CLINICAL AND LABORATORY STANDARDS INSTITUTE®

April 2000

C39-A

A Designated Comparison Method for the Measurement of Ionized Calcium in Serum; Approved Standard

This document provides a designated comparison method to standardize the measurement of ionized calcium made by ion-selective electrode (ISE) potentiometry. This system can be used to assign ionized calcium concentrations to a commercially available, serum-based material to improve the traceability and transferability of results for the measurement of ionized calcium in the clinical laboratory.

A standard for global application developed through the Clinical and Laboratory Standards Institute consensus process.

Clinical and Laboratory Standards Institute

Setting the standard for quality in clinical laboratory testing around the world.

The Clinical and Laboratory Standards Institute (CLSI) is a not-for-profit membership organization that brings together the varied perspectives and expertise of the worldwide laboratory community for the advancement of a common cause: to foster excellence in laboratory medicine by developing and implementing clinical laboratory standards and guidelines that help laboratories fulfill their responsibilities with efficiency, effectiveness, and global applicability.

Consensus Process

Consensus—the substantial agreement by materially affected, competent, and interested parties—is core to the development of all CLSI documents. It does not always connote unanimous agreement, but does mean that the participants in the development of a consensus document have considered and resolved all relevant objections and accept the resulting agreement.

Commenting on Documents

CLSI documents undergo periodic evaluation and modification to keep pace with advancements in technologies, procedures, methods, and protocols affecting the laboratory or health care.

CLSI's consensus process depends on experts who volunteer to serve as contributing authors and/or as participants in the reviewing and commenting process. At the end of each comment period, the committee that developed the document is obligated to review all comments, respond in writing to all substantive comments, and revise the draft document as appropriate.

Comments on published CLSI documents are equally essential, and may be submitted by anyone, at any time, on any document. All comments are addressed according to the consensus process by a committee of experts.

Appeals Process

If it is believed that an objection has not been adequately addressed, the process for appeals is documented in the CLSI Administrative Procedures.

All comments and responses submitted on draft and published documents are retained on file at CLSI and are available upon request.

Get Involved—Volunteer!

Do you use CLSI documents in your workplace? Do you see room for improvement? Would you like to get involved in the revision process? Or maybe you see a need to develop a new document for an emerging technology? CLSI wants to hear from you. We are always looking for volunteers. By donating your time and talents to improve the standards that affect your own work, you will play an active role in improving public health across the globe.

For further information on committee participation or to submit comments, contact CLSI.

Clinical and Laboratory Standards Institute
950 West Valley Road, Suite 2500
Wayne, PA 19087 USA
P: 610.688.0100
F: 610.688.0700
www.clsi.org
standard@clsi.org

NOTE: This document is no longer being reviewed as part of the CLSI consensus process. However, because of its usefulness to segments of the health care community, it is available for its informational content.

C39-A
Vol. 20 No. 6
Replaces C39-P
Vol. 18 No. 23

ISBN 1-56238-398-1
ISSN 0273-3099

A Designated Comparison Method for the Measurement of Ionized Calcium in Serum; Approved Standard

Volume 20 Number 6

Paul D'Orazio, Ph.D.
Gary A. Graham, Ph.D., DABCC
Carolyn Bergkuist, M.S.
Alan D. Cormier, Ph.D.
Sharon S. Ehrmeyer, Ph.D.
Ioannis Laios, Ph.D.
Arthur Malenfant, Ph.D.
Richard R. Miller, Jr.
John G. Toffaletti, Ph.D.
Jesper H. Wandrup, M.D., Ph.D., M.Sc.

Abstract

CLSI document C39-A *A Designated Comparison Method for the Measurement of Ionized Calcium in Serum; Approved Standard* provides a candidate designated comparison method to standardize the measurement of ionized calcium made by ion-selective electrode (ISE) potentiometry. This system can be used to assign ionized calcium concentrations to a commercially available, serum-based material to improve the traceability and transferability of results for the measurement of ionized calcium in the clinical laboratory. This standard addresses the principle of the test, the assignment of ionized calcium concentrations to NIST Standard Reference Material 956a, the materials and methods used, and the results and conclusions of an interlaboratory study to assign the ionized calcium concentrations.

