CLINICAL AND LABORATORY STANDARDS INSTITUTE®

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GP34-A

Validation and Verification of Tubes for Venous and Capillary Blood Specimen Collection; Approved Guideline

This document provides guidance for conducting validation and verification testing for venous and capillary blood collection tubes.

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

Clinical and Laboratory Standards Institute

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

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Validation and Verification of Tubes for Venous and Capillary Blood Specimen Collection; Approved Guideline

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Abstract

Clinical and Laboratory Standards Institute document GP34-A—*Validation and Verification of Tubes for Venous and Capillary Blood Specimen Collection; Approved Guideline* is a guideline for manufacturers of venous and capillary blood collection tubes and users of blood collection tubes for serum, plasma, and whole blood testing. GP34 provides guidelines for validation and verification of test (examination) performance.

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Foreword

Currently, no guideline is available for either *in vitro* diagnostic (IVD) manufacturers or clinical laboratories to validate or verify use of the various venous and capillary blood collection tubes within each of the following laboratory medicine disciplines: chemistry, immunochemistry, hematology, and coagulation. However, for microbiology assays or culture methods, several documents address validation and quality control of collection tubes (see CLSI documents M40, M47, and M15).[1-3]

This guideline contains information on tubes for venous and capillary blood collection. It is written for manufacturers of venous and capillary blood collection devices; for assay/instrument manufacturers; and for those who are responsible for acquisition, handling, and use of the equipment described in this document.

Specimen collection devices, especially venous and capillary blood collection tubes, are classified as IVD devices. Because these devices are used to collect patient blood samples that are analyzed on highly sensitive clinical instrumentation, it is extremely critical for accurate and precise test results that these collection devices be verified for use on this instrumentation.

IVD manufacturers are challenged by regulatory agencies to ensure safety and efficacy of their devices as part of the validation process before release of the devices for use in the clinical laboratory. Tube manufacturers can use this guidance document to establish and standardize their validation process for both current and new blood collection tubes. In addition to this document, CLSI standard H01, *Tubes and Additives for Venous Blood Specimen Collection*[4]—a complementary document to this guideline—details the requirements for materials, manufacturing, and labeling of blood collection devices.

Additionally, accrediting organizations challenge clinical laboratories to ensure the acceptability or compatibility of their venous and capillary blood collection devices, with their current instrumentation and patient population.[5] This type of verification will help the clinical laboratories ensure accurate and precise test results for their collection device and test system.

Key Words

Capillary blood collection, instrumentation, validation, venous blood collection tubes, verification

Validation and Verification of Tubes for Venous and Capillary Blood Specimen Collection; Approved Guideline

1 Scope

This document provides step-by-step recommendations for validation and verification of venous and capillary blood collection devices. Capillary blood collection devices addressed in this document include only microcollection devices (see Section 3.2). It also includes guidance for ascertaining the acceptability/compatibility for clinical performance in chemistry, immunochemistry, hematology, and coagulation. This guideline does not address validation and verification for clinical performance in immunohematology, molecular diagnostics, arterial blood gas analysis, proteomics, or genomics.

The focus and procedures of this document are for quantitative measurement only. For qualitative measurement, the study requires a different study design.

This document is written for manufacturers of venous and capillary blood collection devices; assay/instrument manufacturers; all clinical laboratory personnel; and those who are responsible for acquisition, handling, and use of the equipment described in this document.

2 Standard Precautions

Because it is often impossible to know what isolates or specimens might be infectious, all patient and laboratory specimens are treated as infectious and handled according to "standard precautions." Standard precautions are guidelines that combine the major features of "universal precautions and body substance isolation" practices. Standard precautions cover the transmission of all known infectious agents and thus are more comprehensive than universal precautions, which are intended to apply only to transmission of blood-borne pathogens. Standard and universal precaution guidelines are available from the US Centers for Disease Control and Prevention.[6] For specific precautions for preventing the laboratory transmission of all known infectious agents from laboratory instruments and materials and for recommendations for the management of exposure to all known infectious disease, refer to CLSI document M29.[7]

3 Terminology

3.1 A Note on Terminology

CLSI, as a global leader in standardization, is firmly committed to achieving global harmonization wherever possible. Harmonization is a process of recognizing, understanding, and explaining differences while taking steps to achieve worldwide uniformity. CLSI recognizes that medical conventions in the global metrological community have evolved differently in the United States, Europe, and elsewhere; that these differences are reflected in CLSI, International Organization for Standardization (ISO), and Comité Européen de Normalisation (European Committee for Standardization; CEN) documents; and that legally required use of terms, regional usage, and different consensus timelines are all important considerations in the harmonization process. In light of this, CLSI's consensus process for development and revision of standards focuses on harmonization of terms to facilitate the global application of standards and guidelines.

