# BeyondCare Quality Monitor for Hematology Inspection Guide*

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*Applicable to XN-Series and XN-L

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# I. Inspection Guide

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## 1. Overview

All laboratories must meet certain standards of operation to be certified to perform testing on human specimens under the Clinical Laboratory Improvement Amendments of 1988 (CLIA) which is under the auspices of Centers for Medicare and Medicaid Services (CMS). All facilities that meet the definition of a laboratory under the CLIA statute and regulations must obtain an appropriate CLIA certificate prior to conducting patient testing. Laboratories must meet standards of quality for accuracy, reliability and timeliness of test results regardless of where the test was performed. Some accreditation organizations have deeming authority status for accrediting laboratories under CLIA. These include College of American Pathologists (CAP), COLA and Joint Commission as well as other organizations.

Joint Commission operates accreditation programs for hospitals. A majority of state governments have come to recognize Joint Commission accreditation as a condition of licensure and the receipt of Medicaid reimbursement. All laboratories within these hospitals must also meet Joint Commission requirements for accreditation.

The CAP Laboratory Accreditation Program's goal is to improve patient safety by advancing the quality of pathology and laboratory services through education, standard setting, and ensuring laboratories meet or exceed regulatory requirements. Software such as Sysmex BeyondCare$^{SM}$ Quality Monitor for Hematology (BCQM$^{h}$) provides tools by which the laboratory can meet the CAP requirements.

This document describes how the BCQM$^{h}$ application can help the laboratory meet various regulatory standards and requirements.

(*) Laboratory Inspection Organizations:

- CAP – College of American Pathologists – www.CAP.org
    - CAP Checklists:
        - All Common (COM) 08.21.2017
        - Laboratory General (GEN) 08.21.2017
        - Hematology and Coagulation (HEM) 08.21.2017
- Joint Commission www.jointcommission.org
    - CAMLAB, January 2017
- CLIA – Clinical Laboratory Improvements Amendments – https://www.cms.gov/Regulations-and-Guidance/Legislation/CLIA/index.html
- COLA
    - COLA Laboratory Accreditation Manual, April 2017
- New York State Department of Health
    - Clinical Laboratory Evaluation Program, January 2017

This document provides an overview section of each applicable regulatory requirement that Sysmex can assist the laboratory when using the BCQM$^h$ application. Reference to CLIA and Joint Commission requirements as well as the CAP All Common, Laboratory General, Hematology and Coagulation and Limited Service Laboratory checklists are provided along with how BCQM$^h$ supports compliance.

# 2. Disclaimers

**SYSMEX PROVIDING THIS INFORMATION DOES NOT MEAN THAT SYSMEX IS RESPONSIBLE FOR PROVIDING DOCUMENTATION FOR CUSTOMER REGULATORY INSPECTIONS. THE CUSTOMER MUST CREATE POLICIES AND PROCEDURES APPLICABLE TO THEIR ACCREDITATION ORGANIZATIONS' REQUIREMENTS. THE CUSTOMER ASSUMES ALL RISK AND RESPONSIBILITY FOR ITS USE OF THE SYSMEX SOFTWARE. CUSTOMER SHALL USE SUCH SOFTWARE ONLY IN ACCORDANCE WITH INSTRUCTIONS CONTAINED IN SYSMEX BCQM USER AND OTHER PUBLISHED MATERIALS AND LABELING, WHICH MAY BE AMENDED FROM TIME TO TIME.**

# 3. College of American Pathologists

| Category/Item # | Title | BCQM$^h$ Support of Compliance |
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| HEM.19360 | **Daily QC - Nonwaived Tests**<br>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. | • Daily Quality Control |
| HEM.19380 | **Target Range Verification**<br>For quantitative tests, a statistically valid target range (e.g. mean, SD, CV) is verified or established for each lot of control material by repetitive analysis in runs that include previously tested control materials. | • Quality Control Target and Limits |
| HEM.20050 | **Numeric QC Data**<br>For numeric QC data, Gaussian or other quality control statistics (e.g. SD and CV) are calculated monthly to define analytic imprecision. | • Quality Control Statistical Analysis |
| HEM.20070 | **Precision Statistics**<br>The laboratory has an action protocol when data from precision statistics change significantly from previous data. | • Corrective Action Process when QC Fails |
| HEM.20140 | **QC Confirmation of Acceptability**<br>The results of controls are reviewed for acceptability before reporting results. | • Daily Quality Control<br>• Corrective Action Process when QC Fails |

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| HEM.20143 | **QC Corrective Action**<br>There are records of corrective action when control results exceed defined acceptability limits. | • Corrective Action Process when QC Fails |
| HEM.20146 | **Monthly QC Review**<br>Quality control data are reviewed and assessed at least monthly by the laboratory director or designee. | • QC Trend Review |
| HEM.25150 | **Pipettors and Dilutors**<br>Pipettors and dilutors (fixed volume or adjustable) are checked at defined intervals (at least annually) for accuracy and reproducibility, (gravimetric, colorimetric or other verification procedure), and results recorded. | • Calibration Verification |
| HEM.25700 | **Calibration - Stabilized Materials**<br>There is a written procedure defining the criteria and specific steps for the periodic calibration of the analyzer with stabilized materials whose target values have been certified by the manufacturer using primary reference procedures. | • Calibration |
| HEM.25760 | **Calibration Verification Criteria**<br>Criteria are established for calibration verification.<br><br>Note with Standard: For automated CBC cell counting instruments, requirements for calibration verification may be considered met if the laboratory follows the manufacturer's instructions for instrument operation and tests two levels of control materials each day of testing. The control results must meet the laboratory's criteria for acceptability. Linearity studies are not required. | • Calibration Verification |
| HEM.25780 | **Recalibration**<br>The laboratory's procedure for recalibration of a parameter(s) requires analysis of stabilized whole blood or other commercial preparations, the parameters of which have been certified by the manufacturer. | • Calibration |
| HEM.25785 | **Verification Following Commercial Calibrator Calibration**<br>Following calibration with commercial calibrators, there is a written procedure for calibration verification. | • Calibration Verification<br>• QC Trend review |
| HEM.25850 | **Stabilized Controls** | |