CLSI. *A Designated Comparison Method for the Measurement of Ionized Calcium in Serum; Approved Standard*. CLSI document C39-A (ISBN 1-56238-398-1). Clinical and Laboratory Standards Institute, 950 West Valley Road, Suite 2500, Wayne, Pennsylvania 19087, USA, 2000.

CLINICAL AND LABORATORY STANDARDS INSTITUTE®

Suggested Citation

CLSI. *A Designated Comparison Method for the Measurement of Ionized Calcium in Serum; Approved Standard.* CLSI document C39-A. Wayne, PA: Clinical and Laboratory Standards Institute; 2000.

Proposed Standard
December 1998

Approved Standard
April 2000

ISBN 1-56238-398-1
ISSN 0273-3099

Committee Membership

Area Committee on Clinical Chemistry and Toxicology

Basil T. Doumas, Ph.D. **Chairholder**	**Medical College of Wisconsin** **Milwaukee, Wisconsin**
W. Gregory Miller, Ph.D. **Vice-Chairholder**	**Virginia Commonwealth University** **Richmond, Virginia**

Subcommittee on Electrolytes

Paul D'Orazio, Ph.D. **Co-Chairholder**	**Instrumentation Laboratory** **Lexington, Massachusetts**
Gary A. Graham, Ph.D., DABCC **Co-Chairholder**	**Ortho-Clinical Diagnostics** **Rochester, New York**
Carolyn Bergkuist, M.S.	Medica Corporation Bedford, Massachusetts
Alan D. Cormier, Ph.D.	AC Consulting Newburyport, Massachusetts
Sharon S. Ehrmeyer, Ph.D.	University of Wisconsin Madison, Wisconsin
Ioannis Laios, Ph.D.	LifeScan, Inc. Milpitas, California
Arthur Malenfant, Ph.D.	NOVA Biomedical Corporation Waltham, Massachusetts
Richard R. Miller, Jr.	Dade Behring Inc. Miami, Florida
John G. Toffaletti, Ph.D.	Duke University Medical Center Durham, North Carolina
Jesper H. Wandrup, M.D., Ph.D., M.Sc.	Radiometer America, Inc. Westlake, Ohio

Advisors

George N. Bowers, Jr., M.D.	Hartford Hospital Hartford, Connecticut
Robert W. Burnett, Ph.D.	Hartford Hospital Hartford, Connecticut
Roger R. Calam, Ph.D., DABCC	St. John Hospital and Medical Center Detroit, Michigan

Advisors (Continued)

Kent C. Dooley, Ph.D.	Children's Hospital, Canada Halifax, Nova Scotia
Richard A. Durst, Ph.D.	Cornell University Geneva, New York
Wayne J. Gilli, BSEE	Naval Undersea Warefare Center Newport, Rhode Island
Neil Greenberg, Ph.D	Ortho-Clinical Diagnostics Rochester, New York
Jack H. Ladenson, Ph.D.	Washington University School of Medicine St. Louis, Missouri
Robert B. McComb, Ph.D.	Hartford Hospital Hartford, Connecticut
Robert F. Moran, Ph.D., FCCM, FAIC	mvi Sciences Methuen, Massachusetts
Anthony O. Okorodudu, Ph.D.	University of Texas Medical Branch Galveston, Texas
Charles Sachs, M.D.	Universite Rene Descartes Paris, France
James L. Seago, Ph.D.	Abbott Laboratories Irving, Texas
Salvador Sena, Ph.D., DABCC	Danbury Hospital Danbury, Connecticut
Lawrence C. Uhteg, M.D., Ph.D.	DiaSorin Columbia, Maryland
Paul A. Van Dreal, Ph.D.	National Health Laboratories Dallas, Texas
Dr. Francesco Zoppi	Ospedale Niguarda Cà Granda Milano, Italy
Beth Ann Wise, M.T. (ASCP), M.S.Ed. *Staff Liaison*	NCCLS Wayne, Pennsylvania
Patrice E. Polgar *Editor*	NCCLS Wayne, Pennsylvania
Donna M. Wilhelm *Assistant Editor*	NCCLS Wayne, Pennsylvania

