**TITLE: VITROS Microslide Lithium Assay**

**Principle:**

The VITROS Li Slide method is performed using the VITROS Li Slides and the VITROS Chemistry Products Calibrator Kit 1 on the VITROS 5600 Integrated System.

The VITROS Li Slide is a multilayered, analytical element coated on a polyester support A drop of patient sample is deposited on the slide and is evenly distributed by the spreading layer to the underlying layers. The lithium in the sample is specifically bound by the crown-ether azo dye (6-dodecyl-6-(2'-hydroxy- 5’-(2’’-4’’-dinitrophenylazo)benzyl)-13, 13-dimethyl-1,4,8,11-tetraoxacyclotetradecane). As the lithium ion binds to the crown-ether, a shift in the peak absorbance of the dye occurs. The increase in absorbance is proportional to the concentration of lithium in the sample. The intensity of the dye is measured by reflectance spectrophotometry at the end of incubation

**Test Type and Conditions**

| **Test Type** | **VITROS System** | **Approximate Incubation Time** | **Temperature** | **Wavelength** | **Reaction Sample Volume** |
| --- | --- | --- | --- | --- | --- |
| Colorimetric | 5600 | 2.3 minutes | 37 °C (98.6 °F) | 600 nm | 10 µL |

**Reaction Scheme**

|  |  |  |
| --- | --- | --- |
| lithium + crown-ether dye | 2 | dye complex |

**Warnings and Precautions**

For *in vitro* diagnostic use only.

|  |  |
| --- | --- |
| **WARNING:** | ***Take care when handling materials and samples of human origin. Since no test method can offer complete assurance that infectious agents are absent, consider all clinical specimens, controls, and calibrators potentially infectious. Handle specimens, solid and liquid waste, and test components in accordance with local regulations and CLSI Guideline M29*** [***3***](#d6e3386)  ***or other published biohazard safety guidelines.*** |

**Clinical Significance:**

Lithium is used in the treatment of bipolar (manic-depressive) illness. Lithium measurements are used to monitor patient compliance and therapy and to diagnose potential overdose. Symptoms of lithium intoxication include sluggishness, drowsiness, muscle weakness, and ataxia. [1](#d6e3372)  ,  [2](#d6e3379)

**Specimen Collection, Preparation and Storage**

**Specimens Recommended**

Serum

 Plasma-Heparin

|  |  |
| --- | --- |
| **IMPORTANT:** | ***Certain collection devices have been reported to affect other analytes and tests.*** [***4***](#d6e3393)  ***Owing to the variety of specimen collection devices available, Ortho-Clinical Diagnostics is unable to provide a definitive statement on the performance of its products with these devices. Confirm that your collection devices are compatible with this test.*** |

**Specimens Not Recommended**

 Plasma:

 Fluoride oxalate

 Lithium heparin

**Serum and Plasma**

***Specimen Collection and Preparation***

Collect specimens using standard laboratory procedures. [5](#d6e3400)  ,  [6](#d6e3407)

|  |  |
| --- | --- |
| **Note:** | For details on minimum fill volume requirements, refer to the operating instructions for your system. |

**Patient Preparation**

No special patient preparation is necessary.

**Special Precautions**

* Samples are commonly drawn approximately 12 hours after the last dose of lithium has been taken. [7](#d6e3414)

 Centrifuge specimens and remove the serum or plasma from the cellular material within 4 hours of collection. [8](#d6e3421)

**Specimen Handling and Storage**

 Handle and store specimens in stoppered containers to avoid contamination and evaporation.

 Mix samples by gentle inversion and bring to room temperature, 18–28 °C (64–82 °F), prior to analysis.

**Specimen Storage and Stability**

| **Storage** | **Temperature** | **Stability** |
| --- | --- | --- |
| Room temperature | 18–28 °C (64–82 °F) | ≤ 8 hours |
| Refrigerated | 2–8 °C (36–46 °F) | ≤ 24 hours |
| Frozen | ≤-18 °C (≤0 °F) | ≤ 6 months |