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| | Two different stabilized control specimens are analyzed and results recorded during each 24-hours of analyzer use. | • Daily Quality Control |
| HEM.25870 | **Commercially Assayed Controls**<br>If commercially ASSAYED controls are used for CBC instruments, control values correspond to the methodology and target values (mean and QC ranges) are verified or established by the laboratory. | • Quality Control Target and Limits |
| HEM.30070 | **Sampling Mode Comparison**<br>There are records that at least annually compare all results obtained for patient specimens analyzed in the multiple sampling modes of the CBC analyzer (e.g. "open" and "closed" modes) to ensure that they are in agreement. | • Comparability of Instruments/Methods |
| HEM.35414 | **Background Checks - Automated Counts**<br>Instrument background counts are performed each day of testing on the diluent fluid and lysing agent to check for contamination that might affect cell counts. | • Background Log |
| HEM.35490 | **Stabilized Controls**<br>Two different stabilized control specimens are analyzed each day of testing with results recorded and reviewed for acceptability. | • Daily Quality Control |
| COM.04200 | **Instrument/Equipment Record Review**<br>Instrument and equipment maintenance and function check records are reviewed and assessed at least monthly by the laboratory director or designee. | • Service History |
| COM.04250 | **Comparability of Instruments/Methods**<br>If the laboratory uses more than one nonwaived instrument/method to test for a given analyte, the instruments/methods are checked against each other at least twice a year for comparability of results. | • Comparability of Instruments/Methods |
| COM.04300 | **Comparability Criteria**<br>Acceptability criteria are defined for comparability of instruments/methods used to test the same analyte, with records of action when the criteria are not met. | • Comparability of Instruments/Methods<br>• Service History |
| COM.30450 | **New Reagent Lot Confirmation of Acceptability**<br>New reagent lots and shipments are checked against old reagent lots or with suitable reference material before or concurrently with being placed in service. | • Calibration Verification<br>• Daily Quality Control |

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| COM.30550 | **Instrument/Equipment Performance Verification**<br>The performance of all instruments and equipment is verified upon installation and after major maintenance or service to ensure that they run according to expectations. | • Calibration Verification |
| COM.30600 | **Maintenance/Function Checks**<br>Appropriate maintenance and function checks are performed and records maintained for all instruments (e.g. analyzers) and equipment (e.g. centrifuges) following a defined schedule, at least as frequent as specified by the manufacturer. | • Calibration Verification |
| COM.30650 | **Instrument Troubleshooting**<br>Instructions are provided for minor troubleshooting and repairs of instruments (such as manufacturer's service manual). | • Corrective Action Process When QC Fails |
| COM.30675 | **Instrument/Equipment Records**<br>Instrument and equipment maintenance, function check, performance verification, and service and repair records (or copies) are promptly available to, and usable by, the technical staff operating the equipment. | • Calibration Verification<br>• Service History<br>• Background Log |

# 4. Joint Commission

| Category/Item # | Title | BCQM$^h$ Support of Compliance |
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| QSA.02.02.01 | The laboratory performs calibration and recalibration.<br>Calibration requirements and methods are based on manufacturer's directions.<br>Procedures that may be exempt from calibration requirements include manual procedures that do not use instrumentation, microscopic procedures, and procedures involving instruments that do not lend themselves to calibration. | • Calibration |
| QSA.02.03.01 | The laboratory performs calibration verification<br><br>Note 2: For automated cell counters, calibration verification requirements are met if the laboratory follows manufacturer's instructions for instrument operation and the | • Calibration Verification |

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| | laboratory test two levels of quality control material each day of patient testing, provided the laboratory quality control criteria are met. | |
| QSA.02.06.01 | Each laboratory specialty and subspecialty has a quality control policy. | • Daily Quality Control<br>• Quality Control Targets and Limits<br>• Corrective Action Process when QC Fails<br>• Quality Control Statistical Analysis<br>• Peer Comparison<br>• QC Trend Review<br>• Calibration Verification<br>• Comparability of Instruments/Methods |
| QSA.02.07.01 | The laboratory has its own quality control ranges with valid statistical measurements for each procedure. | • Quality Control Target and Limits |
| QSA.02.08.01 | The laboratory performs correlations to evaluate the results of the same test performed with different methodologies or instruments or at different locations | • Comparability of Instruments/Methods |
| QSA.02.09.01 | The laboratory performs quality control testing in the same manner as it performs patient testing. | • Daily Quality Control |
| QSA.02.10.01 | The laboratory performs quality control testing to monitor the accuracy and precision of the analytic process | • Quality Control Statistical Analysis |
| QSA.02.12.01 | The laboratory investigates and takes corrective action for deficiencies identified through quality control surveillance | • Corrective Action Process When QC Fails |
| QSA.11.01.01 | On each day of patient testing, the laboratory verifies each hematology procedure and test parameter against known standards or controls within the range of clinically significant values. | • Daily Quality Control |

# 5. CLIA

| Category/Item # | Title | BCQM$^h$ Support of Compliance |
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| 493.1250 | **Condition: Analytic systems**<br>Each laboratory that performs nonwaived testing must meet the applicable analytic systems requirements in §§493.1251 through 493.1283, unless HHS approves a procedure, specified in Appendix C of the State Operations Manual (CMS Pub.7), that provides equivalent quality testing. The laboratory must monitor and evaluate the overall quality of the analytic systems and correct identified problems as specified in §493.1289 for each specialty and subspecialty of testing performed. | • Quality Control Statistical Analysis<br>• Peer Comparison<br>• QCTrend Review<br>• Corrective Action Process When QC Fails |
| 493.1251 | **Standard: Procedure manual**<br>(a) A written procedures manual for all tests, assays, and examinations performed by the laboratory must be available to, and followed by, laboratory personnel. Textbooks may supplement but not replace the laboratory's written procedures for testing or examining specimens.<br>(b)(5) Calibration and calibration verification procedures.<br>(b)(7) Control procedures. Determine if the laboratory's quality control procedures include the following:<br>• Type of control (e.g., manufacturer or in-house, electronic);<br>• Identity (e.g., normal, abnormal, level I, II, patient or a control);<br>• Number and frequency of testing controls;<br>• Control limits established in accordance with §§493.1253 and 493.1256; and<br>• Criteria to determine acceptable control results.<br>(b)(8) Corrective action to take when calibration or control results fail to meet the laboratory's criteria for acceptability.<br><br>Manufacturer's test system instructions or operator manuals may be used, when applicable, to meet the requirements of paragraphs (b)(1) through (b)(12) of this section. Any of the items under paragraphs | • Daily Quality Control<br>• Calibration Verification<br>• Corrective Action Process When QC Fails |