Active Membership
(as of 1 January 2000)

Sustaining Members

Abbott Laboratories
American Association for Clinical Chemistry
Bayer Corporation
Beckman Coulter, Inc.
BD and Company
bioMérieux, Inc.
College of American Pathologists
Dade Behring Inc.
Nippon Becton Dickinson Co., Ltd.
Ortho-Clinical Diagnostics, Inc.
Pfizer Inc
Roche Diagnostics, Inc.

Professional Members

American Academy of Family Physicians
American Association of Blood Banks
American Association for Clinical Chemistry
American Association for Respiratory Care
American Chemical Society
American Medical Technologists
American Public Health Association
American Society for Clinical Laboratory Science
American Society of Hematology
American Society for Microbiology
American Society of Parasitologists, Inc.
American Type Culture Collection, Inc.
Asociación Española Primera de Socorros (Uruguay)
Asociacion Mexicana de Bioquimica Clinica A.C.
Assn. of Public Health Laboratories
Assoc. Micro. Clinici Italiani-A.M.C.L.I.
Australasian Association of Clinical Biochemists
British Society for Antimicrobial Chemotherapy
Canadian Society for Medical Laboratory Science-Société Canadienne de Science de Laboratoire Médical
Canadian Society of Clinical Chemists
Clinical Laboratory Management Association
College of American Pathologists
College of Medical Laboratory Technologists of Ontario
College of Physicians and Surgeons of Saskatchewan
Commission on Office Laboratory Accreditation
Danish Society of Clinical Chemistry
Fundacion Bioquimica de la Provincia (Argentina)
International Association of Medical Laboratory Technologists
International Council for Standardization in Haematology
International Federation of Clinical Chemistry
International Society for Analytical Cytology
Italian Society of Clinical Biochemistry
Japan Society of Clinical Chemistry
Japanese Association of Medical Technologists (Tokyo)
Japanese Committee for Clinical Laboratory Standards
Joint Commission on Accreditation of Healthcare Organizations
National Academy of Clinical Biochemistry
National Society for Histotechnology, Inc.
Ontario Medical Association Laboratory Proficiency Testing Program
Ordre professionnel des technologistes médicaux du Québec
RCPA Quality Assurance Programs PTY Limited
Sociedade Brasileira de Analises Clinicas
Sociedade Brasileira de Patologia Clinica
Sociedad Espanola de Quimica Clinica

Government Members

Armed Forces Institute of Pathology
Association of Public Health Laboratory Directors
BC Centre for Disease Control
Centers for Disease Control and Prevention
Chinese Committee for Clinical Laboratory Standards
Commonwealth of Pennsylvania Bureau of Laboratories
Department of Veterans Affairs
Deutsches Institut für Normung (DIN)
FDA Center for Devices and Radiological Health
FDA Division of Anti-Infective Drug Products
Health Care Financing Administration/CLIA Program
Health Care Financing Administration
Iowa State Hygienic Laboratory
Massachusetts Department of Public Health Laboratories
Michigan Department of Public Health
National Association of Testing Authorities – Australia
National Center of Infectious and Parasitic Diseases (Bulgaria)
National Institute of Standards and Technology
Ohio Department of Health
Oklahoma State Department of Health
Ontario Ministry of Health
Saskatchewan Health-Provincial Laboratory
Scientific Institute of Public Health; Belgium Ministry of Social Affairs, Public Health and the Environment
South African Institute for Medical Research
Swedish Institute for Infectious Disease Control
Thailand Department of Medical Sciences

