Every patient deserves the GOLD STANDARD ...
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# Chemistry and Toxicology Checklist

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ON-LINE CHECKLIST AVAILABILITY

Participants of the CAP accreditation programs may download the checklists from the CAP website (www.cap.org) by logging into e-LAB Solutions. They are available in different checklist types and formatting options, including:

- **Master** — contains ALL of the requirements and instructions available in PDF, Word/XML or Excel formats
- **Custom** — customized based on the laboratory’s activity (test) menu; available in PDF, Word/XML or Excel formats
- **Changes Only** — contains only those requirements with significant changes since the previous checklist edition in a track changes format to show the differences; in PDF version only. Requirements that have been moved or merged appear in a table at the end of the file.

SUMMARY OF CHECKLIST EDITION CHANGES

Chemistry and Toxicology Checklist

07/28/2015 Edition

The information below includes a listing of checklist requirements with significant changes in the current edition and previous edition of this checklist. The list is separated into three categories:

1. **New**
2. **Revised:**
   - Modifications that may require a change in policy, procedure, or process for continued compliance; or
   - A change to the Phase
3. **Deleted/Moved/Merged:**
   - Deleted
   - Moved — Relocation of a requirement into a different checklist (requirements that have been resequenced within the same checklist are not listed)
   - Merged — The combining of similar requirements

**NOTE:** The listing of requirements below is from the Master version of the checklist. The customized checklist version created for on-site inspections and self-evaluations may not list all of these requirements.

**NEW Checklist Requirements**

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**REVISED Checklist Requirements**

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### Chemistry and Toxicology Checklist

#### DELETED/MOVED/MERGED Checklist Requirements

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INTRODUCTION

This checklist is used in conjunction with the All Common and Laboratory General Checklists to inspect a chemistry laboratory section or department.

Certain requirements are different for waived versus nonwaived tests. Refer to the checklist headings and explanatory text to determine applicability based on test complexity. The current list of tests waived under CLIA may be found at http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfClia/analyteswaived.cfm.

Note for non-US laboratories: Checklist requirements apply to all laboratories unless a specific disclaimer of exclusion is stated in the checklist.

CHEMISTRY & TOXICOLOGY GENERAL ISSUES

QUALITY MANAGEMENT AND QUALITY CONTROL

SPECIMEN COLLECTION AND HANDLING

Inspector Instructions:

- **Aliquoting process.** Determine if the process and procedure are adequate to prevent cross-contamination and specimen mix-ups.

- **What procedure does your laboratory follow when aliquots are made from the primary specimen?**

CHM.12133  Aliquoting  Phase II

There is a written aliquoting procedure to ensure prevention of cross contamination of specimens and aliquots.

NOTE: Certain limited volume specimens may warrant the use of previously aliquotted specimens. In such cases, the laboratory must have a clearly defined, documented policy specifying such circumstances and a procedure describing how it is performed.
CALIBRATION AND STANDARDS

Inspector Instructions:

- Sampling of calibration and AMR policies and procedures
- Sampling of calibration/calibration verification records
- Sampling of AMR verification records
- Sampling of patient reports/worksheets for verification of results outside of AMR
- Current DEA license (for US laboratories that handle pure controlled substance(s))

- Sampling of calibration materials (quality)

- What is your course of action if calibration is unacceptable?
- When was the last time you performed a calibration procedure and how did you verify the calibration?
- What is your course of action when results fall outside the AMR?
- What is your course of action when you receive calibration materials for non-FDA cleared/approved assays?
- How does your laboratory verify concentration techniques?

- Further evaluate the responses, corrective actions, and resolutions for unacceptable calibration, and unacceptable calibration verification

CHM.12950  Calibration, Calibration/Verification - Waived Tests  Phase II

For waived tests, testing personnel follow manufacturer’s instructions for calibration, calibration verification, and related functions.

Evidence of Compliance:
✓ Written procedure consistent with the manufacturer’s instructions for each waived test AND
✓ Records for calibration/calibration verification/related functions as required by the manufacturer AND
✓ Records of recalibration or other appropriate corrective action when calibration verification is unacceptable

The remaining requirements in this checklist on CALIBRATION, CALIBRATION VERIFICATION, and ANALYTIC MEASUREMENT RANGE (AMR) do not apply to waived tests.

This introduction discusses the processes of calibration, calibration verification, and analytical measurement range verification (AMR).

DEFINITIONS:

CALIBRATION is the set of operations that establish, under specified conditions, the relationship between reagent system/instrument response and the corresponding concentration/activity values of an analyte.
Calibration procedures are typically specified in the manufacturer's instructions, but may also be established by the laboratory.

CALIBRATION VERIFICATION denotes the process of confirming that the current calibration settings for each analyte remain valid for a test system. If calibration verification confirms that the current calibration settings for each analyte are valid, it is not necessary to perform a complete calibration or recalibration of the test system. Each laboratory must define limits for accepting or rejecting tests of calibration verification. Calibration verification can be accomplished in several ways. If the manufacturer provides a calibration validation or verification process, it should be followed. Other techniques include (1) assay of the current method calibration materials as unknown specimens, and determination that the correct target values are recovered, and (2) assay of matrix-appropriate materials with target values that are specific for the method.

REQUIRED FREQUENCY OF CALIBRATION VERIFICATION

Laboratories must calibrate a test system when it is first placed in service and perform calibration verification at least every six months thereafter. However, a laboratory may opt to recalibrate a test system (rather than perform calibration verification) at least every six months. If a test system has been recalibrated then it is NOT necessary to also perform calibration verification sooner than six months following recalibration. In addition to this six-month schedule, calibration verification or recalibration is required (regardless of the length of time since last performed) immediately if any of the following occurs:

1. A change of reagent lots for chemically or physically active or critical components, unless the laboratory can demonstrate that the use of different lots does not affect the accuracy of patient/client test results, and the range used to report patient/client test data
2. If QC materials reflect an unusual trend or shift or are outside of the laboratory’s acceptable limits, and other means of assessing and correcting unacceptable control values fail to identify and correct the problem
3. After major maintenance or service. The Laboratory Director must determine what constitutes major maintenance or service.
4. When recommended by the manufacturer

MATERIALS SUITABLE FOR CALIBRATION VERIFICATION

Materials for calibration verification must have a matrix appropriate for the clinical specimens assayed by that method and target values appropriate for the measurement system. Suitable materials may include, but are not limited to:

1. Calibrators used to calibrate the analytical system
2. Materials provided by the analytical measurement system vendor for the purpose of calibration verification
3. Previously tested unaltered patient/client specimens
4. Primary or secondary standards or reference materials with matrix characteristics and target values appropriate for the method,
5. Third party general purpose reference materials that are suitable for verification of calibration following reagent lot changes if the material is listed in the package insert or claimed by the method manufacturer to be commutable with patient specimens for the method. A commutable reference material is one that gives the same numeric result as would a patient specimen containing the same quantity of analyte in the analytic method under discussion; i.e. matrix effects are absent. Commutability between a reference material and patient specimens can be demonstrated using the protocol in CLSI EP14-A3,
6. Proficiency testing material or proficiency testing validated material with matrix characteristics and target values appropriate for the method

In general, routine control materials are not suitable for calibration verification, except in situations where the material is specifically designated by the method manufacturer as suitable for verification of the method's calibration process.

ANALYTICAL MEASUREMENT RANGE

DEFINITIONS:
The ANALYTICAL MEASUREMENT RANGE (AMR) is the range of analyte values that a method can directly measure on the specimen without any dilution, concentration, or other pretreatment not part of the usual assay process.

LINEARITY AND THE AMR
An important concept in verifying the AMR is that a plot of measured values from test samples vs. their actual (or expected) concentration or relative concentrations must be linear within defined acceptance criteria over the AMR. Verifying linearity using such a plot verifies the AMR. Beyond the limits of the AMR, there may not be a linear relationship between measured and actual analyte concentrations, and test results may therefore be unreliable. For patient samples, only measured values that fall within the AMR (or can be brought into the AMR by sample dilution or concentration) should be reported. Values that fall outside the AMR may be reported as "less than" or "greater than" the limits of the AMR (see the note below, Patent Samples with Unusually High Concentrations of Analyte).

AMR VERIFICATION
Minimum requirements can be met by using matrix appropriate materials, which include the low, mid and high concentration or activity range of the AMR and recovering appropriate target values, within defined acceptance criteria. Records of AMR verification must be available.

The best practice for AMR verification is to demonstrate a linear relationship, within defined acceptance criteria, between measured concentrations of analytes and expected values for a set of four or more matrix-appropriate samples that cover the AMR.

AMR verification may be accomplished through the calibration procedure under certain circumstances. It is not necessary to perform a separate AMR verification if the calibration of an assay includes calibrators that span the full range of the AMR, with low, midpoint and high values (i.e. three points) included. A one-point or two-point calibration does not include all of the necessary points to validate the AMR.

REQUIRED FREQUENCY OF AMR VERIFICATION
When initially introducing a new method, it is necessary to verify the AMR independently from the calibration process. In this situation, suitable materials for the AMR verification include those listed below (see OTHER MATERIALS SUITABLE FOR AMR VERIFICATION). Additionally, when multipoint calibration that spans the AMR is utilized, a set of calibrators from a different lot number than that used to calibrate the system may be suitable for independent AMR verification.

The AMR must be verified at least every six months after a method is initially placed in service and following the criteria defined in the checklist. If multipoint calibrators that span the AMR are used for calibration/calibration verification, it is not necessary to independently verify the AMR, as long as the system is calibrated at least every 6 months.

OTHER MATERIALS SUITABLE FOR AMR VERIFICATION
The materials used for AMR verification must be known to have matrix characteristics appropriate for the method. The matrix of the sample (i.e. the environment in which the sample is suspended or dissolved) may influence the measurement of the analyte. In many cases, the method manufacturer will recommend suitable materials. The verification must include specimens, which at a minimum, are near the low, midpoint, and high values of the AMR. Suitable materials for AMR verification include the following:

1. Linearity material of appropriate matrix, e.g. CAP CVL Survey-based or other suitable linearity verification material
2. Previously tested patient/client specimens, that may be altered by admixture with other specimens, dilution, spiking in known amounts of an analyte, or other technique
3. Primary or secondary standards or reference materials with matrix characteristics and target values appropriate for the method
4. Patient samples that have reference method assigned target values
5. Control materials, if they adequately span the AMR and have method specific target values
Closeness of Sample Concentrations or Activities to the Upper and Lower Limits of the AMR

When verifying the AMR, it is required that materials used are near the upper and lower limits of the AMR. Factors to consider in verifying the AMR are the expected analytic imprecision near the limits, the clinical impact of errors near the limits, and the availability of test specimens near the limits. It may be difficult to obtain specimens with values near the limits for some analytes. In such cases, reasonable procedures should be adopted based on available specimen materials. The method manufacturer's instructions for verifying the AMR should be followed, when available. The Laboratory Director must define limits for accepting or rejecting verification tests of the AMR.

Patient Samples with Unusually High Concentrations of Analyte

In the case of samples with very high concentrations or activities of an analyte, very large dilutions may be required to bring the concentration or activity into the AMR. Making large dilutions of patient samples can introduce error, and the Laboratory Director should establish appropriate volumes of sample and diluent to be used to minimize dilution errors. For example, pipetting 1 µL of a sample is difficult to do accurately and larger sample and diluent volumes should be specified. Note that for some analytes, an acceptable dilution protocol may not exist because dilution would alter the analyte or the matrix causing erroneous results, e.g. free drugs or free hormones. Also note that for some analytes, there may be no clinical relevance to reporting a numeric result greater than a stated value. If it is not possible to achieve a measured value that is within the AMR by using allowable dilutions, or there is no clinical value to reporting a higher value, then the result may be reported as “greater than” the value of the highest allowable dilution.

REVISED** 07/28/2015

CHM.13000 Calibration Procedure

Calibration procedures for each test system are appropriate, and the calibration records are reviewed for acceptability.

NOTE: Calibration must be performed following manufacturer’s instructions, at minimum, including the number, type, and concentration of calibration materials and criteria for acceptable performance.

REFERENCES

CHM.13100 Calibration Materials

High quality materials with test system and matrix-appropriate target values are used for calibration and calibration verification whenever possible.

NOTE: Calibration materials establish the relationship between test system response and the corresponding concentration/activities of an analyte. They have defined analyte target values and appropriate matrix characteristics for the clinical specimens and specific assay method. Many instrument systems require calibration materials with system-specific target values to produce accurate results for clinical specimens.

Evidence of Compliance:
✓ Written policy defining appropriate calibration/calibration verification materials

REFERENCES

CHM.13125 Calibration Materials - Non-FDA Cleared/Approved Assays Phase II

There is a record of the quality of all calibration materials used for in vitro diagnostic devices.

NOTE: Standards used to prepare calibrators for in vitro diagnostic devices require certificates of purity from the vendor, or a check on purity as part of the initial assay validation process. The laboratory should maintain records that verify the accuracy of a new lot of calibrators by checking the new lot against the current lot.

For laboratories subject to US regulations, this applies to non-FDA-cleared/approved assays.

Evidence of Compliance:
✓ Records of accuracy checks with each new lot

CHM.13175 Pure Controlled Substances Phase II

If the laboratory procedures require the use of chemicals (for standards, controls, etc.) covered by the Controlled Substances ACT, the laboratory maintains appropriate licenses.

NOTE: The intent is to be compliant with national and state laws.

For US laboratories, a DEA license, and in some states, a State license is required for controlled substances. A DEA license is not required for certain commercial solutions of controlled substances.

CHM.13400 Calibration/Calibration Verification Criteria Phase II

Criteria are established for frequency of recalibration or calibration verification, and the acceptability of results.

NOTE: Criteria typically include:

1. At changes of reagent lots for chemically or physically active or critical components, unless the laboratory can demonstrate that the use of different lots does not affect the accuracy of patient/client test results and the range used to report patient/client test data
2. If QC materials reflect an unusual trend or shift or are outside of the laboratory’s acceptable limits, and other means of assessing and correcting unacceptable control values fail to identify and correct the problem
3. After major preventive maintenance or change of a critical instrument component
4. When recommended by the manufacturer
5. At least every six months

Evidence of Compliance:
✓ Written policy defining the method, frequency and limits of acceptability of calibration verification for each instrument/test system AND
✓ Records of calibration verification at defined frequency

REFERENCES
The test system is recalibrated when calibration verification fails to meet the established criteria of the laboratory.

Evidence of Compliance:
✓ Written policy defining criteria for recalibration AND
✓ Records of recalibration, if calibration or calibration verification has failed

REFERENCES

**REVISED** 04/21/2014
CHM.13600 AMR Verification

Verification of the analytical measurement range (AMR) is performed with matrix-appropriate materials which, at a minimum, include the low, mid and high range of the AMR, appropriate acceptance criteria are defined, and the process is performed at least every six months and following defined criteria. Records are maintained.

NOTE: The AMR must be verified at least every six months after a method is initially placed in service and if any of the following occur:

1. A change of reagent lots for chemically or physically active or critical components, unless the laboratory can demonstrate that the use of different lots does not affect the accuracy of patient/client test results, and the range used to report patient/client test data
2. If QC materials reflect an unusual trend or shift or are outside of the laboratory’s acceptable limits and other means of assessing and correcting unacceptable control values fail to identify and correct the problem
3. After major preventive maintenance or change of a critical instrument component
4. When recommended by the manufacturer

AMR verification is not required for methods that measure an analyte quantitatively or semi-quantitatively, and report a qualitative value based on concentration threshold. For such methods, e.g. drugs of abuse, refer to checklist requirement CHM.13750.

Evidence of Compliance:
✓ Written policy for AMR verification defining the types of materials used, frequency and acceptability criteria

REFERENCES

CHM.13710 Diluted or Concentrated Samples

If a result is greater than or less than the AMR, a numeric result is not reported unless the sample is processed by dilution, a mixing procedure or concentration so that the result falls within the AMR.