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| | (b)(1) through (b)(12) of this section not provided by the manufacturer must be provided by the laboratory. | |
| 493.1253 | **Standard: Establishment and verification of performance specifications**<br>(a)(1) Maintenance as defined by the manufacturer and with at least the frequency specified by the manufacturer.<br>(a)(2) Function checks as defined by the manufacturer and with at least the frequency specified by the manufacturer. Function checks must be within the manufacturer's established limits before patient testing is conducted. | • Calibration Verification<br>• Quality Control Targets and Limits |
| 493.1255 | **Standard: Calibration and calibration verification procedures**<br>(a)(1) Following the manufacturer's test system instructions, using calibration materials provided or specified, and with at least the frequency recommended by the manufacturer<br>(a)(3) Whenever calibration verification fails to meet the laboratory's acceptable limits for calibration verification.<br>(b) Perform and document calibration verification procedure<br>**(**b)(1) Following the manufacturer's calibration verification instructions;<br>(b)(2) Using the criteria verified or established by the laboratory under §493.1253(b)(3)—<br>(b)(3)(iii) Control 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.<br><br>EXCEPTIONS:<br>3. For automated cell counters, the calibration verification requirements are considered met if the laboratory follows the manufacturer's instructions for instrument operation and tests 2 levels of control materials each day of testing provided the control results meet the laboratory's criteria for acceptability. This exception does not apply to centrifugal hematology test systems. | • Calibration Verification<br>• Calibration<br>• Trend Review<br>• Daily Quality Control |

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| 493.1256 | **Standard: Control procedures**<br><br>(a) For each test system, the laboratory is responsible for having control procedures that monitor the accuracy and precision of the complete analytic process.<br>(b) The laboratory must establish the number, type, and frequency of testing control materials using, if applicable, the performance specifications verified or established by the laboratory as specified in §493.1253(b)(3).<br>**(**c) The control procedures must--<br>(c)(1) Detect immediate errors that occur due to test system failure, adverse environmental conditions, and operator performance.<br>(c)(2) Monitor over time the accuracy and precision of test performance that may be influenced by changes in test system performance and environmental conditions, and variance in operator performance.<br>(d)(2) For each test system, perform control procedures using the number and frequency specified by the manufacturer or established by the laboratory when they meet or exceed the requirements in paragraph (d)(3) of this section.<br>(d)(3) At least once each day patient specimens are assayed or examined perform the following for:<br>Interpretive Guidelines §493.1256(d) | • Daily Quality Control<br>• Quality Control Targets and Limits<br>• Quality Control Statistical Analysis<br>• QC Trend Review |
| 493.1282 | **Standard: Corrective actions**<br>**Interpretive Guidelines §493.1282(b)(2)**<br>When an internal control fails to fall within the defined limits of acceptability, the laboratory must identify the reason for the failure and correct the problem before resuming testing of patients. The laboratory must evaluate all patients test results since the last acceptable external control. | • Corrective Action Process When QC Fails |

# 6. New York State

| Category/Item # | Title | BCQM$^h$ Support of Compliance |
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| Calibration S1 | **Calibration Sustaining Standard of Practice 1 (Calibration S1): Procedure**<br>The laboratory must determine, perform and document the test system's calibration procedures for each applicable test system:<br>a) at a minimum, in accordance with the manufacturer's instructions, if provided, using calibration materials provided or specified by the manufacturer; and,<br>b) in accordance with criteria verified or established by the laboratory from activities pursuant to Validation Sustaining Standard of Practice 5,<br>i. including the number, type and concentration of calibration materials, acceptable limits for calibration, and the frequency of calibration; and,<br>ii. using calibration materials appropriate for the methodology and, if possible, traceable to a reference method or reference material of known value; and,<br>c) whenever calibration verification fails to meet the laboratory's acceptable limits for calibration verification.<br>**Regulatory authority: 10 NYCRR subdivision 58-1.10(g)**<br><br><u>Guidance</u><br>For hematology cell counting instruments which have been cleared or approved by the FDA and have not been modified by the laboratory, the calibration requirements are considered to be met if the laboratory follows the manufacturer's instructions for operation and at least two controls are run each day of testing. | • Calibration Verification<br>• Calibration |
| Calibration S2 | **Calibration Sustaining Standard of Practice 2 (Calibration S2): Periodic Verification**<br>The laboratory shall perform and document calibration verification procedures, minimally, in accordance with the manufacturer's calibration verification instructions where | • Calibration Verification |

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| | provided, or in accordance with the criteria established by the laboratory,<br>a) including the number, type and concentration of calibration materials, acceptable limits for calibration verification and frequency of calibration verification; and,<br>b) using calibration material appropriate for the methodology and, if possible, traceable to a reference method or reference material of known value; and verifying the laboratory's established reportable range of test results, which shall include at least a minimal (or zero) value, a mid-point value, and a maximum value at the upper limit of that range; and,<br>c) at least every six months, and when any of the following occur:<br>i. a complete change of reagents for a procedure is introduced, unless the laboratory can demonstrate that changing reagent lots does not affect the reportable range, and control values are not adversely affected by reagent lot number changes;<br>ii. major preventive maintenance or replacement of critical parts that may influence test performance;<br>iii. controls reflect an unusual trend or shift or are outside the laboratory's acceptable limits and other means of assessing or correcting unacceptable control values have failed to identify and correct the problem; or,<br>iv. the laboratory's established schedule for verifying the reportable range requires more frequent calibration verification.<br>**Regulatory authority: 10 NYCRR subdivision 58-1.10(g)** | |
| QC Design S2a | **Quality Control Sustaining Standard of Practice 2a (QC Design S2a): Minimum Requirements**<br>a) Unless an individualized quality control plan is established as described in Quality Control Sustaining Standard of Practice 1, at least once each day patient specimens are examined, the laboratory shall: | • Daily Quality Control |