Industry Members

AB Biodisk
Abbott Laboratories
Accumetrics, Inc.
Amersham Pharmacia Biotech
Ammirati Regulatory Consulting
Asséssor
AstraZeneca
Aventis
Avocet Medical, Inc.
Bayer Corporation - Elkhart, IN
Bayer Corporation - Middletown, VA
Bayer Corporation - Tarrytown, NY
Bayer Corporation - West Haven, CT
Bayer Medical Ltd.
Beckman Coulter, Inc.
Beckman Coulter, Inc. Primary Care Diagnostics
Beckman Coulter K.K. (Japan)
BD and Company
BD Biosciences
BD Consumer Products
BD Immunocytometry Systems
BD Italia S.P.A.
BD VACUTAINER Systems
Biolog, Inc.
bioMérieux, Inc.
Biometrology Consultants
Bio-Rad Laboratories, Inc.
Biotest AG
Bristol-Myers Squibb Company
Canadian Reference Laboratory Ltd.
CASCO•NERL Diagnostics
Checkpoint Development Inc.
Clinical Lab Engineering
COBE Laboratories, Inc.
Combact Diagnostic Systems Ltd.
Community Medical Center (NJ)
Control Lab (Brazil)
Copan Diagnostics Inc.
Cosmetic Ingredient Review
Cubist Pharmaceuticals
Cytometrics, Inc.
Dade Behring Inc. - Deerfield, IL
Dade Behring Inc. - Glasgow, DE
Dade Behring Inc. - Marburg, Germany
Dade Behring Inc. - Sacramento, CA
Dade Behring Inc. - San Jose, CA
DAKO A/S
Diagnostic Products Corporation
DiaSorin
Eiken Chemical Company, Ltd.
Enterprise Analysis Corporation
Fort Dodge Animal Health
Gen-Probe
Glaxo-Wellcome, Inc.
Greiner Meditech, Inc.
Health Systems Concepts, Inc.
Helena Laboratories
Home Diagnostics, Inc.
Hycor Biomedical Inc.
I-STAT Corporation
Instrumentation Laboratory
Integ, Inc.
International Technidyne Corporation
Johnson City Medical Center
Kendall Sherwood-Davis & Geck
Labtest Diagnostica S.A.
LifeScan, Inc. (a Johnson & Johnson Company)
Lilly Research Laboratories
Medical Device Consultants, Inc.
Medical Laboratory Automation Inc.
MediSense Products (Div. of Abbott Laboratories)
Medtronic Perfusion Systems
Merck & Company, Inc.
mvi Sciences (MA)
Nabi
Neometrics Inc.
Nichols Institute Diagnostics (Div. of Quest Diagnostics, Inc.)
Nissui Pharmaceutical Co., Ltd.
Nippon Becton Dickinson Co., Ltd.
Norfolk Associates, Inc.
OBC Associates
Olympus Corporation
Optical Sensors, Inc.
Organon Teknika Corporation
Ortho-Clinical Diagnostics, Inc. (England)
Ortho-Clinical Diagnostics, Inc. (Raritan, NJ)
Ortho-Clinical Diagnostics, Inc. (Rochester, NY)
Oxoid Inc.
Pfizer Inc
Pharmacia & Upjohn
Procter & Gamble Pharmaceuticals, Inc.
The Product Development Group
Quest Diagnostics Incorporated
Quintiles, Inc.
Radiometer America, Inc.
Radiometer Medical A/S
David G. Rhoads Associates, Inc.
Roche Diagnostics GmbH
Roche Diagnostics, Inc.
Roche Laboratories (Div. Hoffmann-La Roche Inc.)
The R.W. Johnson Pharmaceutical Research Institute
Sanofi Diagnostics Pasteur
Sarstedt, Inc.
SARL Laboratoire Carron (France)
Schering Corporation
Schleicher & Schuell, Inc.
Second Opinion
SenDx Medical, Inc.
Showa Yakuhin Kako Company, Ltd.
SmithKline Beecham, S.A.
Streck Laboratories, Inc.
Sysmex Corporation (Japan)
Sysmex Corporation (Long Grove, IL)
The Toledo Hospital (OH)
Trek Diagnostic Systems, Inc.
Vetoquinol S.A.
Vysis, Inc.
Wallac Oy
Warner-Lambert Company
Wyeth-Ayerst
Xyletech Systems, Inc.
YD Consultant