**Reagents**

|  |  |  |
| --- | --- | --- |
| **Slide Ingredients** | 3 | 1. **Upper slide mount**
2. **Spreading layer (BaSO4): buffer, pH 11.0**
3. **Buffer layer: buffer, pH 11.0**
4. **Reagent layer: crown-ether azo dye**
5. **Support layer**
6. **Lower slide mount**
 |
| ***Reactive Ingredients per cm2*** |
| (6-dodecyl-6-(2’-hydroxy-5’-(2’’-4’’-dinitrophenylazo)benzyl)-13,13-dimethyl-1,4,8,11-tetraoxacyclotetradecane) (crown-ether azo dye) 40 µg. |
| ***Other Ingredients*** |
| Pigment, binders, buffer, surfactants, dye solubilizer and cross-linking agent. |

**Reagent Handling**

|  |  |
| --- | --- |
| **Caution:** | **Do not use slide cartridges with damaged or incompletely sealed packaging.** |

* Inspect the packaging for signs of damage.
* Be careful when opening the outer packaging with a sharp instrument so as to avoid damage to the individual product packaging.

**Reagent Preparation**

|  |  |
| --- | --- |
| **IMPORTANT:** | *The slide cartridge must reach room temperature, 18–28 °C (64–82 °F), before it is unwrapped and loaded into the slide supply.* |

 1 .Remove the slide cartridges from storage.

 2. Warm the wrapped cartridge at room temperature for 60 minutes.

1. Unwrap and load the cartridge into the slide supply.

|  |  |
| --- | --- |
| **Note:** | Load the cartridges within 24 hours after they reach room temperature, 18–28 °C (64–82 °F). |

**Reagent Storage and Stability**

VITROS Li Slides are stable until the expiration date on the carton when they are stored and handled as specified. Do not use beyond the expiration date.

| **Reagent** | **Storage Condition** | **Stability** |
| --- | --- | --- |
| Unopened | Frozen | ≤-18 °C (≤0 °F) | Until expiration date |
| Opened | On-analyzer | System turned on | ≤ 5 weeks |
| On-analyzer | System turned off | ≤ 2 hours |

Verify performance with quality control materials:

* If the system is turned off for more than 2 hours.
* After reloading cartridges that have been removed from the slide supply and stored for later use.

**Calibration**

**Required Calibrators**

VITROS Chemistry Products Calibrator Kit 1

**Calibrator Preparation, Handling, and Storage**

Refer to the Instructions for Use for VITROS Calibrator Kit 1.

**Calibration Procedure**

Refer to the operating instructions for your system.

**When to Calibrate**

Calibrate:

* When the slide lot number changes.
* When critical system parts are replaced due to service or maintenance.
* When government regulations require.

For example, in the USA, CLIA regulations require calibration or calibration verification at least once every six months.

The VITROS Li test may also need to be calibrated:

* If quality control results are consistently outside acceptable range.
* After certain service procedures have been performed.

For additional information, refer to the operating instructions for your system.

**Calculations**

Reflectance from the slide is measured at 600 nm after the fixed incubation time. Once a calibration has been performed for each slide lot, lithium concentration in unknown samples can be determined using the software-resident endpoint colorimetric math model and the response obtained from each unknown test slide.

**Validity of a Calibration**

Calibration parameters are automatically assessed by the VITROS Integrated System,( see the Review Assay Data screen). Failure to meet any of the pre-defined quality parameters results in a failed calibration. The calibration report should be used in conjunction with quality control results to determine the validity of a calibration.

**Measuring (Reportable or Dynamic) Range**

0.02-4.00 mmol/L

 For out-of-range samples, refer to “Sample Dilution.”

**Traceability of Calibration**

Values assigned to the VITROS Chemistry Products Calibrator Kit 1 for lithium are traceable to the Certified NIST (National Institute of Standards and Technology) Reference Material, SRM® (Standard Reference Material) 924. The Ortho-Clinical Diagnostics calibration laboratory uses SRM® 924 to calibrate the flame atomic absorption spectroscopy method [9](#d6e3427)  to support lithium value assignment for VITROS Calibrator Kit 1.

**Quality Control**

 Refer to Chemistry Quality Control Procedure for Specifics

At least once each day of use, analyze two levels of a quality control material with known Acetaminophen concentrations. If the results fall outside of the laboratory’s acceptable limits, follow the Chemistry Quality Control Procedure.

**Quality Control Material Selection**

|  |  |
| --- | --- |
| **IMPORTANT:** | *VITROS Performance Verifiers are recommended for use with the VITROS Chemistry and Integrated Systems. Evaluate the performance of other commercial control fluids for compatibility with this test before using for quality control.* |

* Control materials other than VITROS Performance Verifiers may show a difference when compared with other lithium methods if they:

– Depart from a true human matrix.