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| | b) for quantitative examinations, include two control materials of different concentration suitable for error detection throughout the reportable range;<br><br>**Regulatory authority: 10 NYCRR subdivision 58-1.10(g)**<br><br><u>Guidance</u><br>Although a run may be defined as up to 24 hours, a laboratory that elects to perform all quality control at a fixed time (e.g., start of the day shift) should demonstrate that the system is stable throughout the 24-hour period. | |
| QC Design S3 | **Quality Control Sustaining Standard of Practice 3 (QC Design S3): Control Limits**<br>Acceptable limits for each lot or shipment of control material shall:<br>a) be established over time by the laboratory, through concurrent testing with a control material having previously determined ranges, or established as fixed limits based on analytical system performance specifications around a validated target value;<br>b) reflect generally accepted medical and analytical requirements for each analyte; and<br>c) be established prior to being placed into use.<br>**Regulatory authority: 10 NYCRR paragraph 19.3(c)(3) and subdivision 58-1.10(g)** | • Daily Control Target and Limits |
| QC Design S4 | **Quality Control Sustaining Standard of Practice 4 (QC Design S4): Assayed Value Verification**<br>For each lot of assayed control material, the laboratory may use the stated value provided the assayed value:<br>a) is verified by the laboratory prior to being placed into use;<br>b) corresponds to the methodology and instrumentation used; and<br>c) ranges reflect generally accepted medical and analytical requirements for each analyte.<br>**Regulatory authority: 10 NYCRR paragraph 19.3(c)(3) and subdivision 58-1.10(g)**<br><br><u>Guidance</u><br>a) The manufacturer's stated value can be verified by running the control materials in a | • Quality Control Targets and Limits |

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| | minimum ten routine assay runs that meet criteria for acceptance with verified controls. | |
| QC Design S5 | **Quality Control Sustaining Standard of Practice 5 (QC Design S5): Calibration Material Used as QC Material**<br>When using calibration material as a control material, the laboratory must use calibration material from a different lot number than that used to establish a cut-off value or to calibrate the test system.<br>**Regulatory authority: 10 NYCRR subdivision 58-1.10(g)** | • Calibration Verification |
| Process QC S1 | **Process QC Sustaining Standard of Practice 1 (Process QC S1): Implementation**<br>For each test system:<br>a) perform control procedures using the number and frequency established as described in Quality Control Sustaining Standard of Practice 1 and any applicable specialty standard(s), or following requirements set forth in QC Design Sustaining Standard of Practice 2a;<br>b) process and test quality control material in the same manner as patient specimens indicative of the laboratory's routine workload; and,<br>c) define the parameters for acceptability of quality control results.<br>**Regulatory authority: 10 NYCRR subdivision 58-1.10(g)** | • Daily Quality Control |
| Process QC S6 | **Process QC Sustaining Standard of Practice 6 (Process QC S6): Operators**<br>Quality control materials must be rotated on a regular basis among all operators who perform the test.<br>**Regulatory authority: 10 NYCRR subdivision 58-1.10(g)**<br><br><u>Guidance</u><br>If a laboratory operates on multiple shifts, quality control material shall be incorporated on other shifts on a regular basis. | • Daily Quality Control |
| Process QC S7 | **Process QC Sustaining Standard of Practice 7 (Process QC S7): Records**<br>Records shall be kept of the actual results for each control determination, including quality control charts and/or other records which | • Daily Quality Control |

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| | identify by date and lot the controls and/or calibrators used by the laboratory.<br>**Regulatory authority: 10 NYCRR paragraph 58-1.11(c)(3)** | |
| Process QC S8 | **Process QC Sustaining Standard of Practice 8 (Process QC S8): Review**<br>The laboratory shall have a system of documented review of quality control records that permits the timely identification of shifts, trends or other indicators of assay instability.<br>**Regulatory authority: 10 NYCRR subdivision 58-1.10(g)** | • Quality Control Statistical Analysis |
| Retention S3 | **Records Retention Sustaining Standard of Practice 3 (Retention S3): Test Request and Process Documents**<br>The laboratory shall retain the following records for at least the period specified, except that where other New York State or Federal regulations or statutes require retention for different periods of time, the laboratory shall retain the appropriate record for the longest period applicable.<br>a) Test requisitions shall be retained for the same period of time as required for the test results or seven years, whichever is less, except that referral information for cytogenetic cases shall be retained for six years.<br>b) Accession records shall be retained for seven years.<br>c) Test procedures shall be retained for at least two years after a procedure has been discontinued, and all test procedures must include the dates of initial use and discontinuance.<br>d) Analytic system records, including worksheets containing instrument readings and/or personal observations upon which the outcome is based, the identity of personnel who performed the tests, quality control, patient results, and product recalls for reagents and consumables shall be retained for at least two years.<br>e) Preventive maintenance, service and repair records shall be retained for as long as the instrument remains in use, except that records of monitoring of temperature-controlled spaces shall be kept for two years. | • Daily Quality Control |

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| | f) Records of test system performance specifications that the laboratory establishes or verifies under Validation Sustaining Standard of Practice 5 and product recalls for equipment parts shall be retained for the period of time the laboratory uses the test system plus two years after the system has been discontinued, but no less than two years.<br>**Regulatory authority: 10 NYCRR paragraphs 58-1.11(c)(2),(3),(4)** | |

# 7. COLA

| Category/Item # | Title | BCQM[h] Support of Compliance |
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| APM 7 R | Directions for calibration and calibration verification procedures should include the following:<br>• Identification of the type and concentration of materials to be used,<br>• The number of calibrators required,<br>• Step by step instructions for performing the calibration or calibration verification procedure,<br>• Acceptable limits or criteria for interpretation of results,<br>• Corrective actions to be taken if the calibration or calibration verification is unacceptable. | • Calibration Verification<br>• Calibration |
| APM 8 R | Control procedures and criteria defining unacceptable control results? | • Daily Quality Control<br>• Quality Control Targets and Limits<br>• Quality Control Statistical Analysis |
| APM 9 R | Corrective actions to take when control or calibration limits are exceeded? | • Corrective Action Process When QC Fails |
| CA 1 R | **For all non-waived tests and methods, as applicable, is calibration performed at the frequency recommended by the manufacturer or at the frequency** | • Calibration Verification<br>• Calibration |