NOTE:
1. A measured value that is outside the AMR may be unreliable and should not be reported in routine practice. Dilution, a mixing procedure* or concentration of a sample may be required to achieve a measured analyte activity or concentration that falls within the AMR. The result must be within the AMR before it is mathematically corrected by the concentration or dilution factor to obtain a reportable numeric result.
2. For each analyte, the composition of the diluent solution and the appropriate volumes of sample and diluent must be specified in the procedure manual. Specifying acceptable volumes is intended to ensure that the volumes pipetted are large enough to be accurate without introducing errors in the dilution ratio.
3. All dilutions, whether automatic or manual, should be performed in a way that ensures that the diluted specimen reacts similarly to the original specimen in the assay system. For some analytes, demonstrating that more than one dilution ratio similarly recovers the elevated concentration may be helpful.

4. This checklist requirement does not apply if the concentration or activity of the analyte that is outside the AMR is reported as "greater than" or "less than" the limits of the AMR.

*This procedure is termed the "method of standard additions." In this procedure, a known quantity (such as a control) is mixed with the unknown, and the concentration of the mixture is measured. If equal volumes of the two samples are used, then the result is multiplied by two, the concentration of the known subtracted, and the concentration of the unknown is the difference.

Evidence of Compliance:
✓ Patient reports or worksheets

REFERENCES

CHM.13720 Maximum Dilution

For analytes that may have results falling outside the limits of the AMR, the laboratory procedure specifies the maximum dilution that may be performed to obtain a reportable numeric result.

NOTE:
1. For each analyte, the laboratory procedure defines the maximum dilution that falls within the AMR and that can be subsequently corrected by the dilution factor to obtain a reportable numeric result. Note that for some analytes, an acceptable dilution procedure may not exist because dilution would alter the analyte or the matrix causing erroneous results, e.g. free drugs or free hormones. Also note that, for some analytes, there may be no clinical relevance to reporting a numeric result greater than a stated value.

2. Analytes for which a dilution procedure is unable to bring the activity or concentration into the AMR should be reported as "greater than" the highest estimated values.

3. Establishment of allowable dilutions is performed when a method is first placed into service and is reviewed biennially thereafter as part of the procedure manual review by the Laboratory Director or designee. The laboratory director is responsible for establishing the maximum allowable dilution of samples that will yield a credible laboratory result for clinical use.

Evidence of Compliance:
✓ Patient reports or worksheets

CHM.13730 Concentration Techniques

Concentration techniques for quantitative tests are verified.

NOTE: Techniques used to concentrate specimens for analysis must be verified at specified, periodic intervals (not to exceed one year or manufacturer's recommendations).

Evidence of Compliance:
✓ Written procedure for verifying the accuracy of concentration techniques AND ✓ Records of concentration technique verification at defined frequency

CHM.13750 Qualitative Cut-Off
For qualitative tests that use a cut-off value to distinguish positive from negative, the cut-off value is established initially, and verified every six months thereafter.

NOTE: This checklist requirement applies only to certain tests that report qualitative results based on a quantitative measurement using a threshold (cut-off value) to discriminate between a positive and negative clinical interpretation. The cut-off value that distinguishes a positive from a negative result must be established when the test is initially placed in service, and verified every six months thereafter. If the value of a calibrator or calibration verification material is near that of the cut-off, then the calibration or calibration verification satisfies this checklist requirement. If the laboratory is not able to access the actual numerical value from the instrument, this checklist requirement does not apply.

Verification of the cut-off should also be performed at changes of lots of analytically critical reagents (unless the laboratory director has determined that such changes do not affect the cut-off); after replacement of major instrument components; after major service to the instrument; and when QC materials reflect an unusual trend or shift or are outside of the laboratory's acceptable limits, and other means of assessing and correcting unacceptable control values fail to identify and correct the problem.

Appropriate materials for establishment and verification of the cut-off are identical to those recommended for calibration verification (listed in the introduction to the Calibration and Standards section of the Chemistry and Toxicology checklist). Note that QC materials are acceptable if the material is specifically claimed by the method manufacturer as suitable for verification of the method's calibration process.

Evidence of Compliance:
✓ Written procedure for initial establishment and verification of the cut-off value AND
✓ Records of initial establishment and verification of cut-off value at defined frequency

**REVISED** 07/28/2015

**Neonatal Bilirubin Testing**

Neonatal bilirubin results in the range of 5 to 25 mg/dL are accurate and suitable for use with standardized clinical practice interpretive guidelines, with accuracy verified at least annually.

NOTE: Each laboratory must assess the accuracy of its instrument/test system over the range of bilirubin values appropriate for the clinical guidelines (5-25 mg/dL). In many cases, acceptable performance can be verified using proficiency testing materials with assigned reference values. In other cases, the laboratory can meet the objective by using patient samples to perform correlation studies against 1) a reference method; OR 2) an alternate method that consistently demonstrates good performance in a proficiency testing program (based on the method mean value as compared to the reference value). In all cases, such comparisons should include at least one or two samples annually in the target clinical range of 5-25 mg/dL.


Evidence of Compliance:
✓ Written assessment of adequacy for the agreement with target values in the range of the clinical guidelines for clinical purposes, at least annually, by the laboratory director or designee

REFERENCES


CONTROLS

Controls are used to ensure that a test system is performing correctly. Traditionally, controls are samples that act as surrogates for patient/client specimens, periodically processed like a patient/client sample to monitor the ongoing performance of the entire analytic process. Under certain circumstances, other types of controls (electronic, procedural, built-in) may be used. (Details are in the checklist requirements in this section, below.)

CONTROLS – WAIVED TESTS

Inspector Instructions:

- Sampling of quality control policies and procedures
- Sampling of QC records
- How do you determine when QC is unacceptable and when corrective actions are needed?
- Select several occurrences in which QC is out of range and follow records to determine if the steps taken follow the laboratory procedure for corrective action

CHM.13840 QC Results - Waived Tests

The laboratory follows manufacturer instructions for quality control, reviews results, and records acceptability prior to reporting patient results.

NOTE: Quality control must be performed according to manufacturer instructions. To detect problems and evaluate trends, testing personnel or supervisory staff must review quality control data on days when controls are run prior to the reporting of results. The laboratory director or designee must review QC data at least monthly or more frequently if specified in the laboratory QC policy.

With respect to internal controls, acceptable control results must be recorded, at a minimum, once per day of patient testing for each device.*

*Acceptable internal control results need not be recorded, if (and only if) an unacceptable instrument control automatically locks the instrument and prevents release of patient results.

Evidence of Compliance:
✓ Written procedure consistent with manufacturer instructions for each waived test AND
✓ Records showing confirmation of acceptable QC results

CHM.13860 QC Corrective Action - Waived Tests
Phase II

There is a record of corrective action when control results exceed defined acceptance limits.

CONTROLS – NONWAIVED TESTS

Inspector Instructions:

- Sampling of quality control policies and procedures
- Sampling of QC records, including external and internal quality control processes

- How do you determine when quality control is unacceptable and when corrective actions are needed?
- How does your laboratory verify or establish acceptable quality control ranges?
- What is your course of action when monthly precision data changes significantly from the previous month’s data?
- What is your course of action when you perform test procedures that do not have commercially available calibration or control materials?

- Select several occurrences in which QC is out of range and follow records to determine if the steps taken follow the laboratory procedure for corrective action
- Use QC data to identify tests that utilize internal quality control processes to confirm that any individualized quality control plan (IQCP) is used as approved by the laboratory director

**REVISED** 07/28/2015
CHM.13900 Daily QC - Nonwaived Tests
Phase II

Controls are run at least daily, or more frequently if specified in manufacturer’s instructions, laboratory procedure, or the CAP Checklist, for quantitative and qualitative tests.

NOTE: The laboratory must define the number and type of quality control used and the frequency of testing in its quality control procedures. Control testing is not required on days when patient testing is not performed.

Controls must be run prior to reporting patient results, after a change of analytically critical reagents, major preventive maintenance, or change of a critical instrument component. Daily quality control must be run as follows:

1. Quantitative tests - two controls at different concentrations at least daily
2. Qualitative tests - a negative control and a positive control (when applicable) at least daily

Controls should verify assay performance at relevant decision points. The selection of these points may be based on clinical or analytical criteria.
If an internal quality control process (e.g. electronic/procedural/built-in) is used instead of an external control material to meet daily quality control requirements, the laboratory must have an individualized quality control plan (IQCP) approved by the laboratory director to address the use of the alternative control system. Please refer to the Individualized Quality Control Plan section of the All Common Checklist for the eligibility of tests for IQCP and requirements for implementation and ongoing monitoring of an IQCP.

Evidence of Compliance:
✓ Records of QC results including external and internal control processes AND
✓ Written quality control procedures AND
✓ Manufacturer product insert or manual

REFERENCES
1) Department of Health and Human Services, Centers for Medicare and Medicaid Services. Medicare, Medicaid and CLIA programs; CLIA fee collection; correction and final rule. Fed Register. 2003(Jan 24):5232 [42CFR493.1256(d)(3) (i, ii)]
2) Steindel SJ, Tetrault G. Quality control practices for calcium, cholesterol, digoxin, and hemoglobin. A College of American Pathologists Q-Probes study in 505 hospital laboratories. *Arch Pathol Lab Med*. 1998;122:401-408

CHM.14000 QC Acceptable Range Verification 

Phase II

For quantitative tests, a valid acceptable range has been established or verified for each lot of control material.

NOTE: For unassayed controls, the laboratory must establish a valid acceptable range by repetitive analysis in runs that include previously tested control material. For assayed controls, the laboratory must verify the acceptability ranges supplied by the manufacturer.

Evidence of Compliance:
✓ Written procedure to establish or verify control ranges AND
✓ Records for control range verification of each lot

REFERENCES

CHM.14125 Calibrator Preparation 

Phase II

If the laboratory prepares calibrators and controls in-house, these materials are prepared separately.
NOTE: In general, calibrators should not be used as QC materials. If calibrators are used as controls, then different preparations should be used for these two functions.

Evidence of Compliance:
✓ Written policy for in-house preparation of calibrators and controls

REFERENCES

Calibrators as Controls

Phase I

If a calibrator obtained from an outside supplier is used as a control, it is a different lot number from that used to calibrate the method.

NOTE: In general, calibrators should not be used as QC materials. However, this practice may be necessary for some methods when a separate control product is not available. In such cases, the calibrator used as a control must be from a different lot number than that used to calibrate the method.

Evidence of Compliance:
✓ Written policy for the use of calibrators as controls AND
✓ QC/calibrator records

REFERENCES

Validation of Accuracy

Phase II

If the laboratory performs test procedures for which calibration and control materials are not commercially available, guidelines have been established to validate the accuracy of patient/client test results.

REFERENCES

QC Data

Phase II

Quality control data are organized and presented so they can be evaluated daily by the technical staff to detect problems, trends, etc.

NOTE: Results of controls must be recorded or plotted to readily detect a malfunction in the instrument or in the analytic system. These control records must be readily available to the person performing the test.

REFERENCES

Numeric QC Data

Phase I

For numeric QC data, quality control statistics (e.g. SD and CV) are calculated monthly to define and monitor analytic imprecision.

NOTE: The laboratory must evaluate the imprecision statistics (e.g. SD and CV, or other appropriate statistics) monthly to confirm that the test system is performing within acceptable limits. For whole blood methods, where stabilized whole blood or other suitable material is not available for QC, such statistics may be generated from previous patient/client samples using the SD of duplicate pairs or other patient data based statistical procedures.

This checklist requirement does not apply to external controls run only to verify new lots/shipments of test materials. However the laboratory should have defined acceptable limits for such controls (either from the manufacturer, or developed by the laboratory).
Evidence of Compliance:
✓ Written procedure for monitoring analytic imprecision including statistical analysis of data
AND
✓ QC records showing monthly monitoring for imprecision

REFERENCES
1) Mukherjee KL. Introductory mathematics for the clinical laboratory. Chicago, IL: American Society of Clinical Pathology, 1979:81-94

**REVISED** 07/28/2015

CHM.14600 QC Corrective Action

There are records of corrective action when control results exceed defined acceptability limits.

NOTE: Patient/client test results obtained in an analytically unacceptable test run or since the last acceptable test run must be re-evaluated to determine if there is a significant clinical difference in patient/client results. Re-evaluation may or may not include re-testing patient samples, depending on the circumstances.

Even if patient samples are no longer available, test results can be re-evaluated to search for evidence of an out-of-control condition that might have affected patient results. For example, evaluation could include comparison of patient means for the run in question to historical patient means, and/or review of selected patient results against previous results to see if there are consistent biases (all results higher or lower currently than previously) for the test(s) in question).

The corrective action for tests that have an IQCP approved by the laboratory director must include an assessment of whether further evaluation of the risk assessment and quality control plan is needed based on the problems identified (e.g. trending for repeat failures, etc.).

REFERENCES

CHM.14800 QC Handling

Control specimens are tested in the same manner and by the same personnel as patient/client samples.

NOTE: QC specimens must be analyzed by personnel who routinely perform patient/client testing - this does not imply that each operator must perform QC daily, so long as each instrument and/or test system has QC performed at required frequencies, and all analysts participate in QC on a regular basis. To the extent possible, all steps of the testing process must be controlled, recognizing that pre-analytic and post-analytic variables may differ from those encountered with patient/clients.

Evidence of Compliance:
✓ Records reflecting that QC is run by the same personnel performing patient testing

REFERENCES
2) ibid, 2003(Jan 24):3708[42CFR493.1256(d)(7-8)]
Chemistry and Toxicology Checklist

CHM.14900  QC Confirmation of Acceptability

The results of controls are reviewed for acceptability before reporting results.

NOTE: Control results must be reviewed before reporting patient/client results. It is implicit in quality control that patient/client test results will not be reported when controls do not yield acceptable results. Controls must be run prior to reporting patient results after a change of analytically critical reagents, major preventive maintenance, or change of a critical instrument component.

Evidence of Compliance:
✓ Written policy stating that controls are reviewed and acceptable prior to reporting patient results AND
✓ Evidence of corrective action taken when QC results are not acceptable

REFERENCES

**REVISED** 07/28/2015

CHM.14916  Monthly QC Review

Quality control data are reviewed and assessed at least monthly by the laboratory director or designee.

NOTE: The review of quality control data must be recorded and include follow-up for outliers, trends, or omissions that were not previously addressed.

The QC data for tests performed less frequently than once per month should be reviewed when the tests are performed.

The review of quality control data for tests that have an IQCP approved by the laboratory director must include an assessment of whether further evaluation of the risk assessment and quality control plan is needed based on problems identified (e.g. trending for repeat failures, etc.).

Evidence of Compliance:
✓ Records of QC review including follow-up for outliers, trends or omissions

RESULTS REPORTING

Inspector Instructions:

- Sampling of reporting policies and procedures
- Sampling of patient reports (reference range included)
- Sampling of patient toxicology reports

CHM.15250  Toxicology Results

There are written procedures for the reporting of toxicology results.

NOTE: In addition to the requirements found in the Laboratory General Checklist, the following information must be included in toxicology reports:
1. If appropriate, substances or classes of substances analyzed as part of the toxicology test
2. Specimen type
3. Report status for positive results (i.e., unconfirmed, confirmed or pending confirmation)
4. For immunoassays, the assay cut-off concentration for each drug or drug class*
5. If the report includes unconfirmed screening results, a statement that such results are to be used only for medical (i.e., treatment) purposes. Unconfirmed screening results must not be used for non-medical purposes (e.g., employment testing, legal testing)

*The cut-off concentrations may either be included in the report or in a separate chart/memorandum available to clinicians.

REFERENCES

METHODS, INSTRUMENT SYSTEMS, AND EQUIPMENT

The checklist requirements in this section should be used in conjunction with the requirements in the All Common Checklist relating to instruments and equipment.