– Contain high concentrations of preservatives, stabilizers, or other nonphysiological additives.

* Do not use control materials stabilized with ethylene glycol.

**Quality Control Procedure Recommendations**

* Choose control levels that check the clinically relevant range.
* Analyze quality control materials in the same manner as patient samples, before or during patient sample processing.
* To verify system performance, analyze control materials:

– After calibration.

– According to local regulations or at least once each day that the test is being performed.

– After specified service procedures are performed. Refer to the operating instructions for your system.

* If control results fall outside your acceptable range, investigate the cause before deciding whether to report patient results.
* For general quality control recommendations, refer to *Statistical Quality Control for Quantitative Measurements: Principles and Definitions; Approved Guideline-Third Edition*  [10](#d6e3433)  or other published guidelines.
* For additional information, refer to the operating instructions for your system.

**Quality Control Material Preparation, Handling, and Storage**

Refer to the Instructions for Use for VITROS Chemistry Products Performance Verifier I and II or to other manufacturer's product literature.

**Testing Procedure**

 **Materials Provided**

 VITROS Chemistry Products Li Slides

 **Materials Required but Not Provided**

* VITROS Chemistry Products Calibrator Kit 1
* Quality control materials, such as VITROS Chemistry Products Performance Verifier I and II
* VITROS Chemistry Products 7% BSA
* VITROS Chemistry Products FS Diluent Pack 2 (BSA/Saline) (for on-analyzer dilution)

 **Operating Instructions**

* Check reagent inventories at least daily to ensure that quantities are sufficient for the planned workload.
* For additional information, refer to the operating instructions for your system.

|  |  |
| --- | --- |
| **IMPORTANT:** | *Bring all fluids and samples to room temperature, 18–28 °C (64–82 °F), prior to analysis.* |

 **Sample Dilution**

 ***Serum and Plasma***

If lithium concentrations exceed the system’s measuring (reportable or dynamic) range:

 **Manual Sample Dilution**

1. Dilute the sample with VITROS 7% BSA.
2. Reanalyze.
3. Multiply the results by the dilution factor to obtain an estimate of the original sample’s lithium concentration.

 **On-Analyzer Sample Dilution (VITROS Integrated**

Refer to the operating instructions for your system for more information on the On-Analyzer Dilution Procedure. For VITROS Integrated system use VITROS Chemistry Products FS Diluent Pack 2 for the dilution.

**Results**

 Reporting Units = mmol/L

 **Reference Interval**

These serum lithium concentrations are based on the 12-hour standardized concentration, measured on a serum sample obtained 12 hours after the last dose. [11](#d6e3440)  ,  [12](#d6e3448)

|   | **Conventional Units (mmol/L)** |
| --- | --- |
| **Therapeutic** [**13**](#d6e3455)  | 0.6–1.2 |
|  **Toxic** [**14**](#d6e3462)  |
|  |  |
| **Severely/Critical** | > 2.5 |

**Procedure Notes:**

**Known Interferences**

The VITROS Li Slide method was screened for interfering substances following NCCLS Protocol EP7. [15](#d6e3469)  The substances listed in the table, when tested at the concentrations indicated, caused the bias shown.

For substances that were tested and did not interfere, refer to “Specificity.”

| **Interferent** [**\***](#d6e830)  | **Interferent Concentration** | **Lithium Concentration** | **Average Bias** |
| --- | --- | --- | --- |
| **Conv. and SI(mmol/L)** | **Conv. and SI(mmol/L)** |
| Methylparaben [**\*\***](#d6e834)  | 150 mg/dL | (10 mmol/L) | 1.0 | -0.17 |
| *N*-Acetylcysteine | 180 mg/dL | (11.0 mmol/L) | 1.0 | -0.15 |
| Hemoglobin | 100 mg/dL | (1 g/L) | 1.2 | +0.04 |
| 250 mg/dL | (2.5 g/L) | 1.2 | +0.12 |
| 500 mg/dL | (5 g/L) | 1.2 | +0.17 |

**\*** It is possible that other interfering substances may be encountered. These results are representative; however, your results may differ somewhat due to test-to-test variation. The degree of interference at concentrations other than those listed might not be predictable.