In order to align the use of terminology in this document with that of ISO, the terms *preexamination*, *examination,* and *postexamination* were adopted. For the sake of introduction and to avoid confusion, the subcommittee chose to include the ISO terms parenthetically where the US terms appear. In addition, the term *sample* replaces the term *specimen* where appropriate, and *measurand* replaces *analyte.* The users of

GP34-A should understand that the fundamental meanings of the terms are identical in many cases, and are defined in the guideline's Definitions section (see Section 3.2). The terms in this document are consistent with those defined in the ISO 15189, ISO 17025, and ISO 9000 series of standards.

3.2 Definitions

accuracy (measurement) – closeness of agreement between a measured quantity value and a true quantity value of a measurand (ISO/IEC Guide 99).[8]

additive – in a specimen collection tube, any ingredient that is placed in a collection container to facilitate an intended function (eg, to prevent the blood from clotting or to prevent glycolysis); **NOTE:** Although the container closure is not considered an additive, it may contain or be coated with additives, which, if they come into contact with the specimen, may be considered additives.

analyte – component represented in the name of a measurable quantity (ISO 17511)[9]; **NOTE 1:** In the type of quantity "mass of protein in 24-hour urine," "protein" is the analyte. In "amount of substance of glucose in plasma," "glucose" is the analyte. In both cases, the long phrase represents the **measurand** (ISO 17511)[9]; **NOTE 2:** In the type of quantity "catalytic concentration of lactate dehydrogenase isoenzyme 1 in plasma," "lactate dehydrogenase isoenzyme 1" is the analyte (ISO 18153).[10]

anticoagulant – an agent that prevents coagulation of blood or blood products.

bias – the difference between the expectation of the test results and an accepted reference value (ISO 3534-1)[11]; **NOTE:** If the comparison method is a reference method, then the difference between the two methods measures the trueness of the new method, measured as bias. If the comparison method is not a reference method, then the trueness of the new method cannot be determined. In this case, one refers to the difference simply as a difference, and not bias.

capillary blood – blood obtained by skin puncture or incision that contains a mixture of undetermined proportions of blood from arterioles, venules, and interstitial and intracellular fluids.

clot activator – material used to initiate the clotting mechanism.

comparative tube – blood collection tube currently used by the clinical laboratory.

control tube – any reference tube used as a comparative tube when evaluating a new or substantially modified tube; **NOTE:** In the United States, these tubes must be US Food and Drug Administration (FDA) cleared.

draw – quantity of blood drawn into the venous blood collection tube from a venipuncture; **NOTE:** For testing purposes, the conditions are defined as follows: 101 kPa (760 mm Hg) pressure and 20 °C ambient temperature. The temperature of the blood collected is assumed to be 37 °C.

error (measurement) – measured quantity value minus a reference quantity value (ISO/IEC Guide 99).[8]

expiration date – date after which the product, when stored under recommended conditions, should no longer be used.

glycolytic inhibitor//antiglycolytic agent – agent that inhibits the use of glucose by blood cells.

imprecision – dispersion of independent results of measurements obtained under specified conditions; **NOTE:** It is expressed numerically as standard deviation (SD) or coefficient of variation (CV).

The Quality Management System Approach

Clinical and Laboratory Standards Institute (CLSI) subscribes to a quality management system approach in the development of standards and guidelines, which facilitates project management; defines a document structure via a template; and provides a process to identify needed documents. The approach is based on the model presented in the most current edition of CLSI document HS01—*A Quality Management System Model for Health Care.* The quality management system approach applies a core set of "quality system essentials" (QSEs), basic to any organization, to all operations in any health care service's path of workflow (ie, operational aspects that define how a particular product or service is provided). The QSEs provide the framework for delivery of any type of product or service, serving as a manager's guide. The QSEs are:

Documents and Records	Equipment	Information Management	Process Improvement
Organization	Purchasing and Inventory	Occurrence Management	Customer Service
Personnel	Process Control	Assessments—External and Internal	Facilities and Safety

GP34-A addresses the QSEs indicated by an "X." For a description of the other documents listed in the grid, please refer to the Related CLSI Reference Materials section on the following page.

Documents and Records	Organization	Personnel	Equipment	Purchasing and Inventory	Process Control	Information Management	Occurrence Management	Assessment—External and Internal	Process Improvement	Customer Service	Facilities and Safety
				H03	X EP05 EP09 EP10 EP15 EP21 H01 H03 H04 H18 H21 M15 M40 M47			EP10			H03 M29

Adapted from CLSI document HS01—*A Quality Management System Model for Health Care*.

Path of Workflow

A path of workflow is the description of the necessary steps to deliver the particular product or service that the organization or entity provides. For example, CLSI document GP26—*Application of a Quality Management System Model for Laboratory Services* defines a clinical laboratory path of workflow, which consists of three sequential processes: preexamination, examination, and postexamination. All clinical laboratories follow these processes to deliver the laboratory's services, namely quality laboratory information.