Inspector Instructions:

- If problems are identified during the review of the methods, instrument systems, and equipment or when asking questions, further evaluate the laboratory’s responses, corrective actions and resolutions
- Select a representative assay and follow the entire process from specimen receipt to final result reporting

RADIOIMMUNOASSAYS

Inspector Instructions:

- Sampling of radioimmunoassay policies and procedures
- Sampling of calibration records
- Sampling of background radioactivity records

CHM.15900 Gamma Counter Calibration Phase II

Gamma counters and/or scintillation counters are calibrated, results recorded and compared to previous values each day of use.

Evidence of Compliance:
✓ Written procedure for calibration

CHM.16000 Background Radioactivity Phase II

The background radioactivity is determined each day of use, including the background in each well of a multi-well counter, with defined upper limits of acceptability.
Evidence of Compliance:
✓ Records of background radioactivity determinations at defined frequency

CHM.16200 Counting Times

Counting times for quantitative procedures are sufficiently long for statistical accuracy and precision.

Evidence of Compliance:
✓ Written procedure defining counting times for each quantitative assay

REFERENCES

CHROMATOGRAPHY AND MASS SPECTROMETRY

THIN LAYER CHROMATOGRAPHY (TLC)

Inspector Instructions:

- Sampling of TLC policies and procedures
- Sampling of control, standards/calibrator records

CHM.16300 Standard/Calibration Materials

Appropriate standards, calibrators, or controls (as applicable) are included with each TLC plate.

NOTE: Appropriate standards must include compounds that test the chromatographic range of the TLC plate, and that test all phases of the staining/development system. This may consist of a standard, previously tested positive patient sample, or dot that contains appropriate compounds.

Evidence of Compliance:
✓ Written policy defining appropriate use of standards/calibrators for TLC AND
✓ Records showing use of appropriate standards/calibrators with each plate

REFERENCES

CHM.16400 Daily QC - TLC

Negative and appropriate positive controls are extracted and run through the entire procedure.

NOTE: Positive and negative controls must be extracted and carried through the entire procedure with each plate or card.

Appropriate positive controls must include drugs/compounds that test the extraction, chromatographic range of the TLC plate, and the staining/development system.

Evidence of Compliance:
✓ Written QC procedure defining QC requirements appropriate to the complexity of the test system AND
QC records at defined frequency

REFERENCES

Chemistry and Toxicology Checklist

■ QA records at defined frequency

REFERENCES

CHM.16500 Solvent Mixtures

Solvent mixtures are prepared fresh as needed.

NOTE: If a mixture of solvents is used, certain components will evaporate with time faster than others. This leads to poor extraction or reproducibility of migration rates. If a commercial kit is used, the manufacturer’s instructions should be followed.

Evidence of Compliance:
■ Written procedure for preparation of solvent mixture

GAS CHROMATOGRAPHY (GC) AND HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

Inspector Instructions:
- Sampling of GC/HPLC policies and procedures
- Sampling of control, calibration/standards records
- Sampling of column verification records
- Sampling of records of sample order
- Records of signal intensity monitoring

■ How does your laboratory evaluate the effectiveness of hydrolysis?
■ How does your laboratory evaluate potential carryover?
■ How have you determined the limit of detection and the AMR?

CHM.16550 Calibration and Calibration Verification

Appropriate calibration or calibration verification is performed on each day of patient testing or following the manufacturer’s instructions.

NOTE: For qualitative assays, an appropriate calibrator should be run at normal and abnormal levels. For quantitative assays, a multipoint calibration may be required if the measurement has a non-linear response. For some assays, a level near the assay’s limit of detection (LOD) or at critical decision point(s) is needed. For measurement systems that have a linear response verified by periodic multipoint calibration verification and AMR verification protocols, a calibration procedure that uses a single calibrator at an appropriate concentration is acceptable. Analyses based on a single point calibration must be controlled by appropriate quality control samples. In addition, inclusion of a negative control (reagent blank) is good laboratory practice.

Evidence of Compliance:
■ Written procedure for calibration/calibration verification and
■ Records of calibration/calibration verification

REFERENCES

CHM.16650 Quality Control

Phase II

Appropriate controls are extracted and run through the entire procedure on each day of patient testing.

NOTE: Controls used in chromatographic procedures must evaluate as much of the complete testing process as is technically feasible. The control process includes any pre-treatment, pre-purification or extraction steps, unless non-pretreated control material is inappropriate. For qualitative assays, the negative and positive controls should be at concentrations that meaningfully confirm performance below and above the decision threshold for the analyte. For quantitative assays, appropriate controls must include at least one normal sample, and at least one sample reflecting a disease range. For some assays, an additional control concentration may be useful to confirm performance near the assay’s LOD*, LOQ** or cut-off, if appropriate, or at a concentration consistent with highly abnormal levels that test the AMR.

*LOD - limit of detection

**LOQ - limit of quantitation

If a hydrolysis step is required in the assay, the laboratory includes a control (when available) with each batch to evaluate the effectiveness of hydrolysis.

Evidence of Compliance:
✓ Written procedure defining QC requirements for each test system AND
✓ QC records at defined frequency

REFERENCES

CHM.16750 Sample Run Order

Phase II

A record of sample run order is maintained for review.

NOTE: The run list must include blanks, standards, controls, and patients included in each run and be stored with the results of each batch run.

CHM.16770 Chromatographic Characteristics/Column Review

Phase II

Chromatographic characteristics and column performance are reviewed and approved for each run before results are released.

NOTE: Checks should record testing variables such as flow rate of carrier gas and amount of sample injected and indications of error, including split peaks, doublets, and tailing.

CHM.16800 Carryover Detection

Phase II

There is a procedure for detection and evaluation of potential carryover.

NOTE: No matter what type of injection is used, the procedure must address criteria for the evaluation of potential carryover from a preceding elevated (high concentration) sample to the following sample in each analytical batch analysis.

Evidence of Compliance:
✓ Records of reassessment of samples with potential carryover
REFERENCES
2) Society of Forensic Toxicologists/American Academy of Forensic Sciences. Forensic Toxicology Laboratory Guidelines. 2002; 8.2.6.13

CHM.16850  Column Verification  Phase II
New columns are verified for performance before use.

Evidence of Compliance:
✓ Written procedure for column verification AND
✓ Records of column verification

CHM.16950  Column/Detector Monitoring  Phase II
The written procedure requires monitoring the performance of the column and detector on each day of use.

NOTE: Unextracted standards, extracted calibrators or controls, typically containing the target compound(s), may be analyzed each day to monitor critical aspects of GC performance. Appropriate criteria for evaluating such parameters as retention time, relative retention time, separation of closely eluting compounds of interest, plates, chromatography quality, and detector response should be established and monitored.

Evidence of Compliance:
✓ Records for column and detector monitoring at defined frequency

CHM.17050  Gas Leakage - GC  Phase I
A written procedure specifies the checking of gas lines and connections for leaks every time tubing or a connection has been manipulated.

Evidence of Compliance:
✓ Records of gas line checks

CHM.17100  Reagent Grade  Phase II
Reagents, solvents and gases are of appropriate grade.

Evidence of Compliance:
✓ Written procedure detailing appropriate grade for materials used.

CHM.17150  Limit of Detection/AMR  Phase II
There are records that the limit of detection (sensitivity) and the AMR for quantitative methods have been determined for each procedure.

REFERENCES
MASS SPECTROMETRY (MS)

Inspector Instructions:

- Sampling of MS policies and procedures
- Identification criteria compliance
- How does your laboratory identify possible ion-suppression?

CHM.18400 Instrument Operation Phase II

There are written procedures for operation and calibration of the mass spectrometer.

REFERENCES

CHM.18600 Mass Spectrometer Tuning Phase II

The mass spectrometers are tuned each day of patient/client testing, or according to manufacturer’s recommendations and tune records are maintained.

NOTE: Acceptable tolerance limits for tune parameters must be defined, and tune records maintained.

CHM.18700 Identification Criteria Phase II

The identification criteria for single stage mass spectrometry (i.e. GC/MS, LC/MS) are in compliance with recommendations.

NOTE: One acceptable criterion for compound identification by GC/MS using ion ratios is that the unknown result must have ion ratios within a predefined or tolerance limit. This limit should be supported by either literature references or through experimental means. Such ion ratio tolerance limits may differ based on the technique applied (e.g. GC/MS versus LC/MS) as well as the analyte(s) being determined (e.g. compounds with mainly ions of low abundance); thus, a defined limit to cover all methods and analytes cannot be given.

Identification using ion ratios typically requires the use of at least two ion ratios. However, one ion ratio of two characteristic ions may be acceptable if there are only a few characteristic ratios AND if there are other identifying characteristics, e.g. retention time. The internal standard’s identification should be monitored with at least one ion ratio. An acceptable criterion for compound identification using total spectra is that the unknown result must have a “spectral match” quality or fit that is within the defined limits that the laboratory has set and validated. Ion ratios determined from total spectra analysis are an acceptable identification method, and should fulfill the same criteria as given above for ion ratio identification.

Laboratories using mass spectrometric methods for quantitative purposes based on total ion current measurements without ion ratios should have ancillary information and assay
characteristics that validate this process, e.g. known compound of interest, retention times, potential interferences by endogenous compounds or other drugs/metabolites, etc.

**Evidence of Compliance:**
✓ QC and test records

**REFERENCES**

**CHM.18800** Identification Criteria

**Phase II**

The identification criteria for tandem mass spectrometry (MS/MS) are validated and recorded.

**NOTE:** In tandem mass spectrometry using multiple reaction monitoring (MRM) there is at least one transition monitored for the internal standard and another for the analyte.

**Evidence of Compliance:**
✓ QC and test records

**REFERENCES**

**REVISED** 04/21/2014

**CHM.18825** Matrix Effect Assessment

**Phase II**

There is a record of assessment of matrix effects in LC-MS test development.

**NOTE:** Matrix effect on analyte ionization can be in both directions: suppression or, less frequently seen, enhancement of ionization. Evaluation of matrix effect on ionization must be performed during assay development and validation.

**Examples of evaluation protocols may include:**
1. Post Column Infusion - Constant infusion of analyte followed by injection of blank matrix specimen extracts to measure ionization response
2. Mobile Phase/Post Extractions Spiking - Compare response of analyte spiked into mobile phase to that of analyte spiked into blank matrix specimen extracts

A minimum of 10 different sources of the matrix of interest should be used during ion suppression/enhancement evaluation. If the average suppression/enhancement exceeds ±25% or the %CV of the ion suppression/enhancement exceeds ±15%, the validation studies must include data to demonstrate that matrix effects do not affect assay accuracy. One approach to validating accuracy is to assess calibration curve (slope) variation with calibrators in mobile phase and different matrices.

While the above represents recognized approaches to ion suppression/enhancement, other referenced approaches may also suffice.

**REFERENCES**

**REVISED** 04/21/2014

**CHM.18850** Matrix Effect Evaluation - Patient Samples

**Phase II**

...
The laboratory LC-MS assay procedure includes an evaluation for possible ion-suppression or enhancement in patient samples during routine testing.

NOTE: Ion suppression (or less frequently, ion enhancement) is a recognized analytical anomaly in LC-MS assays. Such suppression can lead to false negative results or poor quantitative analyses (especially near assay limit of quantitation). While difficult to predict and observe from specimen to specimen, certain precautions should be used to try to recognize when ion suppression or enhancement occurs.

Routine monitoring of the signal intensity of internal standard(s) is an effective way to recognize signal suppression in a single patient sample, due to unexpected interfering components of the matrix. Internal standards to be used are those that cover the areas of the elution profile where matrix effects are most pronounced, and that the suitability of these internal standards has been determined (i.e. with acceptance limits) during assay development and validation. Internal standard abundance acceptance criteria may be based on signal to noise ratio or may be compared to internal standard abundance in QC samples. As an example, for isotopically-labeled internal standards, if there is poor recovery of the internal standard, a signal to noise ratio greater than 3:1 should still suffice for acceptance of the specimen in question. If recovery of the isotopically-labeled internal standard is considered poor, then an alternate analysis should be considered, e.g. the method of standard addition. For analogue-type internal standards, internal standard recovery may be used as a guide for identification of ion suppression/enhancement, although another option, such as the method of standard addition, would be a reasonable alternative. It should be noted that even isotopically-labeled internal standards do not always readily identify ion suppression or enhancement.

Evidence of Compliance:
✓ Written procedure requiring monitoring of internal standards OR records of alternative methods used

INDUCTIVELY COUPLED PLASMA – MASS SPECTROMETRY (ICP/MS)

Inspector Instructions:

- Sampling of ICP/MS policies and procedures
- Sampling of calibration records

CHM.20400 Tuning Solution

An appropriate tuning solution or autotune is used to verify assay performance each day of use.

NOTE: Tuning solutions may contain a single element or multiple elements. Use of such solutions and/or autotuning verifies general system performance, control for potential interferences and mass resolution, optimization of ion lens voltages and check signal stability. Failure to use a tuning solution or autotune may affect ICP/MS sensitivity and selectivity.
Evidence of Compliance:
✓ Records of instrument tuning at defined frequency

CHM.20500 Peak Width

The peak width is optimized.

NOTE: ICP/MS peak width must be optimized. In quadrupole ICP/MS experiments, there is generally mass unit resolution. If a mass spectral peak is too broad, a false positive finding may occur, since it may overlap with another analyte. If a mass spectral peak is too narrow, sensitivity is sacrificed. Most manufacturers of ICP/MS instrumentation designate an acceptable peak width range. The peak width range is generally determined using a tuning solution. Some software packages automatically check and alter peak width range. Peak width optimization is generally verified daily. There may be times when it may be desirable to go outside the manufacturers specified peak width range. For example, brass is an alloy of copper and zinc. In ICP/MS, copper peaks surround that of zinc. Therefore, the copper peaks may interfere with the ability to detect zinc. Hence, by narrowing the zinc peak width, the possible interference due to copper may be mitigated or eliminated. With high resolution ICP/MS, it may be acceptable to have designated acceptable peak width range levels for different analytes.

Evidence of Compliance:
✓ Records of verification of peak width optimization

CHM.20600 Common Interferences Minimized

When appropriate, oxides and doubly-charged species are minimized.

NOTE: Oxides and doubly-charged species are common interferences in ICP/MS. Oxides of various elements may have overlapping signals with elements of the same mass, thus leading to false-positive findings. Special techniques such as high resolution ICP/MS, dynamic-reaction cell and collision-reaction cell processes may eliminate the concern for oxide interference. Elements with a second ionization potential greater than or equal to 15.8 eV (the ionization potential of argon) may be doubly-charged. Such doubly-charged species may suggest the presence of an element that is not truly present. For example, gadolinium has an isotope at m/e154. It has a doubly-charged species at m/e 77, which is also the same mass as an isotope of selenium, as well as a mass used as a correction factor for arsenic interference by ArC\(^{37}\). Despite the potential for a doubly-charged species, if the analyte of interest cannot be interfered with by known doubly-charged species, then such concern is unwarranted.

Evidence of Compliance:
✓ Written procedure defining technique to minimize common interference

CHM.20700 Dual Detector Mode

If the dual detector mode is applied, the calibration is verified.

NOTE: In ICP/MS, calibration can be performed in two modes – pulse counting for lower concentrations and analog for higher concentrations. If a range is necessary that overlaps with both modes, then the laboratory should employ a cross-calibration. This is generally accomplished by use of a tuning solution whereby a full calibration is performed in both modes followed by software adjustment for a smooth transition. If a concentration range is needed that only encompasses one mode or the other, then a cross-calibration is unnecessary as long as the appropriate mode is employed.

Evidence of Compliance:
✓ Records of calibration verification and cross-calibration, if needed
CHM.20800 Reaction/Collision Cell

If a reaction/collision cell is utilized, the reaction/collision gases are optimized.