**\*\*** A preservative found in some controls, proficiency fluids, and sterile saline flushes

 **Other Limitations**

Certain drugs and clinical conditions are known to alter lithium concentration *in vivo*. For additional information, refer to one of the published summaries. [16](#d6e3476)

**Performance Characteristics**

 **Method Comparison**

The plots and table show the results of a comparison of serum samples analyzed on the VITROS 750 System with those analyzed using the Atomic Absorption comparative method. [9](#d6e3427)  Testing followed NCCLS Protocol EP9. [18](#d6e3490)

The table also shows the results of comparisons of serum samples between the VITROS 750 System and a commercially available method, comparisons of the VITROS 250 and 950 Systems with the VITROS 750 System, and comparisons of the VITROS 5,1 FS System with the VITROS 950 System.

In addition, the table shows the results of comparisons of serum and plasma samples on the VITROS 5600 Integrated System and the VITROS 5,1 FS Chemistry System. The testing followed NCCLS Protocol EP9. [19](#d6e3497)

| Conventional and SI Units | Alternate Units |
| --- | --- |
| VITROS 750 System (mmol/L) | 4 | VITROS 750 System (mEq/L) | 5 |
| Comparative Method: Atomic Absorption | Comparative Method: Atomic Absorption |

|  | **n** | **Slope** | **Correlation Coefficient** | **Conventional and SI Units (mmol/L)** |
| --- | --- | --- | --- | --- |
| **Range of Sample Conc.** | **Intercept** | **Sy.x** |
| **750 vs. comparative method** | 102 | 1.00 | 0.999 | 0.2–3.7 | +0.01 | 0.04 |
| **250 vs. 750** | 58 | 0.98 | 1.000 | 0.2–3.7 | +0.02 | 0.02 |
| **950 vs. 750** | 99 | 1.00 | 1.000 | 0.3–3.9 | 0.00 | 0.03 |
| **5,1 FS** [**†**](#d6e1290)  **vs. 950** | 125 | 1.00 | 1.000 | 0.2–4.0 | -0.01 | 0.02 |
| **750 vs. commercial method** [**\***](#d6e1286)  | 197 | 1.00 | 0.992 | 0.2–3.8 | +0.04 | 0.05 |
| **5600 vs. 5,1 FS** [**†**](#d6e1290)  | 109 | 0.99 | 0.998 | 0.2–3.8 | -0.01 | 0.06 |

 \* ISE method

**Precision**

Precision was evaluated with quality control materials on VITROS 250, 750, 950, and 5,1 FS Systems following NCCLS Protocol EP5. [20](#d6e3512)  Precision was also evaluated with quality control materials on the VITROS 5600 Integrated System following NCCLS Protocol EP5. [21](#d6e3519)

The data presented are a representation of test performance and are provided as a guideline. Variables such as sample handling and storage, reagent handling and storage, laboratory environment, and system maintenance can affect reproducibility of test results.

|  | **Conventional and SI Units (mmol/L)** | **Alternate Units (mEq/L)** | **Within Lab CV%** [**\*\***](#d6e2002)  | **No. Observ.** | **No. Days** |
| --- | --- | --- | --- | --- | --- |
| **Mean Conc.** | **Within Day SD** [**\***](#d6e1998)  | **Within Lab SD** [**\*\***](#d6e2002)  | **Mean Conc.** | **Within Day SD** [**\***](#d6e1998)  | **Within Lab SD** [**\*\***](#d6e2002)  |
| **250** | 0.5 | 0.03 | 0.05 | 0.5 | 0.03 | 0.05 | 9.3 | 80 | 20 |
| 1.0 | 0.04 | 0.05 | 1.0 | 0.04 | 0.05 | 5.4 | 80 | 20 |
| 1.6 | 0.04 | 0.05 | 1.6 | 0.04 | 0.05 | 3.1 | 80 | 20 |
| 2.2 | 0.04 | 0.07 | 2.2 | 0.04 | 0.07 | 3.2 | 80 | 20 |
| 3.5 | 0.04 | 0.06 | 3.5 | 0.04 | 0.06 | 1.8 | 80 | 20 |
| **750** | 0.5 | 0.03 | 0.03 | 0.5 | 0.03 | 0.03 | 5.6 | 80 | 20 |
| 1.0 | 0.03 | 0.04 | 1.0 | 0.03 | 0.04 | 3.8 | 80 | 20 |
| 1.2 | 0.03 | 0.04 | 1.2 | 0.03 | 0.04 | 3.3 | 80 | 20 |
| 2.1 | 0.05 | 0.05 | 2.1 | 0.04 | 0.05 | 2.5 | 80 | 20 |
| 2.3 | 0.04 | 0.05 | 2.3 | 0.04 | 0.05 | 1.9 | 80 | 20 |
| **950** | 0.7 | 0.03 | 0.03 | 0.7 | 0.03 | 0.03 | 4.5 | 92 | 23 |
| 1.9 | 0.04 | 0.04 | 1.9 | 0.04 | 0.04 | 2.3 | 92 | 23 |
| **5,1 FS** [**†**](#d6e2006)  | 1.1 | 0.03 | 0.04 | 1.1 | 0.03 | 0.04 | 3.3 | 90 | 22 |
| 2.5 | 0.03 | 0.05 | 2.5 | 0.03 | 0.05 | 2.0 | 88 | 22 |
| **5600** | 1.1 | 0.03 | 0.04 | 1.1 | 0.03 | 0.04 | 3.6 | 92 | 23 |
| 2.4 | 0.04 | 0.06 | 2.4 | 0.04 | 0.06 | 2.5 | 92 | 23 |