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| | **determined by the laboratory if more stringent than the manufacturer?**<br>Calibration is the process of method standardization according to manufacturer's instructions or as determined by the laboratory during verification of performance specifications. This is performed by using calibrators (standards) of the number, type and concentration indicated by the manufacturer to actually set parameters in the instrument as the basis of determining all other test results. Automated cell counters must be calibrated at least every six months. | |
| CA 2 R | **Is calibration verification performed, according to the manufacturer's instructions including:**<br>• the number, type and concentration of materials to be used,<br>• use of materials at low, medium and high values within the reportable range, as determined by the laboratory,<br>• acceptable limits for calibration verification, once every six months or more often if required by laboratory procedures?<br>Calibration verification is intended to confirm that the calibration setting continues to provide accurate results over the reportable range of the test system. It requires a These specimens need to have known values and should be tested in the same manner as patients. The results obtained are then compared to the known values within manufacturer or laboratory defined limits of acceptability. If the calibration is holding, the recovered value should match the expected value. If not, recalibration is indicated. This procedure is used to verify that a new lot of reagents, a complete change of reagents, or instrument service of critical parts<br>has not negatively affected the calibration. It may also be used in troubleshooting unacceptable QC results.<br>If the laboratory's calibration procedures includes 3 or more standards (low, mid point, and high) and is performed at least every 6 months, the requirement for calibration | • Calibration Verification |

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| | verification is automatically met and the laboratory does not need to take further action in this regard.<br>EXCEPTIONS<br>• For automated cell counters, calibration verification is met if the lab follows manufacturer's instructions for instrument operation and performs a minimum of two (2) levels of QC each day of testing. | |
| CA 3 R | **Do you follow accepted methods for calibration and calibration verification for all non-waived test systems?**<br>These instructions can be found in your instrument operator's manual. | • Calibration Verification<br>• Calibration |
| CA 4 R | **Does the calibration procedure use calibration materials that are traceable to a National Institute of Standards and Technology (NIST) standard?**<br>Most standards which are usually included with the reagents for the test is traceable to a NIST standard, or other national or worldwide standard. Refer to the package insert included with the reagents. If the package insert does not indicate this, check with your manufacturer. Traceable standards are not available for all analytes. You may need to purchase a separate standard set, traceable to a NIST standard, to be used only for calibration or calibration verification. | • Quality Control Targets and Limits |
| CA 5 R | **Do you perform calibration verification whenever a new lot number or a complete change of reagents occurs, unless it can be shown that such changes do not affect test results?**<br>Exception: Calibration verification does not need to be performed in the case of a lot number change or a complete change of reagents if it can be shown that the calibration of the instrument or method is not affected by these changes. This can be demonstrated by documenting several consecutive instances where there were no adjustments to the calibration needed. | • Calibration Verification |
| CA 6 E | **Do you perform a calibration verification whenever a test system has major preventive maintenance; a critical part is changed; and when controls show shifts,** | • Calibration Verification |

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| | **trends, or are out-of-limits; and recalibrate whenever the instrument fails calibration verification?**<br>Service contracts include calibration as part of the preventive maintenance performed by the contractor. If they perform this necessary calibration for you, be sure to retain all relevant documentation. | |
| CA 7 R | **Does the laboratory perform and document all corrective actions taken when calibration/calibration verification values are not within established limits?** | • Corrective Action Process When QC Fails |
| CA 8 R | **Do you recalibrate when quality control shows trends, shifts, or is out of limits, and other corrective action has not remedied the problem?**<br>This is a good troubleshooting and corrective action step to be taken after other corrective actions have been attempted and failed to rectify the problem. Sometimes calibration drifts on instruments between regularly scheduled calibrations and needs to be re-set. Many times recalibration corrects the Quality Control problem. If this doesn't work, it may be time to request a service call for the instrument. | • Calibration |
| CA 9 R | **Do you keep records of all calibration and calibration verification activities including the number, type and concentration of materials used, results obtained, and any adjustments to the calibration?** | • Calibration Verification<br>• Calibration |
| QC 1 E | **Do you have a quality control program that monitors the complete analytic process for each test performed?**<br>A quality control program must be capable of detecting errors throughout the complete analytic process. This includes errors related to test system components and environmental conditions, as well as operator variance. The quality control program must detect both immediate errors and those that occur over time. A quality control program includes running control materials prior to or concurrent with patient specimens. The program defines the number, type and frequency of controls performed; the established or expected ranges for control values; a process for identification and review | • Daily Quality Control<br>• Quality Control Targets and Limits<br>• Corrective Action Process When QC Fails |

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| | of system problems; description of corrective actions to be taken when unacceptable results are obtained; and documentation of all activities. | |
| QC 2 R | **The frequency of performing controls?** | • Daily Quality Control |
| QC 3 R | **The number of controls to perform?** | • Daily Quality Control |
| QC 4 R | **The type of controls to perform?**<br>Many controls come in various concentrations (e.g., low, normal, high). If the manufacturer does not specify that all levels of control be performed each day of patient testing, then the CLIA requirement of at least two levels applies. If the test system has more than two levels of controls, you should specify the frequency for running each level of control. For example, you may decide that the normal controls should be part of every run and the low and the high controls will be alternated to provide a second control each day of testing. Or you may establish a schedule to rotate the controls run each day. | • Daily Quality Control |
| QC 5 R | **The acceptable limits for control results?**<br>For Quantitative controls, statistical parameters (for example mean and standard deviation) for each batch and lot number of control materials must be defined and available. Acceptable limits should be listed on the package insert of the commercially assayed controls for the methodology and instrumentation you are using. Qualitative controls are positive or negative, reactive or nonreactive,<br>or of graded reactivity (weakly or strongly reactive). This is listed in the package insert as well as on the label of the control material. | • Quality Control Targets and Limits |
| QC 6 R | **The corrective actions to take if controls exceed those limits?**<br>Patient results may not be reported if the control material does not produce the values or reaction expected. A policy must be established for corrective action when controls are out of the acceptable range. | • Corrective Action Process When QC Fails |