NOTE: Optimization of reaction/collision gases will allow for maximization of sensitivity and minimization of background counts. Such optimization is generally accomplished through use of a separate tuning solution and is controlled by a separate part of most software packages than that used for autotuning.

Evidence of Compliance: ✓ Records of optimization of reaction/collision gases

CHM.20900 Calibration Curve

An adequate and appropriate calibration curve is established for quantitative testing.

Evidence of Compliance: ✓ Written procedure defining criteria for establishing the calibration curve for quantitative testing

CHM.21000 Instrument Operation

There are written procedures for operation, calibration and detection of drift in performance for ICP/MS equipment.

NOTE: Procedures for ICP/MS equipment must include criteria for performance and procedures to detect drift, which can occur rapidly. One way in which instrument drift can be detected is by evaluating control materials at defined intervals during a run.

CHM.21100 Isotope/Standard Criteria

Appropriate criteria are defined for selection of both the isotope(s) and the associated internal standard(s) related to each quantified element.

NOTE: When isotopes and internal standards are measured by ICP/MS, interferences (isobaric and polyatomic species) and relative abundances must be considered and described in written procedures and/or assay validation materials.

CHM.21200 Contamination

There are written procedures to minimize and detect contamination of results obtained by ICP/MS.

NOTE: Potential sources of contamination that should be evaluated and managed in an ICP/MS laboratory include specimen collection, reagent handling, carryover between samples, and engineering controls within the analytical environment.

CHM.21300 Gas/Reagent Purity

The purity of each gas and reagent used with ICP/MS is defined in a written procedure and appropriate for the intended use.

NOTE: Purity of gasses and reagents (including water) used with ICP/MS should be defined and validated to identify and minimize interferences and sources of contamination.

CHM.21400 Controls/Calibrators/Blanks
Controls, calibrators and blanks are matrix-matched to the sample type.

**NOTE:** The matrices of controls, calibrators and blanks may affect the ions generated and should be considered in the design and validation of each ICP/MS assay. If matrices are not an issue, the laboratory should have a record that matrix-matching is not necessary.

**Evidence of Compliance:**

✓ Written procedure defining the use of matrix-matched controls/calibrators/blanks OR a record that matrix-matching is unnecessary

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**ATOMIC ABSORPTION SPECTROPHOTOMETERS**

**Inspector Instructions:**

• Sampling of AA Spectrophotometer policies and procedures
  • Calibration records

• How does your laboratory ensure optimal lamp performance?

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**CHM.21600 Burner Head/Aspirator**

*The burner head and aspirator are flushed thoroughly with water each day of use.*

**Evidence of Compliance:**

✓ Record of burner head and aspirator maintenance

**CHM.21700 Optical Beam Alignment**

*The optical beam alignment is checked at defined frequencies, and results are recorded.*

*NOTE: This should be done at least weekly, although daily checking is preferred.*

**CHM.21800 Atomizer**

*The atomizer is cleaned and flow rate optimized at regular, specified intervals, and the results recorded.*

**CHM.21900 Sampler System**

*Automatic sampler systems (e.g. on graphite furnace) are checked for precision at specified periodic intervals.*

**Evidence of Compliance:**

✓ Records of sampler system checks at defined frequency

**CHM.22000 Graphite Furnace**
If a graphite furnace is used, the blank value of a graphite tube is verified for each element tested.

NOTE: Residue from assayed samples may accumulate on the graphite tube, thus potentially resulting in false positive findings should the residue contain the element of interest. In addition, checking for the response of a blank may also serve as one of the indicators that the graphite tube may need replacement.

Evidence of Compliance:
✓ Record of graphite tube checks at defined frequency

CHM.22100 Calibration Curve

An adequate and appropriate calibration curve is established for quantitative testing.

Evidence of Compliance:
✓ Written procedure for establishing the calibration curve for quantitative testing

CHM.22200 Lamp Energy

The lamp’s energy is verified and recorded for each run.

NOTE: Atomic absorption spectrophotometric lamp energy must be verified and recorded for each run. Lamps lose performance characteristics over time. Decrements in lamp performance may be observed by a loss of sensitivity. Poor lamp performance may also serve as an indicator of another system failure, e.g. loose connections.

COLORIMETERS, SPECTROPHOTOMETERS, AND FLUORIMETERS

The following requirements apply to stand-alone instruments; they are not applicable to instruments embedded in automated equipment for which the manufacturer’s instructions must be followed.

Inspector Instructions:

● Sampling of colorimeter/spectrophotometer policies and procedures
● Sampling of manufacturer required system checks

● How does your laboratory verify calibration curves?

CHM.22300 Absorbance/Linearity

Absorbance and/or fluorescence linearity is checked and recorded at least annually or as often as specified by the manufacturer, with filters or standard solutions.

Evidence of Compliance:
✓ Records of absorbance and linearity checks at required frequency

CHM.22400 Wavelength Calibration
Spectrophotometer (including ELISA plate readers) wavelength calibration, absorbance and linearity are checked at least annually (or as often as specified by the manufacturer), with appropriate solutions, filters or emission line source lamps, and the results recorded.

NOTE: Some spectrophotometer designs, e.g. diode array, have no moving parts that can alter wavelength accuracy and do not require routine verification. The manufacturer's instructions should be followed.

Evidence of Compliance:
✓ Records of wavelength calibration checks at required frequency

CHM.22500 Stray Light

Stray light is checked at least annually with extinction filters or appropriate solutions, if required by the instrument manufacturer.

Evidence of Compliance:
✓ Records of stray light checks at required frequency

**REVISED** 07/28/2015
CHM.22600 Calibration Curves

For procedures using calibration curves, all the curves are rerun at defined intervals and/or verified after servicing or recalibration of instruments.

NOTE: Calibration curves must be run following manufacturer's instructions, at minimum, and as defined in laboratory procedure.

Evidence of Compliance:
✓ Records of calibration curve rerun and/or verification at defined frequency

FLAME PHOTOMETERS

Inspector Instructions:

- Sampling of flame photometer policies and procedures
- Sampling of system cleaning
- Filters (clean, not scratched, not deteriorated)

**REVISED** 07/28/2015
CHM.22700 Filter Photometers

Filters (filter photometers) are checked at least annually to ensure they are in good condition (e.g. clean, free of scratches).

Evidence of Compliance:
✓ Records of filter checks at defined frequency
**Chemistry and Toxicology Checklist**

**CHM.22900 Burner/Chimney**

**Phase II**

**The burner, chimney and appropriate optical surfaces are checked for dirt and film and cleaned at defined intervals.**

**Evidence of Compliance:**

- Record of maintenance at defined frequency

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**GLASSWARE**

**Inspector Instructions:**

- Pipette verification procedure
- Sampling of pipette/dilutor checks

**ASK**

- What is your laboratory’s course of action prior to using non-certified volumetric glassware?

---

**CHM.23800 Glassware Accuracy**

**Phase II**

**Glass volumetric flasks are of certified accuracy (Class A, National Institute of Standards and Technology (NIST) Standard or equivalent) or if non-certified volumetric glassware is used, all items are checked for accuracy of calibration before initial use.**

**Evidence of Compliance:**

- Pipettes marked Class A OR NIST certificate OR validation study of accuracy for non-certified glassware

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**CHM.23900 Pipette Accuracy**

**Phase II**

**Glass volumetric pipettes are of certified accuracy (Class A); or they are checked by gravimetric, colorimetric, or some other validation procedure before initial use.**

**NOTE:** The following Table shows the American Society for Testing and Materials' calibration (accuracy) specifications for Class A volumetric pipettes:

Reconstitution of lyophilized calibrators, controls, or proficiency testing materials, or any other tasks requiring accurate volumetric measurement, must be performed only with measuring devices of Class A accuracy, or those for which accuracy has been defined and deemed acceptable for the intended use.

If initial calibration is performed by the manufacturer or other outside facility, sufficient information must be provided to justify acceptance of the pipette’s calibration based on the laboratory’s written specifications of acceptable bias and imprecision. The outside facility must also provide a record of the technique used to check calibration and ship the pipette in a manner that protects it from damage in transit.
## Nominal Capacity (mL) vs Variation (± mL)

<table>
<thead>
<tr>
<th>Capacity Range</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 - 2</td>
<td>0.006</td>
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<tr>
<td>3 - 7</td>
<td>0.01</td>
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<tr>
<td>8 - 10</td>
<td>0.02</td>
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<tr>
<td>15 - 30</td>
<td>0.03</td>
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<tr>
<td>40 - 50</td>
<td>0.05</td>
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<tr>
<td>100</td>
<td>0.08</td>
</tr>
</tbody>
</table>

### Evidence of Compliance:

- Pipettes marked Class A OR NIST certificate OR validation study of accuracy for non-certified pipettes

### REFERENCES


**REVISED** 07/28/2015

### CHM.24000 Pipette Accuracy - Non Class A Phase II

Non-class A pipettes that are used for quantitative dispensing of material are checked for accuracy and reproducibility at defined intervals (at least annually), and results recorded.

**NOTE:** Pipette checks must be performed following manufacturer’s instructions, at minimum, and as defined in laboratory procedure. Such checks are most simply done gravimetrically. This consists of transferring a number of measured samples of water from the pipette to a balance. Each weight is recorded, the weights are converted to volumes, and then means (for accuracy), and SD/CV (for imprecision) are calculated. Alternative approaches include spectrophotometry or (less frequently) the use of radioactive isotopes, and commercial kits are available from a number of vendors. Computer software is useful where there are many pipettes, and provides convenient records.

### REFERENCES


### CHM.24100 Measuring Devices Phase I

The use of less precise measuring devices such as serological plastic pipettes and graduated cylinders are limited to situations where the accuracy and precision of calibrated glass pipettes are not required.

**NOTE:** In contrast with the more stringent accuracy requirements of glass pipettes, ASTM requirements for plastic pipettes are ± 3% of the stated volume. The procedure manual should specify when the use of non-class A measuring devices is permissible.

### REFERENCES
**PIPETTES - FIXED VOLUME, ADJUSTABLE AND/OR MICROPIPETTES**

Pipettes and diluting devices of all types must be checked for accuracy and reproducibility before being placed in service and at least annually thereafter.

**Inspector Instructions:**

- Pipette calibration procedure
- Sampling of pipette/dilutor checks
- How are you assured your automatic pipetting systems exhibit no carryover effects?

**CHM.24200 Pipette Accuracy Phase II**

There is a written procedure defining how pipettes used for quantitative dispensing (fixed volume, adjustable volume, micropipettes, and analytic instruments with integral automatic pipettors) are checked for accuracy of calibration and reproducibility (gravimetric, colorimetric, volumetric or other verification procedure) before being placed in service initially, and the result recorded.

NOTE: The initial calibration may be performed by the manufacturer or other outside facility, but in such cases the laboratory must have a record from the manufacturer or other facility that includes the technique used to check calibration, the method of shipment to prevent damage in transit, and the bias and imprecision of the pipette(s). The bias and imprecision must meet the specifications established by the laboratory.

**REFERENCES**


**REVISED** 07/28/2015

**CHM.24300 Pipette Accuracy Phase II**

Pipettes used for quantitative dispensing are checked for accuracy and reproducibility (gravimetric, colorimetric, volumetric or other verification procedure) at defined intervals (at least annually), and results recorded.

NOTE: Pipette checks must be performed following manufacturer's instructions, at minimum, and as defined in laboratory procedure.
For analytic instruments with integral automatic pipettors, the accuracy and precision of the pipetting system should be checked at least annually, unless that is not practical for the end-user laboratory. Manufacturers’ recommendations should be followed.

REFERENCES
5) Johnson B. Calibration to dye for: Artel’s new pipette calibration system. Scientist. 1999;13(12):14

CHM.24400 Pipette Carryover Phase II

The laboratory evaluates its automatic pipetting systems for carryover.

NOTE: The laboratory must have written procedures for evaluating whether carryover effects are present. This requirement applies to both stand-alone pipette systems and to sample pipettes integrated with analytic instruments.

In practice, carryover is a problem only for analytes with a wide clinical range of analyte concentration, such that a minute degree of carry-over could have significant clinical implications. Examples include immunoassays such as β-HCG, certain enzymes (e.g. CK), and certain drugs of abuse (e.g. benzoylcegonine [cocaine metabolite], which may be present in high concentrations). The laboratory should select representative examples of such analytes for carryover studies.

Evaluation for carryover is not required for automatic pipettes that use disposable tips.

One suggested method to study carryover is to run known high patient samples, followed by known low samples to see if the results of the low-level material are affected. If carryover is detected, the laboratory must determine the analyte concentration above which subsequent samples may be affected, and define this value in the procedure. Results of each analytical run must be reviewed to ensure that no results exceed this level. If results that exceed the defined level are detected, then the appropriate course of action must be defined (repeat analysis of subsequent samples, for example).

Carryover studies must be performed, as applicable, as part of the initial evaluation of an instrument. (The laboratory may use the data from carryover studies performed by instrument manufacturers, as appropriate.) Carryover studies should be repeated after major maintenance or repair of the pipetting assembly of the instrument.

Evidence of Compliance:
✓ Record of carryover studies at defined frequency

REFERENCES
ANALYTICAL BALANCES

Inspector Instructions:

- Sampling of balance service records
- Sampling of balance accuracy check records
- Analytical balances (mounting)
- Standard weights (maintained, appropriate class)

CHM.25300  Balance Maintenance  Phase I

Balances are cleaned, serviced and checked at least annually only by qualified service personnel (i.e. service contract or as needed).

Evidence of Compliance:
✓ Records of balance maintenance

CHM.25400  Balance Mounting  Phase I

Analytical balances are mounted such that vibrations do not interfere with readings.

**REVISED** 07/28/2015

CHM.25500  Analytical Balance Accuracy  Phase II

Standard weights of the appropriate ANSI/ASTM Class are available and used for verifying accuracy of analytical balances at defined intervals, with records maintained.

NOTE: The verification of accuracy of the analytical balance must be performed on a regular schedule to ensure accurate creation of analytical calibrators and/or weighed-in controls from standard materials, as well as when gravimetrically checking the accuracy of pipettes.

Accuracy must be verified at least every six months if used for weighing materials to make standard solutions for method calibration. Accuracy must be verified at the time of installation and whenever a balance is moved. Acceptable ranges must be defined.

External verification of accuracy requires the appropriate class of ASTM specification weights.
ASTM Class 1 weights are appropriate for calibrating high precision analytical balances (0.01 to 0.1 mg limit of precision).
ASTM Class 2 weights are appropriate for calibrating precision top-loading balances (0.001 to 0.01 g precision).
ASTM Class 3 weights are appropriate for calibrating moderate precision balances, (0.01 to 0.1 g precision).

Evidence of Compliance:
✓ Written procedure defining criteria for the use of standard weights for accuracy checks of analytical balances

REFERENCES
Weight Maintenance

Weights are well-maintained (clean, in a covered container, not corroded) and appropriate lifting or handling devices are available.

NOTE: Weights must be well-maintained (covered when not in use, not corroded) and only be handled by devices that will not allow residual contaminants to remain on the masses. Certified masses will only meet their specifications if maintained in pristine condition.

PERSONNEL

Inspector Instructions:

- Records of education and experience

CHM.25800  Bench Testing Supervision

The person in charge of bench testing/section supervisor in chemistry has education equivalent to an associate's degree (or beyond) in chemical, physical or biological science or medical technology and at least four years experience (one of which must be in clinical chemistry) under a qualified section director.

Evidence of Compliance:

✓ Records of qualifications including degree or transcript, current license (if required) and work history in related field

CHM.25900  Bench Testing Supervision

The person in charge of bench testing/section supervisor in toxicology has education equivalent to an associate's degree (or beyond) in chemical, physical or biological science or medical technology, and at least four years experience (one of which must be in toxicology) under a qualified section director.