Trade Associations

Association of Medical Diagnostic Manufacturers
Health Industry Manufacturers Association
Japan Association Clinical Reagents Ind. (Tokyo, Japan)
Medical Industry Association of Australia

Associate Active Members

67th CSH Wuerzburg, GE (NY)
121st General Hospital (CA)
Acadiana Medical Laboratories, LTD (LA)
Advocate Laboratories (IL)
Albany Medical Center Hospital (NY)
Allegheny General Hospital (PA)
Allegheny University of the Health Sciences (PA)
Allina Laboratories (MN)
Alton Ochsner Medical Foundation (LA)
American Medical Laboratories (VA)
Anzac House (Australia)

Asan Medical Center (Korea)
Associated Regional & University Pathologists (UT)
Aurora Consolidated Laboratories (WI)
Baystate Medical Center (MA)
Brantford General Hospital (Brantford, ON, Canada)
Brazileiro De Promocao (Brazil)
Bristol Regional Medical Center (TN)
Brookdale Hospital Medical Center (NY)
Brooke Army Medical Center (TX)
Brooks Air Force Base (TX)
Broward General Medical Center (FL)
Calgary Laboratory Services (Calgary, AB, Canada)
Carilion Consolidated Laboratory (VA)
CB Healthcare Complex (Sydney, NS, Canada)
Central Kansas Medical Center
Centro Diagnostico Italiano (Milano, Italy)
Champlain Valley Physicians Hospital (NY)
Children's Hospital (LA)
Children's Hospital Medical Center (Akron, OH)
Children's Hospital of Philadelphia (PA)
Clendo Lab (Puerto Rico)
CLSI Laboratories (PA)
Commonwealth of Kentucky
Commonwealth of Virginia (DCLS)
CompuNet Clinical Laboratories (OH)
Consolidated Laboratory Services (CA)
Danville Regional Medical Center (VA)
Dean Medical Center (WI)
Delaware Public Health Laboratory
Detroit Health Department (MI)
Diagnostic Laboratory Services, Inc. (HI)
Duke University Medical Center (NC)
Durham Regional Hospital (NC)
Duzen Laboratories (Turkey)
Dynacare Laboratories - Eastern Region (Ottawa, ON, Canada)
E.A. Conway Medical Center (LA)
Elmhurst Memorial Hospital (IL)
Elyria Memorial Hospital (OH)
Emory University Hospital (GA)
Fairfax Hospital (VA)
Fairview-University Medical Center (MN)
Foothills Hospital (Calgary, AB, Canada)
Fox Chase Cancer Center (PA)
Franklin Square Hospital Center (MD)
Fresenius Medical Care/Life Chem (NJ)
Fresno Community Hospital and Medical Center
Gambro Healthcare Laboratory (FL)
