CLINICAL AND LABORATORY STANDARDS INSTITUTE®

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# C31-A2

## Ionized Calcium Determinations: Precollection Variables, Specimen Choice, Collection, and Handling; Approved Guideline—Second Edition

This document addresses preanalytical considerations, such as patient condition, specimen choice, collection, and handling—that can influence the accuracy and clinical utility of ionized calcium measurements.

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# Ionized Calcium Determinations: Precollection Variables, Specimen Choice, Collection, and Handling; Approved Guideline—Second Edition

Volume 21 Number 10

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## Abstract

*Ionized Calcium Determinations: Precollection Variables, Specimen Choice, Collection, and Handling; Approved Guideline—Second Edition* (CLSI document C31-A2) is a guideline for specimen collection for ionized calcium determinations. The primary audience for this publication is personnel responsible for ionized calcium determinations. This document discusses the reasons for *in vivo* (nonpathologic) and *in vitro* changes in ionized calcium concentrations, and it presents recommendations for avoiding or minimizing these effects.

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## Foreword

Ionized calcium determinations have proven to be clinically useful in the differential diagnosis of calcium disorders of endocrine origin, identification of hypercalcemia in various neoplasias, and managing the critically ill adult and neonatal patient. However, it is the responsibility of the laboratorian to choose which specimen is most appropriate for each clinical situation and how to collect and handle that specimen to ensure accuracy and clinical utility. This choice is complicated by the equilibrium between free (ionized) and bound calcium in blood, which is influenced by alterations in hydrogen ion and/or ligand concentrations. This guideline is designed to aid the laboratorian in determining the most appropriate specimen and its proper handling for each specific purpose.

Specifically, C31-A2 offers guidance in recognizing preanalytical factors that can affect ionized calcium determinations. The influence of patient conditions (e.g., physical activity, posture, meals, ventilation rate, and circadian variation) is considered in Section 5, while the advantages and disadvantages of whole blood, serum, and plasma are discussed in Section 6. The guideline also describes the selection of the collection site and device in Section 7. In Section 8, appropriate transportation, processing, and storage procedures are recommended.

References to pH-adjusted ionized calcium results are found throughout the guideline, and appropriate citations are provided.

**Key Words**

Ionized calcium, pH, preanalytical conditions, precollection variables, specimen choice, specimen collection, specimen transportation

# Ionized Calcium Determinations: Precollection Variables, Specimen Choice, Collection, and Handling; Approved Guideline—Second Edition

## 1 Introduction

Ionized calcium is widely recognized as a better indicator of physiological calcium status in blood than total calcium. Generally, the reasons for measuring ionized calcium can be divided into three clinical categories: monitoring trends in acute or critical care, routine diagnostic care, and research. Generally, ionized calcium measurements for diagnostic purposes or research purposes require a high degree of accuracy.

This document describes the preanalytical variables for ionized calcium determinations and makes recommendations for minimizing the effects of these variables on the accuracy of ionized calcium measurements. Patient preparation and specimen handling options are presented, as well as the advantages and disadvantages of the various choices for specimen type, collection device, and technique. Recommendations are offered in each section.

## 2 Scope

This document addresses the preanalytical variables that can influence the accuracy and clinical utility of ionized calcium measurements.

## 3 Standard Precautions

Because it is often impossible to know which specimens 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. 1996;Vol 17;1:53-80.), [MMWR 1987;36(suppl 2S):2S-18S] and (MMWR 1988;37:377-382, 387-388). For specific precautions for preventing the laboratory transmission of blood-borne infection from laboratory instruments and materials; and recommendations for the management of blood-borne exposure, refer to NCCLS document M29—*Protection of Laboratory Workers from Instrument Biohazards and Infectious Disease Transmitted by Blood, Body Fluids, and Tissue*.

## 4 Definitions[a]

**Circadian variation/chronobiological variation, diurnal variation,** *n* – Variations in physiological parameters, including blood analyte concentrations, which are related to cyclic events, i.e., time of day, season of the year, and ingestion of meals.

**Ionized calcium,** *n* – The portion of calcium ions in the plasma water of whole blood that is not bound by protein or other molecules; **NOTE:** This parameter has also been called "free" or "ionic" calcium.

**pH-adjusted ionized calcium,** *n* – A calculated result empirically based on a measured pH and ionized calcium concentration, with the ionized calcium concentration normalized to a pH of 7.40; **NOTE:** These

[a] Some of these definitions are found in NCCLS document NRSCL8—*Terminology and Definitions for Use in NCCLS Documents*. For complete definitions and detailed source information, please refer to the most current edition of that document.