Evidence of Compliance:

✓ Records of qualifications including degree or transcript, current license (if required) and work history in related field

CHM.25950  Bench Testing Supervision

The person in charge of bench testing/section supervisor in the blood gas section has education and experience equivalent to an associate's degree (or beyond) in a chemical, physical or biological science or medical technology (or certified or registered respiratory therapist) and at least four years experience (one of which must be in blood gas testing) under a qualified section director.

Evidence of Compliance:

✓ Records of qualifications including degree or transcript, current license (if required) and work history in related field
LABORATORY SAFETY

The inspector should review relevant requirements from the Safety section of the Laboratory General checklist, to assure that the chemistry laboratory is in compliance. Please elaborate upon the location and the details of each deficiency in the Inspector's Summation Report.

RADIATION SAFETY

Inspector Instructions:

**READ**
- Sampling of radiation safety policies and procedures
- Sampling of radiation area surveys/wipe tests records
- Sampling of radioactive waste disposal records
- Sampling of personnel records of radionuclide training

**OBSERVE**
- Radionuclide storage areas (properly shielded)
- Appropriate signage where radioactive materials are used/stored

**ASK**
- Does your laboratory have representation at radiation safety committee meetings?
- How does your laboratory check the effectiveness of workbench decontamination?

CHM.27900  Radiation Safety Manual  
**Phase II**

There is an up-to-date radiation safety manual that includes sections on decontamination and radioactive waste.

*NOTE: For US laboratories, this is required by the Nuclear Regulatory Commission (NRC).*

REFERENCES

CHM.28000  Workspace Decontamination  
**Phase II**

Workbenches and sinks are decontaminated each day of use, and the effectiveness tested at least monthly.

*NOTE: If the laboratory uses only iodine-125 either a wipe test or a portable scintillation probe can be used.*

Evidence of Compliance:
- ✓ Records of daily workbench/sink decontamination **AND**
- ✓ Records of monthly effectiveness tests
CHM.28100 Radionuclides Handling

There are written policies regarding authorization or restriction of personnel handling radionuclides.

NOTE: These policies should be incorporated into the department's radiation safety manual.

CHM.28200 Radionuclide Leak

There are written procedures for notification if a damaged or leaking radionuclide shipment is received.

NOTE: Procedures must include inspection, monitoring of shipments, and instructions for notification, if leakage or damage is noted in a radionuclide shipment.

Evidence of Compliance:
✓ Records of inspections and notifications

REFERENCES

CHM.28300 Radionuclide Storage

Radionuclide storage and decay areas are properly shielded, if required for specific isotopic materials.

NOTE: Radionuclide storage and decay areas must be properly shielded, if required for specific isotopic materials, to avoid excessive exposure to personnel and interference with counting procedures.

Evidence of Compliance:
✓ Written procedure defining shielding requirements for radionuclide storage and decay areas

CHM.28400 Radiation Surveys

There are regular radiation area surveys and wipe tests, with records maintained.

NOTE: Routine radiation surveys and wipe tests to determine exposure rates and detect contamination must be performed and recorded at defined frequency.

Evidence of Compliance:
✓ Written procedure defining frequency of radiation survey and wipe tests to determine exposure rates and detect contamination

CHM.28500 Radioactive Material Sign

All areas or rooms where radioactive materials are being used or stored are posted to indicate the presence of radioactive materials.
NOTE: For US laboratories, all areas or rooms where radioactive materials are being used or stored must be posted to indicate the presence of radioactive materials, consistent with 10CFR20, Appendix C.

REFERENCES

CHM.28600 Radionuclide Training
Phase II

Personnel receive training in decontamination routines and in the safe handling and proper disposal of radionuclides (wastes, syringes, needles, and sponges) with records maintained.

CHM.28700 Radioactive Waste
Phase II

Radioactive waste is stored separately, under required conditions, and appropriately discarded, with records maintained.

NOTE: Records of the radioactive trash disposal must be maintained. For US laboratories, NRC regulations specify that separate areas be established for the receipt of radioactive waste and that these areas be properly shielded to reduce radiation levels below those maximum permissible limits specified in 10CFR20.

Evidence of Compliance:
✓ Written procedure defining criteria for proper storage and disposal of radioactive waste

REFERENCES

CHM.28800 Safety Committee Representation
Phase II

There are records indicating that a laboratory representative is a member of and/or attends institutional radiation safety committee meetings regularly.

NOTE: Independent laboratories must have a radiation safety officer who fulfills the functions of an institutional radiation safety committee.

Evidence of Compliance:
✓ Records of laboratory participation in institutional Safety Committee meeting OR participation in other appropriate group responsible for radiation safety

GENERAL CHEMISTRY

CHEMISTRY

THERAPEUTIC DRUG MONITORING

Inspector Instructions:
• Sampling of TDM policies and procedures
• Sampling of TDM patient reports (dosage, time of drug administration)
How is the clinician able to link TDM laboratory results to the dosage and time the patient received the drug?

**CHM.28900 Specimen Collection/Drug Dosing**

**Phase I**

As applicable, the laboratory has provided information to clinical personnel of the optimal specimen collection time in relation to drug dosing.

**Evidence of Compliance:**
✓ Written procedure defining criteria for specimen collection for TDM

**REFERENCES**

**CHM.29000 TDM Results**

**Phase II**

Where applicable, TDM results are reported in relation to patient dosing and/or timing information.

**NOTE:** The intent is to have a mechanism whereby the clinician can easily and accurately link TDM results from the laboratory to the dosage and time of drug administration. Ideally, the test result, dose and administration time would be reported in juxtaposition on the patient chart. This may be the responsibility of the laboratory, or an integrating function of reported laboratory analytic data with clinical information from other sources.

**Evidence of Compliance:**
✓ Written procedure defining criteria for reporting TDM results

**REFERENCES**

**NEW** 07/28/2015

**CHM.29025 Immunosuppressive Drug Result Reporting**

**Phase II**

For the reporting of immunosuppressive drug results, the patient report contains all of the following:

1. Appropriate therapeutic ranges based on the test method used
2. Analytical method (all tests) and method platform (immunoassays only)
3. Elements required in GEN.41096

**NOTE:** For immunosuppressive drugs (e.g. cyclosporine, sirolimus, tacrolimus, mycophenolic acid, everolimus), the therapeutic range may depend upon the test method, type of transplant, and length of time since the transplant procedure. Results from different types of samples and different methods are not interchangeable.

**Evidence of Compliance:**
✓ Written procedure for reporting immunosuppressive drug results AND
✓ Patient results showing required report elements
SWEAT TESTING FOR CYSTIC FIBROSIS

The laboratory diagnosis of cystic fibrosis includes SCREENING and CONFIRMATORY sweat testing. Screening tests include: sweat conductivity, cystic fibrosis indicator patch system, Orion skin measuring electrode, and sweat osmolality. Confirmatory tests include quantitative analysis of sweat chloride.

SPECIMEN COLLECTION AND HANDLING

Inspector Instructions:

- Sampling of sweat testing policies and procedures
- Sampling of records/log of insufficient sweat samples
- Sampling of iontophoresis unit maintenance records

- An employee performing the sweat collection procedure, if possible

- How do you ensure effective disinfection of the sweat collection equipment?
- What is your course of action if the patient is receiving oxygen from an open delivery system?

NOTE: To increase the likelihood of collecting an adequate sweat specimen, sweat chloride testing can be evaluated in asymptomatic newborns with a positive newborn screen result when the infant is at least two weeks of age and weighs >2kg.

In symptomatic newborns (e.g. those with meconium ileus), sweat chloride can be evaluated as early as 48 hours after birth if an adequate sweat volume can be collected; although, the likelihood of an inconclusive result may be greater at this age.

Evidence of Compliance:

✓ Written policy defining criteria for sweat testing OR collection manual that includes parameters for patient age

REFERENCES


The laboratory reviews the procedures employed for disinfection of equipment and facilities used for sweat collection at least biennially.

**NOTE:** The purpose of this review is to assure continued effectiveness. One suggested approach is biennial evaluation by the infection control department of the institution.

**Evidence of Compliance:**
✓ Written procedure for disinfection of equipment and facility

**CHM.29200 Sweat Collection and Analysis Procedure**

The laboratory follows generally accepted procedures for sweat collection and analysis, including steps to minimize sample evaporation or contamination.

**Phase II**

**NOTE:** Because sample evaporation and contamination can have significant impact on the validity of test results, laboratories must incorporate the following steps into their procedure and/or follow manufacturer’s recommendations:

**A. When using gauze or filter paper collection pads:**

1. Use gauze and/or filter paper that is low in electrolyte content
2. Wash the patient's skin thoroughly with distilled or deionized water, then dry before stimulation. Repeat after stimulation and before collection
3. Do not touch the weighing vial, wax film, collection site, or collection pad. Always use forceps or powder-free gloves
4. Use two pieces of waterproof adhesive tape on all sides of the paraffin wax film or wrap with a disposable stretch bandage to produce an airtight seal
5. Blot back into the collection pad any condensate that may have formed on the wax film during collection. Failure to collect the condensate can result in false positive test results
6. After collection, quickly transfer the specimen pad to the weighing vial and reweigh promptly

**B. When collecting sweat into Macroduct coils:**

1. Wash the patient's skin thoroughly with distilled, deionized water. Leave the skin slightly wet after washing the area where the electrode will be attached or add a drop of distilled or deionized water to either the skin or the Pilogel surface (after installation in the electrode). Repeat after stimulation and before collection
2. Avoid touching the collecting surface of the coil
3. Fasten the collector to the extremity with firm strap pressure. Test for proper attachment after sweat appears in the coils
4. Do not attempt to remove the entire collector assembly from the patient's extremity before separating the coil from the main body. Loss of specimen may occur
5. Do not contaminate the nippers or sweat dispensing needle with sweat sample

**C. When collecting and analyzing sweat using the Nanoduct system:**

1. Wash the patient's skin thoroughly with distilled, deionized water. Leave the skin slightly wet after washing the area where the electrode will be attached or add a drop of distilled or deionized water to either the skin or the pilogel surface (after installation in the electrode). Repeat after stimulation and before collection
2. Avoid touching the collecting surface of the device

**Evidence of Compliance:**
✓ Written procedure defining criteria for sweat collection and analysis including required elements OR other procedure following manufacturer's recommendations
REFERENCES

CHM.29300 Sweat Stimulation Phase II

The protocol requires sweat stimulation and collection from the patient’s lower arm or upper leg, using a site that is free from diffuse inflammation or rash.

NOTE: The protocol should require that sweat is stimulated and collected from the patient’s lower arm or upper leg. Sweat must not be stimulated or collected from the head or trunk. Sweat must not be stimulated or collected from an area of diffuse inflammation, such as a rash or eczematous lesion, because of the likelihood of contamination by serous fluid.

REFERENCES

CHM.29400 Pilocarpine Grade Phase II

If the laboratory prepares the pilocarpine solution for iontophoresis, the source of the pilocarpine is USP grade or equivalent.

CHM.29500 Electrode Placement Phase II

The protocol requires that the electrodes used for stimulation are placed such that iontophoretic current never crosses the patient’s trunk.

NOTE: The protocol must specify that electrodes used for stimulation be placed so that current does not cross the trunk, to avoid the possibility of current crossing the heart, resulting in cardiac depolarization.

**REVISED** 07/28/2015

CHM.29600 Iontophoresis Conditions and Equipment Maintenance Phase II

The written procedure specifies the conditions of iontophoresis and maintenance requirements.

NOTE: For safety reasons, the iontophoretic current source must be battery-powered, to avoid the possibility of patient exposure to line voltage. For manually controlled devices, iontophoresis must be performed for no more than five minutes at a current less than 4 mA, to prevent burns. The iontophoresis unit must be tested by qualified personnel (such as engineering personnel) for current leakage and current control at defined frequencies and records maintained.

CHM.29700 Iontophoretic Stimulation Phase II

The protocol specifies that iontophoresis is withheld from patients receiving oxygen by an open delivery system.

NOTE: While the possibility of an explosion due to the generation of an electrical spark is remote, it cannot be ignored. Often, these patients can temporarily receive oxygen via a facemask or nasal cannula, in which case sweat testing can be done.

CHM.29800 Iontophoretic Stimulation Phase II
The procedure specifies that the area of iontophoretic stimulation is equivalent to the area of sweat collection.

NOTE: The procedure must specify that the area of iontophoretic stimulation is equivalent to the area of sweat collection. Sweat electrolyte concentration is related to sweat rate. At low sweat rates, sweat electrolyte concentration decreases. The average sweat rate should exceed 1 g/m²/min.

To ensure adequate sweat stimulation and accurately reflect sweat electrolyte concentration, a minimum acceptable sweat volume or weight is required. This requirement is based on the size of the electrode and stimulation area, the type and size of collecting media, and the duration of sweat collection. To standardize the process, the stimulation and collection area should be equivalent, and the time of collection consistent. For example, for the positive electrode, use a 1 ½ inch x 1 ½ inch electrode over a 2 x 2 inch gauze pad saturated with pilocarpine for stimulation, then collect sweat onto a 2 x 2 inch pre-weighed gauze pad.

REFERENCES

CHM.29850 Appropriate Sweat Collection Device Phase II

The sweat collection device is appropriate for the iontophoresis system.

NOTE: The sweat collection device must be designed for use with the appropriate iontophoresis system so that the stimulation and collection area are equivalent and the appropriate minimum acceptable sweat volume or weight can be achieved. Examples of acceptable combinations include:

- Stimulation with Wescor Pilogel iontophoresis and collection into Wescor Macroduct coils
- Stimulation with copper electrodes over gauze/filter paper pilocarpine pads and collection into gauze/filter paper
- Stimulation and collection into Wescor Nanoduct conductivity cell

Examples of unacceptable combinations include:

- Stimulation with Wescor Pilogel iontophoresis and collection into gauze/filter paper
- Stimulation with Polychrome iontophoresis and collection into Wescor Macroduct coils, gauze or filter paper
- Stimulation with copper electrodes over gauze/filter paper pilocarpine pads and collection into Wescor Macroduct coils

REFERENCES
2) Cystic Fibrosis Foundation Center Accreditation Guidelines. Bethesda, MD, 2004

CHM.29900 Sweat Collection Time Phase II

The procedure specifies that sweat collection time may not exceed 30 minutes.

NOTE: Extending the collection time will not significantly increase the sweat yield and may lead to sample evaporation. Samples may be taken from less than maximally stimulated glands. This may lead to a false-negative result. In addition, altering the collection time will affect the minimum
acceptable sweat weight or volume, because the time parameter of the rate equation has been changed.

Evidence of Compliance:
✓ Written procedure for sweat collection

CHM.30000 Sweat Collection Parameters

The protocol specifies the parameters of sweat collection.

NOTE: These must include an established minimum acceptable sweat volume or weight based on the area of stimulation, area of collection and standardized time for collection. The average sweat rate should exceed 1 g/m²/min, which in general corresponds to a minimum sample weight of about 75 mg of sweat collected on a 2x2 inch gauze or filter paper and about 15 µL of sweat collected in Macroduct coil in 30 min. Samples less than the required volume or weight must not be analyzed.

REFERENCES

CHM.30100 Sweat Sample Rejection

The procedure specifies that multiple insufficient sweat samples are rejected and not pooled for analysis.

NOTE: The laboratory must reject individual samples that do not meet minimum sample size requirements. The average sweat rate of 1 g/m²/min is determined independently for each site. The requirement is a physiologic one, not an analytic one. Samples less than the required volume or weight must not be pooled to achieve the weight/volume requirement. Measurement on samples from less than maximally stimulated sweat glands may lead to false-negative results.

Evidence of Compliance:
✓ Records of specimen rejection

CHM.30150 Sweat Rejection Incidence Rate

The incidence of insufficient sweat samples is routinely monitored.