GDS Technology, Inc (IN)
Grady Memorial Hospital (GA)
Greater Southeast Community Hospital (DC)
Guthrie Clinic Laboratories (PA)
Halifax Medical Center (FL)
Harris Methodist Fort Worth (TX)
Harris Methodist Northwest (TX)
Hartford Hospital (CT)
Hays Pathology Laboratories, P.A. (KS)
Health Alliance Laboratory (OH)
Health Network Lab (PA)
Health Sciences Centre (Winnipeg, MB, Canada)
Heartland Health System (MO)
Hinsdale Hospital (IL)
Hoag Memorial Hospital Presbyterian (CA)
Holmes Regional Medical Center (FL)
Holy Spirit Hospital (PA)
Holzer Medical Center (OH)
Hospital for Sick Children (Toronto, ON, Canada)
Hospital Israelita Albert Einstein (Brazil)
Hotel Dieu Hospital (Windsor, ON, Canada)
Huddinge University Hospital (Sweden)
Hurley Medical Center (MI)
Indiana University
Instituto Scientifico HS. Raffaele (Italy)
International Health Management Associates, Inc. (IL)
Intermountain Health Care Laboratory Services (UT)
Jacobi Medical Center (NY)
John Peter Smith Hospital (TX)
John Randolph Hospital (VA)
Johns Hopkins Medical Institutions (MD)
Johnson City Medical Center (IN)
Kaiser Permanente (CA)
Kaiser Permanente (NC)
Kantousspital (Switzerland)
Klinicni Center (Slovenia)
LabCorp (NC)
Laboratoire de Santé Publique du Quebec (Canada)
Laboratório Fleury S/C Ltda. (Brazil)
Laboratory Corporation of America (MO)
Lakeland Regional Medical Center (FL)
Lancaster General Hospital (PA)
Langley Air Force Base (VA)
Lewis-Gale Medical Center (VA)
Libero Instituto Univ. Campus BioMedico (Italy)
LAC and USC Healthcare Network (CA)
Louisiana State University Medical Center
Lutheran Hospital (WI)
Massachusetts General Hospital (Microbiology Laboratory)
Massachusetts General Hospital (Pathology Laboratory)
Mayo Clinic Scottsdale (AZ)
MDS Metro Laboratory Services (Burnaby, BC, Canada)
Medical Center of Southern Indiana
Medical College of Virginia Hospital
Melrose-Wakefield Hospital (MA)
Memorial Hospital (CO)
Memorial Medical Center (Napoleon Ave., New Orleans, LA)
Memorial Medical Center (N. Jefferson Davis Pkwy., New Orleans, LA)
Memorial Medical Center (IL)
Mercy Health System (PA)
Mercy Hospital (NC)
Methodist Hospital (TX)
Methodist Hospital Indiana
Methodist Hospitals of Memphis (TN)
Mid Michigan Medical Center - Midland