**\*** Within Day precision was determined using two runs/day with at least two replications.

**\*\*** Within Lab precision was determined using a single lot of slides and calibrating weekly.

**†** Analytical processing hardware and software algorithms on the VITROS 4600 Chemistry System are designed to the same specifications as those applied to the VITROS 5,1 FS Chemistry System. Assay performance on the VITROS 4600 System has been demonstrated to be comparable to that on the VITROS 5,1 FS System. All performance characteristics for VITROS 5,1 FS System are therefore applicable to the VITROS 4600 System.

**Specificity**

The substances listed in the table were tested with VITROS Li Slides at a lithium concentration of 1.0 mmol/L following NCCLS Protocol EP7 [15](#d6e3469)  and found not to interfere, bias <0.13 mmol/L, at the concentration shown.

| **Compound** | **Concentration** |  | **Compound** | **Concentration** |
| --- | --- | --- | --- | --- |
| Acetate | 25 mmol/L | 25 mmol/L |  | Ibuprofen | 40 mg/dL | 2 mmol/L |
| Acetaminophen | 20 mg/dL | 1 mmol/L |  | Imipramine | 10 mg/dL | 357 µmol/L |
| N-Acetylcysteine | 90 mg/dL | 6 mmol/L |  | Intralipid | 800 mg/dL | 8 g/L |
| Acetylsalicylic acid | 50 mg/dL | 3 mmol/L |  | Iron | 124 µmol/L | 124 µmol/L |
| Acyclovir | 25 mg/dL | 1 mmol/L |  | Isoniazid | 7 mg/dL | 511 µmol/L |
| Albuterol | 18 mg/dL | 375 µmol/L |  | Keflin | 100 mg/dL | 3 mmol/L |
| Allopurinol | 5 mg/dL | 367 µmol/L |  | Lidocaine | 6 mg/dL | 256 µmol/L |
| Amitriptyline | 10 mg/dL | 360 µmol/L |  | Magnesium | 5 mmol/L | 5 mmol/L |
| Ammonia | 0.5 mmol/L | 0.5 mmol/L |  | Mannitol | 650 mg/dL | 36 mmol/L |