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| QC 7 R | **Are appropriate reference materials used for controls?**<br>The type of reference materials which should be used for controls should be specified by the manufacturer. The control material which your laboratory uses should be recorded as part of the procedure for each test (or may be included as part of a quality control program for a particular instrument). | • Quality Control Target and Limits |
| QC 8 R | **Are the materials used as controls verified by repetitive testing to meet the manufacturer's established parameters for mean and standard deviation?**<br>The Surveyor will look at records that demonstrate that the mean and standard deviation for new lot<br>numbers of QC have been verified prior to use. For definition of "mean" and "standard deviation," refer to LabGuide 50.<br>• The Surveyor will look for records of parallel testing. The new lot of control materials should be run as patient samples for at least 5 different days, when possible, along with current lot of quality control.<br>• The Surveyor will check the QC records for quantitative tests. The control ranges need to be appropriate for the methodology in use by the laboratory. There should be a separate record or notation when there is a control lot number change and verification of the manufacturer's mean and standard deviation. If the control does not have ranges for the laboratory's methodology, more values will be needed to establish a mean and SD. | • Quality Control Target and Limits |
| QC 10 R | **Are manufacturer's instructions for the use of reagents, controls, and kits followed?**<br>This criterion applies to waived and non-waived testing.<br>• The Surveyor will review manufacturer's instructions and your test records to make sure that manufacturer's instructions are being met consistently. This includes the type of specimen, the test procedure, | • Daily Quality Control<br>• Quality Control Target and Limits |

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| | materials used, Quality Control, calibration, and the manufacturer's intended use of the test. | |
| QC 13 R | **When QC or calibration material is used to establish a cut off value for determining positive or negative reactivity in patient samples, is the test controlled using materials of a different lot number than those used to establish the cut off value?**<br>It is not acceptable to use the same material (lot number) to standardize or calibrate a test system and to determine ongoing test accuracy and precision. If there was a problem with the material used to standardize the system, you would not be able to obtain accurate results on patient samples; however you would be unable to detect this through the performance of QC. Essentially a bias would be set in your instrument causing results to be consistently high or low. By using a material of a different lot number you are likely to get something with a different value and different acceptable range. This will allow you to challenge the system and ensure the results obtained are within acceptable limits.<br>Necessity may require that the same type of material be used as both calibrator and QC for a given test system. When this occurs, the materials used cannot be of the same lot number. | • Calibration<br>• Calibration Verification |
| QC 14 R | **Do you run controls, before resuming patient testing, when there is a complete change of reagents, major preventative maintenance is performed or any critical part is replaced that may influence test performance?**<br>If you have a complete change of reagents, major preventative maintenance is performed or a critical part is replaced, control materials must be run to verify test performance before patient testing may resume. Refer to your Quality Control program for<br>the number and type of controls required for the test system involved. | • Calibration Verification<br>• QC Trend Review |
| QC 15 E | **If you perform quantitative tests, are two different control concentrations performed each day of patient testing?** | • Daily Quality Control |

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| | • The Surveyor will review laboratory documentation to demonstrate that two levels of controls are performed each day of patient testing. Records should include the date of test, the values obtained, and an indication of who performed the test. Acceptable ran ges for the lot number used should be available for the Surveyor to review. | • Quality Control Target and Limits |
| QC 16 R | **For each quantitative test performed, are quality control data prepared and plotted with each testing event, or are statistical parameters calculated to permit the laboratory to assess continued accuracy and precision of the method?**<br>Control charts, graphs, or statistical parameters (i.e. mean, SD, and CV) should be maintained for all quantitative tests performed by the laboratory. Many instruments and Laboratory Information Systems have the capability to track this information electronically. This data should be reviewed weekly or following every 5-7 data points if performed infrequently to detect changes such as shifts or trends that may be indicators of test system problems that need to be addressed.<br>Such routine reviews may permit the laboratory to recognize a developing potential problem and take action to prevent unacceptable results, which could ultimately impact the quality of patient results or create disruptions in access to needed testing due to instrument, test system, or environmental failures. | • QC Trend Review<br>• Quality Control Statistical Analysis |
| QC 25 R | **Are control results reviewed by testing personnel in order to detect possible errors that may occur due to the following conditions:**<br>• **Instrument or procedural failures,**<br>• **Adverse environmental conditions, AND**<br>• **Variance in operator performance?**<br>Testing personnel need to be aware of the importance of ensuring acceptability of results prior to conducting patient testing. A failure in control results can be related to a number of | • Quality Control Statistical Analysis |

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| | different causes such as reagents, instrumentation, operator error, or environmental conditions. All of which can also impact the accuracy of patient results. Staff should be trained to routinely review QC results and document acceptability prior to conducting patient testing. Many laboratories elect to have staff initial daily records to indicate that QC was performed and in range. If electronic capabilities exist it is not necessary that computerized reports be printed on a daily basis; however they must at least be reviewed on screen. This should be documented in some fashion. At a minimum the laboratory must be able to demonstrate the QC is reviewed based on corrective action documentation for any unacceptable result. | |
| QC 25 R | **Before you begin patient testing, do you take appropriate action and record it when controls exceed acceptable limits?**<br>Daily quality control results must meet your criteria for acceptability prior to reporting patient test results.<br>• The Surveyor will review QC and patient records to make sure that the lab has taken and documented corrective action before reporting patient results when QC has failed. Records may be in the form of corrective action logs, QC logs with notations, patient test result logs or reports which include QC documentation. | • Corrective Action Process When QC Fails |
| QC 28 R | **Does the laboratory director or qualified designee regularly review the quality control data with laboratory personnel?**<br>The laboratory director is responsible to assure that QC is routinely reviewed to detect and correct potential problems that may impact the accuracy of patient results. This responsibility may be delegated; however the director is responsible for the performance and quality of the review. The QC results which have been reviewed should be initialed by the person reviewing them. The QC review should assess the following for acceptability with laboratory policy:<br>• Number, type and frequency of QC performance | • Quality Control Statistical Analysis<br>• Daily Quality Control |