Montreal Children's Hospital (Canada)
Montreal General Hospital (Canada)
Mount Sinai Hospital (NY)
National University Hospital (Singapore)
Naval Surface Warfare Center (IN)
Nebraska Health System
New Britain General Hospital (CT)
New England Medical Center Hospital (MA)
The New York Blood Center
The New York Hospital Medical Center of Queens
New York State Department of Health
NorDx (ME)
North Carolina Laboratory of Public Health
North Carolina School of Veterinary Medicine
Northridge Hospital Medical Center (CA)
Northwestern Memorial Hospital (IL)
Olin E. Teague Medical Center (TX)
Our Lady of Lourdes Hospital (NJ)
Our Lady of the Resurrection Medical Center (IL)
Pathology and Cytology Laboratories, Inc. (KY)
The Permanente Medical Group (CA)
Pocono Hospital (PA)
Presbyterian Hospital of Dallas (TX)
Providence Health System (OR)
Providence Medical Center (WA)
Queen Elizabeth Hospital (Prince Edward Island, Canada)
Queensland Health Pathology Services (Australia)
Quintiles Laboratories, Ltd. (GA)
Regions Hospital
Research Medical Center (MO)
Riyadh Armed Forces Hospital (Saudi Arabia)
Robert F. Kennedy Medical Center (CA)
Royal Columbian Hospital (New Westminster, BC, Canada)
Saint Mary's Regional Medical Center (NV)
St. Alexius Medical Center (ND)
St. Anthony Hospital (CO)
St. Boniface General Hospital (Winnipeg, Canada)
St. Elizabeth Hospital (NJ)
St. John Hospital and Medical Center (MI)
St. John Regional Hospital (St. John, NB, Canada)
St. Joseph Medical Center (MD)
St. Joseph Hospital (NE)
St. Joseph Mercy – Oakland (MI)
St. Joseph's Hospital - Marshfield Clinic (WI)
St. Luke's Hospital (PA)
St. Luke's Regional Medical Center (IA)
St. Mary Hospital (NJ)
St. Mary Medical Center (IN)
St. Mary of the Plains Hospital (TX)
Salina Regional Health Center (KS)
San Francisco General Hospital (CA)
Santa Cabrini Hospital (Montreal, PQ Canada)
Santa Clara Valley Medical Center (CA)
Seoul Nat'l University Hospital (Korea)
Shanghai Center for the Clinical Laboratory (China)
Shands Healthcare (FL)
SmithKline Beecham Clinical Laboratories (GA)
SmithKline Beecham Clinical Laboratories (WA)
South Bend Medical Foundation (IN)
Southern California Permanente Medical Group
South Western Area Pathology Service (Australia)
Speare Memorial Hospital (NH)
Speciality Laboratories, Inc. (CA)
Stanford Health Services (CA)
Stormont-Vail Regional Medical Center (KS)
Sun Health-Boswell Hospital (AZ)
Sunrise Hospital and Medical Center (NV)
Sutter Health (CA)
Tampa General Hospital (FL)
Tripler Army Medical Center (HI)
Tulane Medical Center Hospital & Clinic (LA)
UCSF Medical Center (CA)
UNC Hospitals (NC)
Unilab Clinical Laboratories (CA)
University of Alberta Hospitals (Canada)
University of Chicago Hospitals (IL)
University Hospital (IN)
University Hospital (Gent) (Belgium)
University Hospital (London, Ontario, Canada)
The University Hospitals (OK)
University of Massachusetts Lowell
University of Medicine & Dentistry, NJ University Hospital
University of Michigan
University of the Ryukyus (Japan)
University of Virginia Medical Center
University of Washington
UPMC Bedford Memorial (PA)
USAF Medical Center (OH)
UZ-KUL Medical Center (Belgium)
VA (Dayton) Medical Center (OH)
VA (Denver) Medical Center (CO)
VA (Martinez) Medical Center (CA)
VA (San Diego) Medical Center (CA)
VA (Tuskegee) Medical Center (AL)
VA Outpatient Clinic (OH)
Vejle Hospital (Denmark)
Via Christi Regional Medical Center (KS)
Viridae Clinical Sciences, Inc. (Vancouver, BC, Canada)
Walter Reed Army Institute of Research (MD)
Warde Medical Laboratory (MI)
Warren Hospital (NJ)
Washoe Medical Center (NV)
Watson Clinic (FL)
Wilford Hall Medical Center (TX)
William Beaumont Hospital (MI)
Williamsburg Community Hospital (VA)
Wilson Memorial Hospital (NY)
Winchester Hospital (MA)
Winn Army Community Hospital (GA)
Wishard Memorial Hospital (IN)
Womack Army Medical Center (NC)
Yonsei University College of Medicine (Korea)
York Hospital (PA)
Zale Lipshy University Hospital (TX)

