Transport, Viral	General Purpose Bacterial Culture Media	*Brucella*	*Clostridium*	*Francisella*	Gram Negative Enteric Bacteria (General)	*Leptospira*	*Pseudomonas*
SFP Agar Base/TSN Agar†					✔				
Simmons Citrate Agar†							✔		
SPS Agar†					✔				
Sterile Swab/Aerobic Collection & Trans. System w/o Agar†	✔								
Triple Sugar Iron Agar†							✔		
Tryptic Soy Agar/**TRYPTICASE**™ Soy Agar†			✔						
Tryptic Soy Broth/**TRYPTICASE**™ Soy Broth†			✔						
Tryptose Phosphate Broth†			✔						

PRODUCTS	APPLICATIONS							
	Staphylococcus	Oxidation-Fermentation (O-F) Test	Mycological Media	Blood Culture	*Salmonella/Shigella*	*Streptococcus*	*Vibrio*	Susceptibility Testing
Azide Blood Agar Base†						✔		
Baird-Parker Agar Base w/ EY Tellurite Enrichment†	✔							
Bismuth Sulfite Agar†					✔			
Blood Culture Bottles Brain Heart Infusion w/ PAB, SPS + CO_2					✔			
Blood Culture Bottles Columbia Broth w/CO_2					✔			
Blood Culture Bottles Columbia Broth w/SPS + CO_2					✔			
Blood Culture Bottles Fluid Thioglycollate Medium w/SPS + CO_2					✔			
Blood Culture BottlesThiol Broth w/CO_2					✔			
Blood Culture BottlesThiol Broth w/SPS + CO_2					✔			
Blood Culture Bottles Tryptic Soy Broth w/CO_2					✔			
Blood Culture Bottles Tryptic Soy Broth w/SPS + CO_2/ **SEPTIC-CHEK**™ TSB w/ SPS + CO_2†					✔			
Brain Heart Infusion Agar†				✔				
Brilliant Green Agar†						✔		
Coagulase Plasma (Rabbit)/ Coagulase Plasma, Rabbit†	✔							

† Available from Difco & Becton Dickinson Microbiology Systems.

Veterinary Testing - Products and Applications

PRODUCTS	APPLICATIONS: Staphylococcus	Oxidation-Fermentation (O-F) Test	Mycological Media	Blood Culture	Salmonella/Shigella	Streptococcus	Vibrio	Susceptibility Testing
Coagulase Plasma EDTA (Rabbit)/ Coagulase Plasma, Rabbit w/EDTA†	✔							
Columbia CNA Agar†						✔		
Corn Meal Agar†			✔					
Decarboxylase Medium Base		✔						
Dispens-O-Disc Susceptilbility Disks: Apramycin 15 mcg								✔
Ceftiofur 30 mcg								✔
Enrofloxacin 5 mcg								✔
Tilmicosin 15 mcg								✔
DNase Test Agar†	✔							
DNase Test Agar w/ Methyl Green/DNase Test Agar w/Toluidine Blue†	✔							
DTM Agar			✔					
Lysine Iron Agar†					✔			
Mannitol Salt Agar†	✔							
MIO Medium					✔			
MR-VP Medium/MR-VP Broth†					✔			
Mueller Hinton Medium/Mueller Hinton II Agar†								✔
Mycological Agar/**MYCOPHIl**™ Agar†			✔					
OF Basal Medium†		✔						
Phenol Red Broth Base†		✔						
Phenylethanol Agar/Phenylethyl Alcohol Agar†	✔					✔		
Purple Agar Base		✔						
Purple Broth Base†		✔						
Sabouraud Dextrose Agar†			✔					
Sabouraud Dextrose Broth			✔					
Selenite Broth/Selenite F Broth					✔			
Selenite Cystine Broth†					✔			
SS Agar/Salmonella Shigella Agar†					✔			
Staph Latex Test/**STAPHYLOSLIDE**™ Test Kit†	✔							
Strep Grouping Kit†						✔		
Tetrathionate Broth Base†					✔			
TCBS Agar†							✔	
Urea Agar Base†			✔					
Vibrio Cholerae Antisera							✔	
VJ Agar (Vogel-Johnson Medium)†	✔							
XLD Agar†					✔			
XLT4 Agar Base and XLT4 Supplement					✔			

† Available from Difco & Becton Dickinson Microbiology Systems.

Water/Wastewater Testing - Products and Applications

PRODUCTS	APPLICATIONS						
	Standard Plate Count	Total Coliforms	Fecal Coliforms / *E. coli*	Fecal Streptococcus	*Salmonella*	Stressed Organisms	*Staphylococcus*
A-1 Medium/A-1 Broth†			✔				
Azide Dextrose Broth†				✔			
BAGG Broth			✔				
Baird-Parker Agar Base w/ EY Tellurite Enrichment/Egg Yolk Tellurite Solution†							✔
Bile Esculin Agar†				✔			
Bile Esculin Azide Agar/**ENTEROCOCCOSEL**™ Agar†				✔			
Bismuth Sulfite Agar†					✔		
Brilliant Green Agar†					✔		
Brilliant Green Agar Modified (Edel-Kempelmacher)					✔		
Brilliant Green Bile 2%/Brilliant Green Bile Broth 2%†		✔					
m Brilliant Green Broth					✔		
Desoxycholate Lactose Agar†		✔					
m E Agar/M-E Agar Base†				✔			
EC Medium/EC Broth†			✔				
EC Medium with MUG/EC Broth w/ MUG†			✔				
m Endo Agar LES/m Endo Agar LES†		✔					
m Endo Broth MF®/m Endo Broth†		✔					
m Enterococcus Agar/m Enterococcus Agar†				✔			
Esculin Iron Agar				✔			
EVA Broth/Ethyl Violet Azide Broth†				✔			
m FC Agar/ m FC Agar†			✔				
m FC Basal Medium			✔				
m FC Broth Base/m FC Broth†			✔				
m HPC Agar/m HPC Agar Base†	✔						
Lactose Peptone Broth		✔					
Lauryl Tryptose Broth/Lauryl Sulfate Broth†		✔					
Lauryl Tryptose Broth with MUG/ Lauryl Sulfate Broth w/ MUG†		✔					
Levine EMB Agar/Levine Eosin Methylene Blue Agar†		✔					
Minerals Modified Glutamate Broth		✔					
Muller Kauffmann Tetrathionate Broth Base					✔		

† Available from Difco & Becton Dickinson Microbiology Systems.

Water/Wastewater Testing - Products and Applications

PRODUCTS	APPLICATIONS: Standard Plate Count	Total Coliforms	Fecal Coliforms / *E. coli*	Fecal Streptococcus	*Salmonella*	Stressed Organisms	*Staphylococcus*
Nutrient Agar w/ MUG†			✔				
Plate Count Agar/Standard Methods Agar†	✔						
Presence-Absence Broth†		✔					
R2A Agar†						✔	
Rosolic Acid			✔				
Selenite Broth/Selenite F Broth†					✔		
Selenite Cystine Broth†					✔		
m Staphylococcus Broth							✔
m T7 Agar						✔	
m TEC Agar						✔	
m Tetrathionate Broth Base					✔		
Tetrathionate Broth Base†					✔		
Tryptone Water			✔				
XLD Agar†					✔		

† Available from Difco & Becton Dickinson Microbiology Systems.