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| | • Acceptability of QC results<br>• Corrective action for out of range results.<br>The Surveyor will review QC records for evidence of review – including initials/signature and date of the review. Reviews should take place at least on a monthly basis. It is not necessary that the QC review be exactly every 30 days, but rather at least one review every calendar month. Each individual analyte needs to have a documented review. If data point(s) fall outside of the acceptable ranges, notation and corrective action, if necessary according to the lab's QC procedures, needs to be included in the review. Corrective actions may include such actions as opening a new bottle of QC, replacing the reagent, or recalibration.<br>Trends or shifts in QC should be noted as well. | |
| QC 29 R | **Are quality control records retained for at least two years?**<br>The Surveyor will review records to verify that instrument print outs, monthly review of statistical data, evaluation of new lots of quality control, corrective action logs, etc, are maintained for at least two years. Electronic records are acceptable. | • QC Trend Review<br>• Corrective Actiuon Process When QC Fails |
| HE 3 E | **If you perform automated hematology, (CBC's, reticulocyte counts, and/or body fluid counts) are a minimum of two levels of commercial control run each day of patient testing?** | • Daily Quality Control |
| QA 9 R | **Does the quality assessment review evaluate the corrective actions taken by laboratory personnel when quality control or calibration is out of range or instruments are out of calibration?**<br>The QA review should look at several months of QC, calibration and maintenance records to see if the laboratory staff is identifying and taking corrective action when problems occur. Beyond this, the laboratory should look for patterns among the<br>incidents requiring corrective action and the actual actions taken. Identification of a pattern of repetitive events is a trigger that | • Corrective Action Process When QC Fails |

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| | something in the process is going awry. Identification of the root of this issue and formulation of process changes to prevent future occurrences is the goal of the QA program. | |
| QA 12 R | **If you perform the same test using different methods or instruments, do you evaluate the variance in the results produced by each method at least twice a year?**<br>When multiple methods are used to perform the same test, it is important for the laboratory and the practitioners it supports to understand the relationship between results produced by each method. This is most critical when tracking results on a specific individual over time. If significant variances in results are present, they could potentially be interpreted as denoting changes in the patient's condition, when in fact they are merely the result of a bias among methods. This is easily done by split specimen analysis. If any bias is noted, it is important to reflect the difference in the reference ranges that are used on the test report. This requirement also includes back-up instruments. | • Comparability of Instruments/Methods |

# 8. BeyondCare Quality Monitor for Hematology (BCQM*h*)

## 8.1 Daily Quality Control

The goal of the BCQM*h* application is to provide a simplified, modernized, analytical quality assurance program which interprets quality assurance data and provides real-time accuracy and precision judgment of your Sysmex analyzer. Using real-time analysis and incorporating multiple algorithms, BCQM*h* will detect analyzer issues earlier than traditional QC practices. BCQM*h* has the potential to detect all possible QC failures with minimum false rejection ensuring analyzer reliability while providing a consistent QC process.

The BCQM*h* application requires laboratories to define how many levels of control are required for each QC analysis and how often controls are required to be analyzed. The minimum QC requirement for BCQM*h* is to analyze at least two levels of controls every 24 hrs. However, for optimal analyzer monitoring, the recommendation is to analyze at least three levels of controls every 24 hrs. The BCQM*h* application simplifies the QC process, only requiring the operator to mix the QC vials and run them on the analyzer.

The BCQM$^h$ application automatically tracks the time between control runs, that the minimum number of control levels are processed, and verifies the analyzer performance is within specifications. When all control requirements and quality are achieved, the application provides a “Ready for Samples” message in the Dashboard screen.

The BCQM$^h$ application interprets QC data generated by the analyzer and provides feedback on the analyzer’s performance, including automatic troubleshooting prompts to help resolve any QC issues. When laboratory intervention is necessary, the application provides dynamic step-by-step instructions that are easy to follow. All actions are documented in the activity log. If QC is within specifications after corrective actions, the failed QC run is automatically removed from the statistical calculations (unmanaged) but is not deleted from the file. The BCQM$^h$ application never allows deletion of QC data. When QC remains outside of specifications after completing all corrective actions, BCQM$^h$ automatically escalates the issue to the Sysmex service team for resolution. All service events are logged in the Service History screen.

QC data is analyzed using multiple algorithms to determine if accuracy or precision problems are present in the analytical system. An analyzer with a green status in BCQM$^h$ indicates accuracy and precision have passed the analysis criteria, ensuring that the system is ready for sample analysis. A yellow status in BCQM$^h$ indicates that more information is needed to determine if the analyzer is ready to run patient samples, and a red status in BCQM$^h$ indicates an accuracy or precision issue. Whenever the analyzer fails the BCQM$^h$ quality checks, the application automatically generates a service repair ticket and prompts Sysmex service to contact the laboratory for resolution.

The QC target is model, parameter, and level specific, similar in concept to the proficiency testing approach.

Sysmex recommends the use of the BCQM$^h$ target/ limit synchronization procedure (described in detail with the BeyondCare$^{SM}$ Quality Monitor for Hematology Instructions for Use - Document Number: 1506-MKT, Rev. 2), when setting up a file for a **new** lot number of quality control material, for both the XN-Series and XN-L Series analyzers. This procedure will enable the operator to update the analyzer target and limits on the XN-Series IPU to match the BCQM$^h$ target and limits. The use of this procedure will also help to minimize false positive Levey-Jennings limit errors and quality control outliers in the analyzer files when using BCQM$^h$ to monitor quality control. The use of the procedure to synchronize the analyzer file target/limits throughout the life of the QC material lot number is optional.

| Area of Compliance | What to look for within the BCQM$^h$ application* |
|---|---|
| BCQM$^h$ Preferences | Number of levels and hours between control runs |
| Summary Report | Green with P (passing) during patient testing hours |
| Detailed Daily Report | Number of control runs and passing control status each day of patient testing |
| Dashboard | Analyzer status green with Ready for Samples |
| Activity Log | When the BCQM$^h$ detects an issue an automated corrective action is provided to the operator. The Activity Log documents the corrective action and operator action. |

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| CLSI Procedure | Control procedures for each model are located in the CLSI Procedure guide. |

* The BCQM$^h$ application is the primary method for determining the analyzer is acceptable for reporting patient results.