NOTE: Laboratories should collect data on the number of patients from whom a sufficient sweat sample has not been obtained. For patients older than three months of age, the annual insufficient rate should not exceed 5%. For patients three months of age or younger, the rate of insufficient samples should not exceed 10%. If these rates are exceeded, the collection procedure should be reevaluated for consistency with the CLSI document C34-A3. The most common cause of insufficient samples is the use of inappropriate collection devices (see CHM.29850).

Evidence of Compliance:
✓ Records of insufficient collection AND
✓ Records of corrective action if rate exceeds the norm

REFERENCES
1) Cystic Fibrosis Foundation Center Accreditation Guidelines. Bethesda, MD, 2009

CHM.30250 Sweat Sample Storage

The procedure describes appropriate storage conditions for collected sweat samples.
NOTE: If there is a significant delay between collection and analysis, appropriate storage conditions must be followed: a) Sweat collected on gauze is stable at refrigerator temperatures for up to 72 hours once reweighed and secured in a vial with a tightly fitting cap; and b) Sweat collected in Macroduct is stable at refrigeration or room temperature for up to 72 hours in a 0.2 mL microcentrifuge tube with a tight fitting cap. Storage of sweat in microbore tubing is not recommended.

REFERENCES
1) Cystic Fibrosis Foundation Center Accreditation Guidelines. Bethesda, MD, 2009

CHM.30300 Sweat Collection Skin Reaction Phase II

The procedure describes the recognition of, and appropriate treatment for, patient skin reactions (allergic or burns) to pilocarpine and/or other reagents used in iontophoresis.

NOTE: Rarely, some patients may develop an area of, urticaria (hives) or small localized burns. In such cases, the procedure must be discontinued immediately and appropriate medical attention obtained. Sweat must not be collected over areas of urticaria or burns.

Evidence of Compliance:
✓ Records of follow-up treatment

ANALYTIC METHODS FOR SWEAT TESTING

Inspector Instructions:

• Sweat testing method validation records
• Sampling of QC logs

CHM.30400 Sweat Test Validation Phase II

For sweat testing, the analytical method is validated by the laboratory prior to patient testing using specimens equivalent to the volume and concentration of patient sweat samples.

NOTE: Validation procedures must include studies of accuracy, precision, and upper/lower limits of the analytic measurement range. The laboratory should be aware that some instruments designed for serum or urine electrolyte determination may lack the sensitivity required for sweat testing.

Evidence of Compliance:
✓ Written procedure defining criteria for validation of the analytical method AND
✓ Records of method validation study(ies)

REFERENCES
1) Pillion DJ, Meccan E. Chloride measurement by microelectrode in cystic fibrosis and normal sweat. Miner Electrolyte Metab. 1987;13:196-200
CHM.30550  Sweat Chloride AMR  

The lower limit of the sweat chloride analytical measurement range is less than or equal to 10 mmol/L.

NOTE: The lower limit of the sweat chloride analytical measurement range must be less than or equal to 10 mmol/L without any dilution, concentration or other pretreatment that is not part of the usual assay procedure.

REFERENCES
1) Cystic Fibrosis Foundation Center Accreditation Guidelines. Bethesda, MD, 2009

CHM.30575  Confirmatory Sweat Test Report  

If the test performed is a confirmatory test (i.e. quantitative analysis of sweat chloride), the upper limit of AMR for sweat chloride results is less than or equal to 160 mmol/L.

NOTE: Even though the analytical instrument may have a higher upper limit of its AMR, sweat chloride concentrations > 160 mmol/L are not physiologically possible. Results of sweat chloride testing greater than 160 mmol/L must not be reported, and the patient must be retested.

Evidence of Compliance:
✓ Patient reports or worksheets

REFERENCES

CHM.30600  Daily QC - Sweat Testing  

The laboratory analyzes two levels of controls (one in the negative range and one in the positive range) at least once each day patient specimens are assayed.

NOTE: If sweat is collected from patients on gauze or filter paper, controls should be placed directly onto the same collection material, eluted, and treated in the same manner as a patient specimen.

For test systems with internal controls, the laboratory may limit daily quality control to the internal controls ONLY if all CAP requirements for internal controls are met, as listed in CHM.13900.

Evidence of Compliance:
✓ Written QC procedure AND
✓ Records of QC results at defined frequency

REFERENCES
REPORTING OF RESULTS

**Inspector Instructions:**

- Sampling of sweat analysis reports (appropriate reference ranges and disclaimer if applicable)

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**CHM.30700 Sweat Test Reporting**

The laboratory report indicates the specific analytes measured in the sweat analysis, and applies the appropriate reference ranges and/or decision levels to patient results.

**NOTE:** The laboratory report must clearly indicate the analytes measured in the sweat test, and apply the appropriate reference intervals and/or decision levels to patient results. Osmolality and conductivity are nonselective methods for sweat analysis; they are not equivalent to sweat chloride concentrations and therefore have their own unique set of reference ranges. When sweat conductivity is expressed as units of aqueous sodium chloride solution, the values are approximately 15 mmol/L higher than when chloride is measured directly.

The Cystic Fibrosis Foundation reference intervals for chloride and conductivity are:

**SWEAT CHLORIDE:** For infants up to and including six months of age: less than or equal to 29 mmol/L, CF unlikely; 30-59 mmol/L, intermediate; greater than or equal to 60 mmol/L, indicative of CF. For individuals older than six months of age: < 40 mmol/L, CF unlikely; 40-59 mmol/L, intermediate; > 60 mmol/L, indicative of CF. The result must be interpreted with regard to the patient's age and clinical presentation.

**SWEAT CONDUCTIVITY:** A patient having a sweat conductivity greater than or equal to 50 mmol/L should be referred to a specialized cystic fibrosis care center for a quantitative analysis of sweat chloride with or without sweat sodium.

**SWEAT OSMOLALITY:** 50-150 mmol/kg, negative; 151-200 mmol/kg, equivocal; > 200 mmol/kg, positive for cystic fibrosis.

**REFERENCES**


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**CHM.30800 Sweat Test Report Disclaimer**

If the test performed is a screening test (e.g. sweat conductivity, CF Indicator patch system, Orion skin measuring electrode, etc.), the report includes a statement regarding the limits of clinical interpretation.

**NOTE:** Suggested wording for such a disclaimer might be: “This result represents a screening test for cystic fibrosis. Patients having borderline or positive results should be referred for a quantitative sweat chloride concentration.”

**REFERENCES**

PRENATAL SCREENING

TEST PANELS

Test panels include: 1) Second trimester quadruple panel: maternal serum alpha-fetoprotein (MSAFP), unconjugated estriol (uE3), and beta-human choric gonadotropin (beta-hCG) and dimeric inhibin-A (DIA); 2) First trimester panel: total or free beta-hCG, pregnancy associated placental protein A (PAPP-A), and nuchal translucency (NT); 3) Sequential and integrated panels: various combinations of first and second trimester tests

REQUISITIONS/CALCULATIONS/REPORTS

Requests for prenatal screening (neural tube defects, Down syndrome, etc.) must include specific information for meaningful interpretation of laboratory tests. For clinical screening purposes, analyte concentrations must be converted to multiple of the median (MoM) values, using gestational-age specific medians. The MoM value is used directly as the interpretative result for neural tube defect screening and for calculating risk for fetal trisomies. Gestational age-specific MoM values need to be adjusted for each patient, based on several variables. The laboratory must work cooperatively with the clinician to ensure that all necessary information is obtained.

Inspector Instructions:

- Sampling of prenatal screen policies and procedures
- Sampling of prenatal screening requisitions for required elements
- Sampling of median value records
- Sampling of records verifying calculated gestational age, maternal age and patient-specific risks
- How does your laboratory verify or establish acceptable median values?
- How does your laboratory monitor assay quality, appropriateness of medians and accuracy of gestational dating?
- What is your course of action if the requisition does not include all necessary information?

CHM.31100 Prenatal Screen Requisitions

Prenatal screening requisitions solicit the first day of the last menstrual period (LMP), the estimated date of confinement (EDC), or estimated gestational age by ultrasound dating.

NOTE: Accurate screening requires that the laboratory know the clinician’s best estimate of the gestational age at the time of the specimen collection. The gestational age allows determination of the best median values for a given screen. The optimum time for neural tube defect detection using MSAFP measurements is between 16-18 weeks gestation.

REFERENCES

Prenatal screening requisitions solicit maternal birth date.

NOTE: Maternal birth date must be included as part of the test requesting process. Maternal age is not necessary when screening for neural tube defects, but is needed to calculate the patient-specific risk for Down syndrome. The patient-specific risk, not the analyte concentration, is used as the screening variable to identify pregnancies at high-risk for Down syndrome.

REFERENCES

CHM.31300  Prenatal Screen Requisitions  Phase II
Prenatal screening requisitions solicit patient race.

NOTE: Patient race must be included as part of the test requesting process.

Both MSAFP and hCG values in black women are approximately 10% to 15% higher than in Caucasian women. Depending upon the racial distribution of the patient population, the laboratory should either have separate MSAFP medians for blacks if enough data is available and Caucasians, or apply an appropriate correction factor for patients from the less common races. Black women also have a lower birth prevalence of neural tube defects, and some screening programs raise the MoM cut-off to take this difference into account (after adjusting the AFP MoM value).

ue3 levels are similar in the two racial groups, ue3 medians need not be adjusted.

DIA medians in blacks are approximately 8% lower than those in Caucasians, and adjustment is recommended.

PAPP-A values are approximately 25% higher in black women, therefore medians should be adjusted.

Current data indicate that statistically significant differences in median values exist for other races and ethnic groups (e.g. Hispanic, Asian, Native American). Most differences tend to be small and do not materially affect the risk calculations for Down syndrome and neural tube defects. However, laboratories that screen large numbers of women may consider using median values specific to ethnic or racial groups if significant differences are identified in their screening population.

REFERENCES

CHM.31400  Prenatal Screen Requisitions  Phase II
Prenatal screening requisitions solicit maternal weight.

NOTE: Maternal weight must be included as part of the test requesting process. The average concentration of all of the analytes used for second trimester screening decreases with increasing maternal weight. Heavier women have lower analyte values, and lighter women have higher levels. This is presumably due to a greater maternal blood volume in the former group. The influence of weight adjustment on neural tube defects screening is small, but
adjustment aids in equalizing false positive and false negative rates in all weight categories. The concentration of first trimester markers also decrease with increasing maternal weight; the relationship between PAPP-A and maternal weight is greater than for any other marker. All first trimester markers should be adjusted for maternal weight. Laboratories can utilize published weight correction equations until sufficient data are collected to establish correction equations using in-house patient data. The linear-reciprocal equation model allows the correction equation to apply to a broader range of maternal weights than the log-linear model and only requires approximately 1000 data points for calculation.

REFERENCES

CHM.31500 Prenatal Screen Requisitions

Prenatal screening requisitions solicit a history of the patient receiving medication (e.g., insulin) to control diabetes at the time of conception.

NOTE: A history of insulin-dependent diabetes mellitus (IDDM) at the time of conception must be included as part of the test requesting process. Pregnant women who have diabetes prior to conception have 12% lower MSAFP levels than nondiabetics of the same gestational age, but have a higher birth prevalence of neural tube defects. If medians derived from nondiabetic women are used to screen women with IDDM, the percentage of women with values exceeding the laboratory's MoM screening cut-off will be inappropriately low, resulting in a lower detection rate. Conversely, if medians from nondiabetic women are used for screening pregnancies from women with IDDM for Down syndrome, the AFP MoM values calculated using non-diabetic medians will be inappropriately low, resulting in an increased number of patients in the screen positive group. Differences are slight for the other analytes. uE3 is 8% lower, second trimester hCG is 5% lower, and DIA is 9% lower in pregnant women with DM. Adjustment for these analytes is optional. PAPP-A and first trimester hCG are not significantly different in DM, and adjustment is not recommended for these analytes. There is no consensus whether correction for gestational diabetes is warranted.

REFERENCES
2) Kucera J. Rate and type of congenital anomalies among offspring of diabetic women. J Reprod Med. 1979;7:61-70

CHM.31600 Prenatal Screen Requisitions

Prenatal screening requisitions solicit clinical evidence of multiple gestations (twins, etc.).

NOTE: Clinical evidence of multiple gestations (twins, etc.) must be included as part of the test requesting process. Women with ultrasonographically confirmed twin pregnancies have, on average, twice the level of MSAFP than that seen in women with singleton pregnancies at the same gestational age. Most laboratories use a screening cutoff level for twin pregnancies between 3.5 and 5.0 MoM, or divide the MoM by two and use an adjusted cutoff level as for singleton pregnancies. However, screening for neural tube defects in twin pregnancies is less efficient than singleton pregnancies. Approximately 50% of twin pregnancies with an open neural tube defect and 5% of unaffected twin pregnancies have a MoM of 4.5 or greater. If twin pregnancies are to be screened for Down syndrome, laboratories need to calculate risks using a method specifically designed for this application. hCG and DIA levels are also approximately twice as high in twin pregnancies, while uE3 levels in twin pregnancies are approximately 1.7 times as high as in singleton pregnancies. There are few data on analyte concentrations
from twin pregnancies with one or both fetuses affected with Down’s syndrome; therefore, only “pseudo risks” can be calculated. Pseudo risks are less reliable than those calculated for singleton pregnancy and some laboratories choose not to report the actual risk, but only report specimens as screen negative or screen positive. Insufficient data are available to calculate Down syndrome risk in pregnancies with three or more fetuses.

REFERENCES

CHM.31700 Prenatal Screen Requisitions

Phase I

The test requisitions ask if this is the initial screening sample or a repeat test for this pregnancy.

NOTE: The interpretation of a repeat maternal serum sample may be different from the interpretation of an initial serum specimen. In neural tube defect screening using AFP, a repeat sample can be interpreted as if it were an initial sample if fixed MoM cut-offs are used to identify high-risk women. If patient-specific risks are calculated for a repeat test result, one should combine the results of both the initial and repeat sample, using published algorithms. Repeat testing is not recommended for Down syndrome screening unless a sample is drawn too early for reliable interpretation. If a test on a second sample is performed, it is essential that the revised risk be calculated using the results from both samples. A method has been published for these calculations.

REFERENCES

CHM.31800 Median Values

Phase II

There is a record that the laboratory has established its own median values or verified that the medians from another source are appropriate for the population being screened.

NOTE: Systematic biases in maternal serum assay values of up to 30% can occur when kits from different manufacturers are used. In addition, between laboratory differences in equipment, reagents, and technique may introduce bias in assay results even when the same kit lot is used. These differences can be minimized by reporting results in multiples of the normal median (assuming that the medians are calculated using values measured on the population to be tested using the kit designated for screening). Ideally, week-specific medians would be established by testing approximately 100 patients per week of gestation. Because analytes are stable, it is possible to use stored frozen specimens collected over a period of years. A second approach is to perform a split specimen study with a reference laboratory and transfer the reference laboratory’s medians using the comparison regression equation from the split specimen study. However, in practice the most practical method is to measure values on 300 consecutively collected specimens spread over the appropriate gestational age range, and perform weighted regression analysis using published models. It is not necessary to document that all specimens are collected from unaffected pregnancies. Smoothing data by weighted regression analysis allows median values to be calculated for weeks with limited data. Package insert medians may be outdated or inappropriate and should not be used even for a short time. Incorrect reference data may lead to inappropriate recommendations in the laboratory report.
Evidence of Compliance:
✓ Records for median value determination OR records for verification of package inserts or other sources

REFERENCES

CHM.31900 Median Value Reverification

Medians are reverified at specified intervals and when new reagent lots are introduced, and the medians are recalculated if necessary.

NOTE: Changing reagent lots can introduce significant bias. One method for assessing a new lot is performing a split specimen comparison study between the new and old lot.

In addition, re-evaluation of medians at specified intervals is a valuable quality control mechanism to ensure validity of reported MoMs. Epidemiological monitoring of Down syndrome screening can be accomplished by determining the median MoMs at frequent intervals (e.g. every 500-1000 patients, weekly or monthly). If a persistent shift is noted, (less than 0.95 or greater than 1.05), new medians should be determined. Records of the median MoMs must be maintained.