| **Compound** | **Concentration** |  | **Compound** | **Concentration** |
| --- | --- | --- | --- | --- |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Amphotericin B | 3.5 mg/dL | 38 µmol/L |  | Mannose | 350 mg/dL | 19 mmol/L |
| Ampicillin | 200 mg/dL | 6 mmol/L |  | Methadone | 1 mg/dL | 32 µmol/L |
| Ascorbic acid | 6 mg/dL | 341 µmol/L |  | Methotrexate | 10 mmol/L | 10 mmol/L |
| Azathioprine | 1 mg/dL | 36 µmol/L |  | Morphine | 0.1 mg/dL | 4 µmol/L |
| Bilirubin | 40 mg/dL | 684 µmol/L |  | Naproxen | 100 mg/dL | 4 mmol/L |
| Calcium | 5 mmol/L | 5 mmol/L |  | Neomycin | 12 mg/dL | 195 µmol/L |
| Captopril | 2 mg/dL | 92 µmol/L |  | Nickel | 0.3 mmol/L | 0.3 mmol/L |
| Carbamazepine | 12 mg/dL | 508 µmol/L |  | Nifedipine | 1 mg/dL | 29 µmol/L |
| Cefazolin | 400 mg/dL | 9 mmol/L |  | Pansporin | 30 mg/dL | 571 µmol/L |
| Ceftriaxone | 250 mg/dL | 5 mmol/L |  | Penicillamine | 4 mg/dL | 268 µmol/L |
| Chloral hydrate | 2 mg/dL | 121 µmol/L |  | Phenobarbital | 40 mg/dL | 2 mmol/L |
| Chloramphenicol | 25 mg/dL | 774 µmol/L |  | Phenylpropanolamine | 0.18 mg/dL | 12 µmol/L |
| Chloride | 140 mmol/L | 140 mmol/L |  | Phenytoin | 20 mg/dL | 793 µmol/L |
| Chlorpromazine | 1 mg/dL | 31 µmol/L |  | Phospholipid, lecithin | 500 mg/dL | 5 g/L |
| Cholesterol | 500 mg/dL | 13 mmol/L |  | Potassium | 10 mmol/L | 10 mmol/L |
| Cholic acid | 6 µmol/L | 6 µmol/L |  | Prednisone | 0.1 mg/dL | 3 µmol/L |
| Cimetidine | 10 mg/dL | 396 µmol/L |  | Procainamide | 10 mg/dL | 425 µmol/L |
| Clonidine | 2 µg/dL | 87 nmol/L |  | Promethazine | 0.2 mg/dL | 7 µmol/L |
| Codeine | 1.7 mg/dL | 57 µmol/L |  | Propranolol | 1 mg/dL | 39 µmol/L |
| Copper | 0.3 mg/dL | 47 µmol/L |  | Pseudoephedrine | 0.28 mg/dL | 17 µmol/L |
| Dexamethazone | 0.14 mg/dL | 4 µmol/L |  | Pyruvate | 2 mg/dL | 230 µmol/L |
| Dextran 40 | 3000 mg/dL | 750 µmol/L |  | Quinidine | 6 mg/dL | 185 µmol/L |
| Digoxin | 3 µg/dL | 38 nmol/L |  | Ranitidine | 15 mg/dL | 478 µmol/L |
| Diltiazem | 0.6 mg/dL | 14 µmol/L |  | Salicylate | 30 mg/dL | 2.2 mmol/L |
| Dopamine | 0.3 mg/dL | 20 µmol/L |  | Sodium | 160 mmol/L | 160 mmol/L |
| Erythromycin | 20 mg/dL | 273 µmol/L |  | Streptokinase | 700 U/L | 700 U/L |
| Ethanol | 350 mg/dL | 76 mmol/L |  | Theophylline | 20 mg/dL | 1 mmol/L |
| Fructose | 30 mg/dL | 1.7 mmol/L |  | Thioridazine | 1.2 mg/dL | 32 µmol/L |
| Furosemide | 10 mg/dL | 302 µmol/L |  | Tolazamide | 55 mg/dL | 2 mmol/L |
| Galactose | 60 mg/dL | 3 mmol/L |  | Total protein | 3 g/dL | 30 g/L |
| Gentamicin | 50 mg/dL | 1 mmol/L |  | Total protein | 10 g/dL | 100 g/L |
| Gentisic acid | 50 mg/dL | 3 mmol/L |  | Trichloroethanol | 2 mg/dL | 134 µmol/L |
| Glutathione | 1 mg/dL | 33 µmol/L |  | Triglycerides | 2000 mg/dL | 23 mmol/L |
| Glyburide | 0.64 mg/dL | 13 µmol/L |  | Trimethoprim | 25 mg/dL | 861 µmol/L |
| Hydrochlorothiazide | 2 mg/dL | 67 µmol/L |  | Valproic acid | 100 mg/dL | 7 mmol/L |
| β-Hydroxybutyric acid | 30 mg/dL | 3 mmol/L |  | Vancomycin | 50 mg/dL | 345 µmol/L |
| Hydroxychloroquine | 1 mg/dL | 30 µmol/L |  | Warfarin | 10 mg/dL | 324 µmol/L |
| Hypaque | 500 mg/dL | 8 mmol/L |  | Zinc | 5 mg/dL | 763 µmol/L |

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