Contents

Contents (Continued)

Foreword

The measurement of ionized calcium in whole blood and serum is performed routinely as a service test in many clinical chemistry laboratories. A variety of manufacturers provides modern instrumentation, which allows the rapid measurement of ionized calcium in whole blood and serum with ion-selective membrane electrodes. These instruments, while highly sophisticated, differ in many ways from one manufacturer to another. All of these differences are known to affect the final ionized calcium result.

The purpose of developing this standard is to provide a candidate designated comparison method to standardize the measurement of ionized calcium made by ion-selective electrode (ISE) potentiometry and further, to use this system to assign ionized calcium concentrations to a commercially available, serum-based material to improve the traceability and transferability of results for the measurement of ionized calcium in the clinical laboratory. Development of this standard builds upon both clinical and industrial experience in laboratories around the world and is the result of many years of study of the analytical aspects of iCa^{2+} measurements.

The designated comparison method described in Appendix A of this document may be used to measure the concentration of ionized calcium in serum, not whole blood. The measurement of ionized calcium in whole blood by ISE potentiometry is known to be affected by the presence of erythrocytes. This effect is also present in commercial systems for the measurement of ionized calcium and is variable from one commercial system to another. This document does not address this problem. However, by standardizing the measurement of ionized calcium to a serum based reference material with concentrations assigned by the DCM, the interlaboratory variability for whole blood measurements of ionized calcium would be improved as well.

Key Words

Designated comparison method, ionized calcium, ion-selective electrode, potentiometry, SRM 956a

A Designated Comparison Method for the Measurement of Ionized Calcium in Serum; Approved Standard

1 Introduction

Ionized calcium (iCa^{2+}) has long been recognized as a better indicator of the physiological calcium status in human blood than total calcium.[1-11] The lack of a reference system for iCa^{2+} has been recognized for several years.[12-15] As expected in the absence of a standardization procedure, reference intervals vary from location to location, even for the same type of commercial analyzer, because of differences among instruments, and from one type of commercial analyzer to another. The purpose of developing this standard is to provide a candidate designated comparison method (DCM) to standardize the measurement of ionized calcium made by ion-selective electrode (ISE) potentiometry; and further, to use this method to assign ionized calcium concentrations to a commercially available, serum-based material to improve the traceability and transferability of results for the measurement of ionized calcium in the clinical laboratory. Development of this method was based on both clinical and industrial experience in laboratories around the world, and is the result of many years of study of the analytical aspects of iCa^{2+} measurements.[6,16-19]

2 Scope

This document emphasizes the use of stable, deep-frozen (-50 °C), pooled serum (NIST SRM 956a) with iCa^{2+} values assigned by a designated comparison method (DCM) as the key material which transfers accuracy for the measurement of ionized calcium. The substance concentration of iCa^{2+} in this human serum-based material is determined on the basis of potentiometric comparison to defined standard solutions made from high-purity reference materials. These standards are aqueous solutions whose compositions are established by convention to contain known concentrations of ionized calcium at an ionic strength of 0.160 mol/kg. In general, preparation of these standards follows the recommendations of the Working Group on Selective Electrodes of the International Federation of Clinical Chemistry (IFCC).[15]

The results of a multisite, interlaboratory study using NIST SRM 956a are reported. The objectives of this study were: 1) to show compatibility of the material with various commercial ionized calcium analyzers; and 2) to show usefulness of SRM 956a for providing uniformity to the measurement of ionized calcium in the clinical laboratory.

This document likewise provides specifications for the data acquisition hardware and software components of the ionized calcium DCM. Detailed information is included on the design of the potentiometric ISE and reference half-cells, liquid-liquid junction, and fabrication of tubular, calcium ion-selective membranes. Operating steps for system calibration, sample measurement, and data reduction are also described. Analytical specifications are described in terms of intralaboratory "within-run" and "day-to-day" imprecision to be expected when this technology is mastered.

3 Standard Precautions

Because it is often impossible to know what might be infectious, all human blood specimens are to be treated as infectious and handled according to "standard precautions." Standard precautions are new guidelines that combine the major features of "universal precautions and body substance isolation" practices. Standard precautions cover the transmission of any pathogen and thus are more comprehensive than universal precautions which are intended to apply only to transmission of blood-borne pathogens. Standard precaution and universal precaution guidelines are available from the U.S. Centers for Disease Control and Prevention (Guideline for Isolation Precautions in Hospitals, Infection Control and Hospital Epidemiology, CDC, Vol 17;1:53-80.), [MMWR 1987;36(suppl 2S):2S-18S] and (MMWR 1988;37:377-