GP34-A addresses the clinical laboratory path of workflow steps indicated by an "X." For a description of the other documents listed in the grid, please refer to the Related CLSI Reference Materials section on the following page.

Preexamination				**Examination**			**Postexamination**	
Examination ordering	Sample collection	Sample transport	Sample receipt/processing	Examination	Results review and follow-up	Interpretation	Results reporting and archiving	Sample management
H03	X H01 H03 H04 H21 M15 M47	H03 H18 H21 M15 M40 M47	H03 H18 M15 M47	H03 H18 M15 M47	H03 M15 M47	 M15 M47	 M47	

Adapted from CLSI document HS01—*A Quality Management System Model for Health Care*.

Related CLSI Reference Materials*

EP05-A2 **Evaluation of Precision Performance of Quantitative Measurement Methods; Approved Guideline—Second Edition (2004).** This document provides guidance for designing an experiment to evaluate the precision performance of quantitative measurement methods; recommendations on comparing the resulting precision estimates with manufacturers' precision performance claims and determining when such comparisons are valid; as well as manufacturers' guidelines for establishing claims.

EP09-A2-IR **Method Comparison and Bias Estimation Using Patient Samples; Approved Guideline—Second Edition (Interim Revision) (2010).** This document addresses procedures for determining the bias between two clinical methods, and the design of a method comparison experiment using split patient samples and data analysis.

EP10-A3 **Preliminary Evaluation of Quantitative Clinical Laboratory Measurement Procedures; Approved Guideline—Third Edition (2006).** This guideline provides experimental design and data analysis for preliminary evaluation of the performance of a measurement procedure or device.

EP15-A2 **User Verification of Performance for Precision and Trueness; Approved Guideline—Second Edition (2005).** This document describes the demonstration of method precision and trueness for clinical laboratory quantitative methods using a protocol designed to be completed within five working days or less.

EP21-A **Estimation of Total Analytical Error for Clinical Laboratory Methods; Approved Guideline (2003).** This document provides manufacturers and end users with a means to estimate total analytical error for an assay. A data collection protocol and an analysis method that can be used to judge the clinical acceptability of new methods using patient specimens are included. These tools can also monitor an assay's total analytical error by using quality control samples.

H01-A5 **Tubes and Additives for Venous Blood Specimen Collection; Approved Standard—Fifth Edition (2003).** This document contains requirements for venous blood collection tubes and additives, including technical descriptions of ethylenediaminetetraacetic acid (EDTA), sodium citrate, and heparin compounds used in blood collection devices.

H03-A6 **Procedures for the Collection of Diagnostic Blood Specimens by Venipuncture; Approved Standard—Sixth Edition (2007).** This document provides procedures for the collection of diagnostic specimens by venipuncture, including line draws, blood culture collection, and venipuncture in children.

H04-A6 **Procedures and Devices for the Collection of Diagnostic Capillary Blood Specimens; Approved Standard—Sixth Edition (2008).** This document provides a technique for the collection of diagnostic capillary blood specimens, including recommendations for collection sites and specimen handling and identification. Specifications for disposable devices used to collect, process, and transfer diagnostic capillary blood specimens are also included.

H18-A4 **Procedures for the Handling and Processing of Blood Specimens for Common Laboratory Tests; Approved Guideline—Fourth Edition (2010).** This document includes criteria for preparing an optimal serum or plasma sample and for the devices used to process blood specimens.

H21-A5 **Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays and Molecular Hemostasis Assays; Approved Guideline—Fifth Edition (2008).** This document provides procedures for collecting, transporting, and storing blood; processing blood specimens; storing plasma for coagulation testing; and general recommendations for performing the tests.

M15-A **Laboratory Diagnosis of Blood-borne Parasitic Diseases; Approved Guideline (2000).** This document provides guidance on specimen collection, optimum timing for preparing blood films, blood film preparations, staining procedures, examination of specimens, and identification of parasites.

* CLSI documents are continually reviewed and revised through the CLSI consensus process; therefore, readers should refer to the most current editions.

Related CLSI Reference Materials (Continued)

M29-A3 **Protection of Laboratory Workers From Occupationally Acquired Infections; Approved Guideline—Third Edition (2005).** Based on US regulations, this document provides guidance on the risk of transmission of infectious agents by aerosols, droplets, blood, and body substances in a laboratory setting; specific precautions for preventing the laboratory transmission of microbial infection from laboratory instruments and materials; and recommendations for the management of exposure to infectious agents.

M40-A **Quality Control of Microbiological Transport Systems; Approved Standard (2003).** This document provides criteria to assist manufacturers and end users of transport devices in providing and selecting dependable products for the transport of microbiological clinical specimens.

M47-A **Principles and Procedures for Blood Cultures; Approved Guideline (2007).** This document provides recommendations for the collection, transport, and processing of blood cultures as well as guidance for the recovery of pathogens from blood specimens taken from patients who are suspected of having bacteremia or fungemia.

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