Evidence of Compliance:
✓ Written procedure defining criteria and frequency for recalculation or reverification of median values AND
✓ Records of median value recalculation or reverification data at defined frequency

REFERENCES

CHM.31950 Establishing Nuchal Translucency (NT) Measurements

If screening panels are offered using nuchal translucency (NT) values, the laboratory should have a written procedure for their establishment and use.

NOTE: Some potential content of these procedures might include:
● Requirements for verifying the credentialing of each sonographer
● Having sonographers provide a set number of NT/CRL measurements prior to initial interpretations
● Implementing sonographer-specific medians when the median NT MoM levels are outside of set limits
● Reviewing data for sonographers available from certifying organization (e.g. NT Quality Review Program - NTQR (https://ntqr.org) or the Fetal Medicine Foundation - FMF (http://fetalmedicineusa.com)
● Establishing communication with sonographers to inform them of monitoring results
● Establishing communications with credentialing organizations to inform them of sonographer performance
Evidence of Compliance:
✓ Written procedure defining criteria for establishing a new sonographer AND
✓ Records of sonographer establishment

REFERENCES

CHM.31960 Nuchal Translucency (NT) Measurements, Monitoring

Phase I

If screening panels are offered using nuchal translucency (NT) values, the laboratory should routinely perform epidemiological monitoring of these measurements.

NOTE: An example of such a monitoring procedure (with action limits) is provided below. For each sonographer with sufficient data (typically at least 30 to 50 measurements over six months), monitor and provide limits for three quality parameters.

● Percent increase in NT measurements (in mm) by gestational age (e.g. 15% to 35%)
● The NT median MoM (e.g. 0.90 to 1.10)
● The distribution of NT MoMs after a logarithmic transformation (log standard deviation), (e.g. 0.08 to 0.13)

Evidence of Compliance:
✓ Records of NT median data study(ies) AND
✓ Records of review at defined frequency

REFERENCES

CHM.32000 Screen Result Statistics

Phase II

The percentages of women with screen-positive test results for neural tube defects (NTD), Down syndrome, and Trisomy 18 are calculated and reviewed at least quarterly.

NOTE: Data from large studies provide guidelines for the percentage of pregnancies that will fall above specified maternal serum AFP MoM levels (NTD screening) or with risks greater than specified risk cutoff levels (Down syndrome screening). Regular comparison of a laboratory’s screen-positive rates with expected rates serves as a continuing measure of assay quality, appropriateness of medians, and accuracy of gestational dating.

Evidence of Compliance:
✓ Written procedure defining criteria for comparison of screen-positive tests to expected rates to include frequency of analysis AND
✓ Records of statistical analysis and evaluation of screen-positive test results at least quarterly

REFERENCES
If the laboratory adds dimeric inhibin A (DIA) (or another marker) to its screening panel, it has followed the same requirements outlined for established markers.

NOTE: Many screening laboratories have added a fourth marker, dimeric inhibin A, to the triple test. If so, the laboratory must demonstrate that it adheres to the checklist items outlined for established markers in the Prenatal Screening section. These include establishing median values appropriate for the population being screened, and adjusting where appropriate for variables that have been shown to influence analyte values, such as maternal weight, maternal race, insulin dependent diabetes, and twin pregnancy. Laboratories must verify that the risks calculated using the additional marker are valid.

Evidence of Compliance:
✓ Records of validation studies for dimeric inhibin A or other markers added to the screening panel

REFERENCES

CHM.32200 Computer Calculations Phase II

There are records that neural tube defect and Down syndrome risk calculations were initially verified for accuracy and reverified with any software updates or changes.

NOTE: Verification can be accomplished by interlaboratory comparisons, by comparison with results calculated or reported by proficiency testing programs, or by use of risk tables available on the CAP website (located in the CAP/APMG Biochemical and Molecular Genetics Resource Committee Genetics Topic Center section). At a minimum, the accuracy of calculated gestational age, maternal age, and patient-specific risks must be verified.

Evidence of Compliance:
✓ Written procedure for verifying accuracy of calculations initially and with changes AND
✓ Records of initial and subsequent calculation checks

INTERPRETIVE REPORTING FOR MATERNAL SCREENING

Inspector Instructions:
• Sampling of maternal screen patient reports (demographics, clinical information, results reported in MoM, cut-off values)

CHM.32300 Maternal Screen Reports Phase II

All of the following demographic and clinical information is included in the report: date of birth; maternal weight; maternal race; first day of the last menstrual period or gestational age as determined by ultrasound examination; specimen draw date; initial or repeat specimen; presence of medication-dependent diabetes; family history of neural tube defect, and presence of multiple gestation if known.
NOTE: Reports must include data essential to the interpretation of the test results to enable both the laboratory and physician to ensure that the interpretations on the report are based on complete and correct information.

In addition to the above, smoking history is recommended.

CHM.32400  Multiple of Population Median

Test results are reported as multiples of the population median (MoM).

NOTE: Reporting of results in terms of multiple of the population median (MoM) simplifies interpretation at various gestational ages, reduces possible systematic between-laboratory and between-kit bias in assay results, and facilitates comparison among laboratories. Laboratories can also compare their experiences with large-scale published studies more readily by using MoM as the reportable interpretive unit. The initial MoM is calculated as the measured analyte value divided by the median value for the appropriate gestational age. The MoM should also be adjusted for the other clinical variables known to influence the concentration of each analyte, generally by dividing by a factor specific for each variable.

Evidence of Compliance:
✓ Written procedure defining criteria for reporting results as MoM

REFERENCES

CHM.32500  Result Cut-off Values

The report classifies a pregnancy as screen-positive or screen-negative for open neural tube defects, based on the MSAFP test results.

NOTE: Cut-off levels based on maternal serum AFP MoM values or risk have been established by large screening programs. Use of these cut-off values in the laboratory report can assist the physician in making clinical decisions about pregnancy management.

REFERENCES

CHM.32600  Result Cut-off Values

The report classifies a pregnancy as screen-positive or screen-negative for fetal Down syndrome, based on the calculated risk.

NOTE: Cut-off levels based on risk for fetal Down syndrome have been established by large screening programs. Use of the cut-off values in the laboratory report can assist the physician in making clinical decisions about pregnancy management.

REFERENCES
AMNIOTIC FLUID ALPHA-FETOPROTEIN (AFAFP)

**Inspector Instructions:**

**READ**

- Sampling of AFAFP policies and procedures
- Sampling of AFAFP patient reports (results reported in MoM)
- Sampling of QC logs

**ASK**

- How does your laboratory verify or establish acceptable median AFAFP values?
- What is your laboratory’s course of action when you receive an amniotic fluid sample that is visibly contaminated with blood?
- What is your laboratory’s course of action when an amniotic fluid has an elevated AFP?

**DISCOVER**

- Select an abnormal AFAFP result and review records for the confirmatory testing performed, including QC for AChE testing

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**REVISED** 07/28/2015

CHM.32700 Median AFAFP Values Phase II

There are records that the laboratory has established its own median AFAFP values or verified that medians provided from another source are appropriate for the population being screened.

**NOTE:** Systematic biases in AFAFP assay values of up to 30% can occur when kits from different manufacturers are used. In addition, between-laboratory differences in equipment, reagents, and technique may introduce bias in assay results even when the same kit is used. These differences can be minimized by reporting results in multiples of the median (assuming that the medians are calculated using values measured on the population to be tested using the kit designed for screening). Package insert medians may be outdated or inappropriate and should only be used as a general guide as to expected medians. When computing AFAFP medians from laboratory data, samples from pregnancies with known (or suspected) neural tube or ventral wall defects should be removed. A reasonable practice would be to trim all values over 2.5 or 3.0 MoM prior to computing medians using a log-linear model (for data between 15 and 22 weeks’ gestation). Medians below 15 weeks do not follow the log-linear model and alternative curve fitting is required.

**Evidence of Compliance:**

✔ Records for median value determination OR records for median values from package inserts or other sources

**REFERENCES**


**CHM.32800 Median Value Reverification**  
Phase II

AFAFP medians are recalculated or reverified at specified intervals.

**Evidence of Compliance:**
- ✓ Written procedure defining criteria and frequency for recalculation or reverification of the AFAFP median **AND**
- ✓ Records of median values recalculation or reverification at defined frequency

**CHM.32900 Multiple of Median**  
Phase II

AFAFP results are reported in multiples of the median (MoM).

**NOTE:** Reporting of AFAFP results in terms of multiples of the median (MoM) simplifies interpretation at various gestational weeks, reduces the systematic between-laboratory and between-kit bias in results, and facilitates comparison of results between laboratories. Laboratories may compare their experiences with large-scale published studies much more readily when using MoM as the interpretive unit for AFP measurements. AFAFP concentrations are higher in black women than in whites and may be different in other racial groups as well. Although no simple correction factors are available at present, the use of race-specific medians is worth consideration.

**Evidence of Compliance:**
- ✓ Written procedure defining criteria for reporting results as MoM

**REFERENCES**

**CHM.33100 Dilution Control**  
Phase II

At least one amniotic fluid dilution control is processed with each analytic run of amniotic fluids.

**Evidence of Compliance:**
- ✓ Records of dilution control with each run

**CHM.33200 AChE Testing**  
Phase II

Acetylcholinesterase (AChE) testing is performed on ALL amniotic fluids having elevated AFAFP concentrations.

**NOTE:** Acetylcholinesterase (AChE) testing is an essential confirmatory test for amniotic fluids with abnormal AFP results. The odds of having a fetus with a neural tube defect are considerably greater if both the AFAFP is elevated and the AChE is positive. The addition of AChE for the detection of neural tube defects will reduce the false positive rate while maintaining a high detection rate. This procedure may be performed in-house or referred to a reference laboratory. If fetal blood is present, acetylcholinesterase results must be interpreted with caution.

**Evidence of Compliance:**
- ✓ Written policy defining criteria for AChE testing on abnormal AFAFP results **AND**
- ✓ Patient reports showing AChE results, as applicable

**REFERENCES**

**CHM.33300** Daily QC - Acetylcholinesterase Phase II

If acetylcholinesterase is run in-house, both positive and negative controls are included with each analytic run.

Evidence of Compliance:
✓ QC records for appropriate controls with each run

**REFERENCES**

**CHM.33400** Acetylcholinesterase Confirmation Phase II

If acetylcholinesterase is run in-house, acetylcholinesterase-positive results are confirmed by addition of a specific inhibitor.

**NOTE:** Positive acetylcholinesterase results must be confirmed by the addition of a specific inhibitor of acetylcholinesterase, such as BW284C51.

Evidence of Compliance:
✓ Written procedure for AChE confirmation testing AND
✓ Records of inhibitor testing for positive acetylcholinesterase results prior to reporting results

**REFERENCES**

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**ELECTROPHORESIS**

**Inspector Instructions:**

- Sampling of electrophoresis policies and procedures
- Sampling of electrophoresis QC logs
- Electrophoretic patterns (appropriate separations)

**CHM.33500** Daily QC - Electrophoresis Phase II

Suitable control samples are run and reviewed with each batch of patient samples for all electrophoresis procedures for which controls are available.
Evidence of Compliance:
✓ Records of electrophoresis QC

CHM.33600 Electrophoresis Separations
Electrophoretic separations are satisfactory.

CHM.33700 Acceptable Limits - Controls
Acceptable limits are set for controls of procedures where the electrophoretic bands are quantified.

Evidence of Compliance:
✓ Records of defined acceptable limits for control range of each lot

HEMOGLOBIN SEPARATION

Hemoglobin solubility testing alone is NOT sufficient for detecting or confirming the presence of sickling hemoglobins in all situations. For purposes of diagnosing hemoglobinopathies, additional tests are required.

Inspector Instructions:
- Sampling of abnormal hemoglobin policies and procedures
- Sampling of patient reports (confirmatory testing, comments)
- Sampling of QC records
- Hemoglobin electrophoretic patterns (appropriate separations and controls)
- Examine a sampling of medium (media) used to identify hemoglobin variants including alkaline/acid electrophoresis, isoelectric focusing, HPLC or other method
- What is your course of action when the primary screening method appears to show Hb S?
- What is your course of action when the primary Hb electrophoresis method shows Hb variants migrating in nonA/nonS positions?

CHM.33708 Hb S Primary Screen
For samples that appear to have Hb S in the primary screening (by any method), the laboratory either 1) performs a second procedure (solubility testing, or other acceptable method) to confirm the presence of Hb S, or 2) includes a comment in the patient report recommending that confirmatory testing be performed.

NOTE: For primary definitive diagnosis screening by electrophoresis or other separation methods, all samples with hemoglobins migrating in the “S” positions or peak must be tested for solubility or by other acceptable confirmatory testing for sickling hemoglobin(s). Known sickling and non-sickling controls both must be included with each run of patient specimens tested.

Evidence of Compliance:
✓ Written policy for follow-up when Hb S appears in the primary screen
**REFERENCES**

16. Hoyer JD, et al. Flow cytometric measurement of hemoglobin F in RBCs: diagnostic usefulness in the distinction of hereditary persistence of fetal hemoglobin (HPFH) and hemoglobin S-HPFH from other conditions with elevated levels of hemoglobin F. Am J Clin Pathol. 2002;117:857-863

**REFERENCES**

7) Honig GR, Adams JG III. Human hemoglobin genetics. Vienna, Austria: Springer-Verlag, 1986
14) Hoyer JD, et al. Flow cytometric measurement of hemoglobin F in RBCs: diagnostic usefulness in the distinction of hereditary persistence of fetal hemoglobin (HPFH) and hemoglobin S-HPFH from other conditions with elevated levels of hemoglobin F. Am J Clin Pathol. 2002;117:857-863

CHM.33764 Hb S Predominant Band

All samples that appear to have Hb S as the predominant band by the primary screening (by whatever method) and that are confirmed as sickling by appropriate methods are further examined to ascertain whether the "Hb S" band or peak contains solely Hb S or both Hb S and Hb D, Hb G or other variant hemoglobins.

NOTE: When the predominant hemoglobin component appears to be Hb S, it is necessary to determine whether this represents homozygous Hb S or a heterozygote for Hb S and another variant such as Hb D, Hb G, Hb-Lepore, or other hemoglobin variant(s). Given the clinical implications of homozygous Hb S (or Hb S/β zero thalassemia) it is imperative to exclude other hemoglobin variants, however rare. Referral of these specimens to a reference laboratory for further workup is acceptable.

Evidence of Compliance:
✓ Written policy defining criteria for determination of homozygous versus heterozygous Hb S AND
✓ Patient records or worksheets showing the exclusion of hemoglobin variants OR referral for further work-up

REFERENCES
1) Black J. Isoelectric focusing in agarose gel for detection and identification of hemoglobin variants. Hemoglobin. 1984;8:117

BLOOD GAS ANALYSIS

The Chemistry and Toxicology Checklist is intended for inspection of laboratory sections performing testing in a dedicated space (e.g. main laboratory, respiratory therapy). Laboratories performing testing at or near the patient bedside (e.g. portable instruments) must use the Point-of-Care Testing Checklist.

The number of checklists needed for test sites under the same CLIA number and CAP number is determined as follows:

- Blood gas testing performed in more than one area under the same supervision use one Chemistry and Toxicology Checklist (e.g. main laboratory and stat lab);
• Blood gas testing performed in more than one area under **different supervision** use separate Chemistry and Toxicology Checklists for each separately supervised site (e.g. main laboratory and respiratory therapy department);

Testing sites within an institution with different CLIA and CAP numbers must submit separate applications and have separate full inspections.

**SPECIMEN COLLECTION AND HANDLING**

**Inspector Instructions:**

- Blood gas collection policy and procedure
- Sampling of records for performance of collateral circulation tests

- How are personnel that perform arterial punctures made aware of possible complications?

**CHM.33800 Knowledgeable - Arterial Punctures**  
**Phase II**

Personnel performing arterial punctures are knowledgeable about the more significant complications of this procedure compared with venipuncture.

**Evidence of Compliance:**

✓ Records of training in personnel files

**REFERENCES**


**CHM.33900 Collateral Circulation**  
**Phase II**

For radial artery sampling, a test for collateral circulation is performed and recorded before arterial puncture, as applicable.

**NOTE:** The various technologies available have been evaluated in the published literature. Consensus should be established between the laboratory and involved clinicians to identify the patient/clients in whom such a test is medically useful in averting potential patient/client injury. The site from where the sample was obtained should be recorded.

**Evidence of Compliance:**

✓ Written collection procedure defining situations that require testing for collateral circulation to include preferred technique(s)

✓ Records of collection site and results of applicable collateral circulation testing

**REFERENCES**


CHM.34000 Ambient Air Contamination Phase II

There is a procedure to prevent ambient air contamination of blood gas samples before analysis.

Evidence of Compliance:
✓ Written procedure for prevention of ambient air contamination

REFERENCES

BLOOD GAS INSTRUMENTS

Inspector Instructions:

• Blood Gas analysis policy and procedure
• Sampling of blood gas calibration records
• Sampling of blood gas QC records

CHM.34200 Calibration Materials Phase II

The materials used for calibration of the pH, CO₂, and O₂ sensors are either in conformance with the instrument manufacturer’s specifications or traceable to NIST Standard Reference Materials.

REFERENCES

CHM.34300 Calibration - Blood Gas Instruments Phase II

Blood gas instruments are calibrated according to manufacturer’s specifications and at least as frequently as recommended by the manufacturer.

NOTE: Instruments used infrequently must be recalibrated each time of use. Some instruments have built in calibration that is performed automatically by the instrument; however, there must be some defined procedure for verifying the reliability of this process. If appropriate, the calibration must compensate for the influence of barometric pressure.

Evidence of Compliance:
✓ Written calibration procedure including defined frequency AND
✓ Records for calibration at defined frequency

**REFERENCES**

**REvised** 07/28/2015
CHM.34400  Daily QC - Blood Gas Instruments  Phase II

A minimum of one level of quality control for pH, pCO₂ and pO₂ is analyzed at least every eight hours of operation when patient specimens are tested, or more frequently if specified in the manufacturer's instructions or laboratory procedure.

**NOTE:** The laboratory must define the number and type of quality control used and the frequency of testing in its quality control procedures. Control testing is not required on days when patient testing is not performed. Controls must be run prior to reporting patient results after a change of analytically critical reagents, major preventive maintenance, or change of a critical instrument component.

If an internal quality control process (e.g. electronic/procedural/built-in) is used instead of an external control material to meet daily quality control requirements, the laboratory must have an individualized quality control plan (IQCP) approved by the laboratory director to address the use of the alternative control system. Please refer to the Individualized Quality Control Plan section of the All Common Checklist for the eligibility of tests for IQCP and requirements for implementation and ongoing monitoring of an IQCP.

**Evidence of Compliance:**
✓ Written quality control procedures **AND**
✓ Records of QC results including external and internal control processes **AND**
✓ Manufacturer product insert or manual

**REFERENCES**
1) Department of Health and Human Services, Centers for Medicare and Medicaid Services. Medicare, Medicaid and CLIA programs; CLIA fee collection; correction and final rule. Fed. Register. 2003(Jan 24) [42CFR493.1267(b)]

**REvised** 07/28/2015
CHM.34500  Daily QC - Blood Gas Instruments  Phase II

The control materials for pH, pCO₂ and pO₂ represent both high and low values on each day of patient testing.

**NOTE:** If using internal controls, the electronic simulators should challenge at high and low values.

**Evidence of Compliance:**
✓ Written procedure defining QC requirements **AND**
✓ QC records reflecting the appropriate use of controls

**REFERENCES**
1) Department of Health and Human Services, Centers for Medicare and Medicaid Services. Medicare, Medicaid and CLIA programs; CLIA fee collection; correction and final rule. Fed. Register. 2003(Jan 24) [42CFR493.1267(b)]
At least one level of quality control material for pH, pCO₂ and pO₂ is included each time patient specimens are tested, except for automated instruments that internally calibrate at least once every 30 minutes of use.

NOTE: An internal quality control process (e.g. electronic/procedural/built-in) may be used to meet this requirement if an individualized quality control plan (IQCP) approved by the laboratory director addresses the use of the alternative control system

Evidence of Compliance:
✓ Written policy defining QC requirements AND
✓ QC results OR record of internal calibrator

REFERENCES
1) Department of Health and Human Services, Centers for Medicare and Medicaid Services. Medicare, Medicaid and CLIA programs; CLIA fee collection; correction and final rule. Fed Register. 2003(Jan 24): 3709 [42CFR493.1267(c)]

LEGAL TESTING

Some laboratories may choose to perform certain tests exclusively for legal purposes (e.g. alcohol for traffic law enforcement, criminal justice and medical examiner systems). In this case, the performance of legal testing must meet forensic, not clinical laboratory, standards. These forensic standards include the requirements for chain-of-custody protocols for specimens and aliquots, specimen seals, increased specimen and record security, appropriate confirmation testing, and a certifying review process.

Certain clinical tests have a higher potential for being involved in a legal proceeding, e.g. blood alcohol tests for motor vehicle accident patients and drugs of abuse tests for patients undergoing drug treatment or neonates suspected of drug exposure, in utero. Therefore, a laboratory may choose to conduct these clinical tests using policies and procedures that meet both forensic and clinical laboratory standards. It is not a requirement, however, to conduct any clinical testing using the standards of legal testing; it is an administrative decision to do so. Toxicology testing for diagnosis, treatment or other clinical purposes must meet only clinical laboratory practice standards.

This section includes requirements that specifically relate to legal or “forensic” toxicology testing requirements. It is not intended for accreditation of workplace drug testing, for testing related to monitoring compliance with drug-of-abuse oversight programs or for post-mortem toxicology. The CAP Forensic Drug Testing (FDT) program is appropriate for workplace testing.
**Inspector Instructions:**

**READ**

- Sampling of legal testing policies and procedures (includes collection, accessioning, specimen retention/storage, record retention)
- Copies of or written evaluation of applicable laws and regulations
- Sampling of external and internal chain-of-custody records
- Sampling of certifying review of analytical and forensic records

**OBSERVE**

- Locked limited-access secured area (contains original specimens/containers)
- Locked limited-access secured area (contains forensic records)

**ASK**

- How do you know your specimen collection containers maintain analyte stability?
- How have you evaluated ethanol specificity in your method for testing legal alcohols?
- Who has access to the secure area where original specimens are stored?
- What is your course of action when unacceptable specimens are received?
- What is your course of action after obtaining an unconfirmed positive test result?
- How do you ensure the confidentiality of patient reports?

**CHM.36700 Regulations/Laws**

**Phase II**

The laboratory is aware of rules and regulations that may affect any legal testing performed by the laboratory.

**Evidence of Compliance:**

✓ Copies of applicable regulations and laws OR records that applicable regulations and laws were evaluated to ensure compliance

**REFERENCES**


**CHM.36800 Specimen Collection Manual - Legal Testing**

**Phase I**

There is a written procedure for collecting blood samples for legal testing, including aspects of skin preparation and use of preservatives.

**REFERENCES**


**CHM.36900 Specimen Collection Container Effectiveness**

**Phase I**

The laboratory has evaluated the effectiveness of its specimen collection containers in maintaining analyte stability.

**NOTE:** The laboratory should evaluate the effectiveness of its specimen collection containers in accurately maintaining analyte stability over time, as changes may occur that would alter the validity of reported measurements. For example, both metabolic consumption of alcohol and production of alcohol by microorganisms must be considered.
Evidence of Compliance:
✓ Written procedure defining criteria for evaluation of specimen collection containers AND
✓ Records of evaluation studies

REFERENCES

CHM.37000 Ethanol Specificity Phase II

If the laboratory tests for legal alcohols, the method has been evaluated for ethanol specificity.

NOTE: The laboratory director must ensure that the method is sufficiently specific for ethanol in the setting in which the test is used. The alcohol dehydrogenase-mediated enzymatic assays are variably susceptible to positive interference by high lactate dehydrogenase and/or high lactate levels, resulting in false positive or falsely elevated ethanol levels. The use of an enzymatic assay is acceptable if the laboratory director has determined the extent of LD and lactate interferences and that the specificity is adequate for the setting in which it is used. The laboratory should have a procedure to manage this specificity problem.

Evidence of Compliance:
✓ Written procedure defining actions to be taken for potential interferences in testing for legal alcohols AND
✓ Records of ethanol specificity evaluation studies OR evaluation of manufacturer’s record of specificity

REFERENCES
2) NCCLS. Blood Alcohol Testing in the Clinical Laboratory; Approved Guideline. NCCLS document T/DM6A. NCCLS, 940 West Valley Road, Suite 1400, Wayne, Pennsylvania 19087-1898 USA, 1997.

CHM.37100 Receiving/Accessioning Phase II

The specimen receiving/accessioning procedure requires a record of type of specimen, verification of specimen identity, completeness of external chain-of-custody records, and integrity (tamper-evident) of the transmittal or shipping container.

Evidence of Compliance:
✓ Written procedure defining criteria for receiving/accessioning of specimens for legal testing

CHM.37200 Chain-of-Custody Records Phase II

The laboratory properly completes appropriate sections of external chain-of-custody records.

Evidence of Compliance:
✓ Written procedure for chain-of-custody

CHM.37300 Chain-of-Custody Records Phase II

There is a requirement for preparation of internal chain-of-custody records for specimens received.
Evidence of Compliance:
✓ Written procedure for chain-of-custody

CHM.37400  Chain-of Custody Documents

The laboratory generates and properly completes internal chain-of-custody records to account for the specimens and aliquots.

NOTE: The chain-of-custody procedure must account for all authorized individuals who handle the specimens/aliquots, or the storage location when not in the possession of an authorized individual. The reason for the transfer of custody should be recorded along with the date of the transfer.

Evidence of Compliance:
✓ Written procedure for chain-of-custody

CHM.37500  Secured Specimen Storage

The original specimens are always maintained in the original containers, and in a limited-access secured area, when not in the possession of an authorized individual.

NOTE: The original specimens must always be maintained either in the direct custody of an authorized individual, or be in a locked secured area accessible only to authorized individuals. This locked and limited-access area may be a refrigerator, freezer or storage room within the laboratory.

Evidence of Compliance:
✓ Written policy defining criteria for storage of and access to specimens for legal testing AND
✓ Records for internal chain-of-custody reflecting limited-access storage OR record of direct custody of the specimen by an authorized person at all times

CHM.37600  Limited-Access Area

Access to the limited-access area is restricted to authorized laboratory personnel.

CHM.37700  Accessioning Procedure

The accessioning procedure for specimens defines criteria for determining the forensic acceptability of specimens for analysis, and there is a procedure for the course of action (i.e. reporting back to the client) that must be followed when unacceptable specimens are identified.

NOTE: Clients and laboratories may have different rules for evaluating a specimen for its forensic acceptability for analysis (chain-of-custody failures, missing information, specimen leakage, inadequate volume, wrong type of specimen submitted, etc.). These evaluation criteria must be recorded in the accessioning procedure along with the actions that laboratory personnel are required to take in reporting these problems to the client. Unacceptable specimens must be monitored by the laboratory as part of its quality management program.

Evidence of Compliance:
✓ Specimen rejection records

CHM.37800  Specimen Retention and Storage

Appropriate specimen retention and storage conditions are defined for positive and negative specimens.
NOTE: The policies and procedures for specimen security, storage, location, retention, and final disposition must be appropriate for each type of specimen tested by the laboratory. The minimum specimen retention time and storage condition must comply with applicable laws and regulations.

CHM.37900 Positive Result Confirmation

The laboratory requires confirmation of all positive results before release.

NOTE: Some clients may request that unconfirmed positive results be reported, with the laboratory storing the specimen for potential confirmation at a later date. If it is locally acceptable to report unconfirmed positive results, a disclaimer must accompany those results to indicate that unconfirmed positive results may NOT meet forensic requirements.

Evidence of Compliance:

✓ Written procedure requiring confirmation of all positive results or the use of a disclaimer on report if unconfirmed results are reported, when applicable AND
✓ Records reflecting the confirmatory testing performed or patient reports including the use of the disclaimer for unconfirmed results

CHM.38000 Second Method Confirmation

The laboratory confirms all positive results, using a second method that is scientifically valid and legally defensible, and which is analytically different from the initial testing method.

NOTE: An exception is that for legal alcohol confirmation testing, the standard of practice does not necessarily require the use of a confirmation method that is analytically different from that of the initial test. However, legal alcohol testing must use a methodology with high specificity for ethanol. The alcohol dehydrogenase-mediated enzymatic assays are variably susceptible to positive interference by high lactate dehydrogenase and/or high lactate levels resulting in false positive or falsely elevated ethanol level. The use of an enzymatic assay is acceptable if the laboratory director has determined the extent of LD and lactate interferences and that the specificity is adequate for the setting in which it is used. The laboratory should have a procedure to manage this specificity problem.

Evidence of Compliance:

✓ Written procedure defining the method for confirmatory testing of all positive results for tests other than legal alcohol AND
✓ Records reflecting the confirmatory testing performed on positive results

REFERENCES


CHM.38100 Review of Analytic Procedure

There is a written procedure that requires that each step of the analysis be reviewed and recorded, and the review of the following information for both screening and confirmatory testing, at a minimum.

1. Results of standards or calibrators
2. Results of quality controls
3. Laboratory identification of samples tested in each batch and the testing sequence of calibrators, controls, and unknowns
4. Identity of analyst(s) performing and reviewing the test results

CHM.38200 Certifying Review
There is a written procedure for the certifying review of the analytical and forensic records for all specimens (negative and positive) before results are released, and directs the certifying review to include the following.

1. External chain-of-custody records
2. Internal chain-of-custody records
3. Review and comparison of both screening and confirmation results
4. Acceptability of quality control results
5. Review of critical analytical data for the identification, quantitation (if required) of each drug in confirmation analyses for calibrators/standards, controls, and unknown specimens
6. Final report for completeness, accuracy, and agreement with the analytical data

CHM.38300 Certifying Review

The certifying review procedure requires a record of the identity of the reviewer and the date review was completed.

CHM.38400 Report Confidentiality

Documented procedures for reporting results emphasize and ensure maintenance of confidentiality of reports.

NOTE: The reporting of legal testing results should be done in a confidential manner to ensure that only authorized client representatives or authorized laboratory personnel can receive, review, or print these results regardless of the methods used for reporting (e.g. telephone, FAX, remote printer, computer terminal).

CHM.38500 Record Retention

There is a written policy that defines the records that must be retained to meet client, legal, regulatory, and accreditation requirements, and the length of retention time.

NOTE: The CAP Laboratory Accreditation Program requires the following forensic records be retained for at least two years. However, the laboratory must be able to store forensic records as long as any legal action is pending.

- Laboratory specimen security logs
- Laboratory accessioning logs
- Chain-of-custody records and requisitions
- Analytical data from screening and confirmation analyses
- Specimen reports
- Quality control program records
- Instrument maintenance/service records
- Instrument calibration records
- Reagent/standard/calibrator/control preparation and verification records
- Method performance validation records
- Personnel files on all laboratory personnel who are involved with the forensic testing performed by the laboratory
- Proficiency testing survey results, reports, and corrective actions
- CAP accreditation reports and corrective actions

CHM.38600 Secured Forensic Records
The forensic records are maintained in a limited-access secured (locked) area that is only accessible to authorized laboratory personnel.

**Evidence of Compliance:**
- Written policy addressing restricted access to forensic records