## 8.2 Quality Control Target and Limits

The BCQM$^h$ application uses a method similar to the proficiency testing concept to calculate the control target values. The control target includes thousands of peer group data points ("Big Data") to reduce uncertainty of the target value.

Sysmex does not recommend individual control target values set by serial number when using the BCQM application. Serial number based control targets are susceptible to incorrect values due to many factors and minimal amount of data when setting a control lot target value.

The Big data method allows for specific targets based on true lot performance of the biological commercial blood control. This also eliminates possible incorrect serial number specific control target values due to damaged control material or problem with the analyzer or reagents.

The daily control target is built from "Big Data" and verified to international conventional reference measurement procedures. The following reference methods were used to assign the values to the fresh whole blood used for reference analyzer calibration:

1. WBC and RBC: Reference method for the enumeration of erythrocytes and leucocytes, ICSH Expert Panel on Cytometry, Clin Lab Haematol. 1994; 16, 131-138. Counts are performed on SCC (Semi-automated Single Channel counter), a volumetric manometer semi-automated electronic impedance cell counter.
2. HGB: Recommendation for reference method for haemoglobinometry in human blood (ICSH standard 1995) and specification for international haemiglobincyanide standard (4th edition), ICSH Expert Panel on Haemoglobinometry, J Clin Pathol 1996; 49: 271-274.
3. CLSI H15-A3: Reference and selected procedures for the quantitative determination of hemoglobin in blood; Approved Standard – Third edition (2000). Photometry on 1:250 dilutions with appropriate reagent (recommended by van Kampen, Zijlstra).
4. HCT: Recommendations for Reference Method for the Packed Cell Volume (ICSH Standard 2001), ICSH Expert Panel on Cytometry, Clin Lab Hematol. 2001; 7:148-170. CLSI H7-A3: Procedure for determining Packed Cell Volume by the Microhematocrit Method; Approved Standard – Third edition.
5. PLT: Platelet counting by the RBC/Platelet Ratio Method, ICSH Expert Panel on Cytometry and International Society of Laboratory Hematology Task Force on Platelet Counting, American Journal of Clinical Pathology 2001; 115:460-464
6. RET%: Methods for Reticulocyte Counting (Automated Blood Cell Counters, Flow Cytometry, and Supravital Dyes); Approved Guideline – Second Edition Manual method CLSI H44-A2.

The traceability report shows the target value (peer group mean obtained through ***Insight***™ Inter-Laboratory Quality Assessment program) which is plotted in comparison to the value obtained with reference methods. This ensures that the target is traceable to be within Assay Reference Range limits. The reference range limits are assigned based on Sysmex Assay Lab

analyzers traceable to international conventional reference measurement procedures. If the target lies within Assay Reference Range limits, then the target is traceable to reference methods and the uncertainty that is inherent within the reference methods.

Sysmex has developed model-specific control range limit percents (%) to help you better manage and/or identify changes in control results through the introduction of Six Sigma based ranges. These range limit percents (%) have been developed using Six Sigma methods, and provide the following benefits.

1. Easy identification of changes in analyzer performance
2. Potentially reduces laboratory costs
3. Helps enhance overall productivity

Sysmex Evidence-Based control limits are calculated using a performance goal of 4 Sigma, ***Insight***™ average parameter bias, and analyzer variability (CV). The HCT, MCV, and MCHC control limits are calculated using 3.5 Sigma goals to account for slight RBC swelling throughout the control product life.

This formula provides a percent limit for each parameter that includes control performance, analyte test variability, allowable bias, and performance goal.

Sysmex Evidence-Based control limits use six cumulative ***Insight***™ reporting periods to calculate the limits.

| Area of Compliance | What to look for within the BCQM$^h$ application |
|---|---|
| Traceability Report | Verification of control target to international conventional reference measurement procedures |
| Evidence-based Control Limits 62-1399 | Sysmex recommended control limits by model |
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## 8.3 Quality Control Statistical Analysis

The BCQM$^h$ application identifies random and systematic errors using multiple real-time algorithms. The algorithms which check for random errors look at the coefficient of variation (CV) of the lot-to-date QC analyzed and the CV of the recent QC sample set. The algorithms which check for systematic errors determine if the lot-to-date standard deviation index (SDI) exceeds the limit and if the recent QC sample set exceeds those SDI limits. There are also algorithms which check for the frequency of out of limit failures which can also indicate random errors. If any of the QC analyses exceeds the algorithm limits, BCQM automatically escalates the issue to the Sysmex service team for resolution.

The Detailed Daily Verification Report provides a visual display of control trending by plotting each level that is analyzed daily onto a scale representing percent of allowable range. The closer the QC levels are in proximity to 0% (target value), the better the accuracy. The further that the QC values plot away from the target in a consistent pattern near the upper or lower limit, may indicate a systematic error. If the QC levels are plotted in close proximity to each

other on the % of range scale, this represents acceptable precision. When the QC levels are plotted by being widely spread and/or exceeding the limit, this may indicate random error.

The ***Insight*™** report also features statistical data alerts to address systematic issues by evaluating SDIs and flagging parameters based on how far the parameter is away from the peer group mean. Random error issues are highlighted when the analyzer CV value is bolded because it is 1.5 times greater than the group CV.

| Area of Compliance | What to look for within the BCQM$^h$ application |
|---|---|
| Detailed Daily Verification Report<br>***Insight*™** Report | DDV Report-Any values that are consistently trending near the upper or lower limit for systematic errors. Any values displaying a red X at the upper or lower limit can be due to random error.<br><br>***Insight*™**: Bias flags for systematic errors, bolded CVs for random errors. |
| Service History | BCQM$^h$ automatically escalates issues requiring resolution to Sysmex service team and documents this in Service History. |
| Detailed Daily Verification Report<br>Continuous Calibration Verification Certificate | DDV Report-QC data plots concisely and nearer to the target value<br>CCV Report- If all QC levels plot near the limits indicates systematic error. If your cv is bolded, this indicates random error. |
| Continuous Calibration Verification Certificate<br>Summary Report<br>Parameter Report<br>Detailed Daily Verification Report | Continuous Calibration Verification Certificate- Notes column indicates if accuracy and precision passed<br>Summary Report- P will display if QC passes accuracy and precision<br>Parameter Report- Notes section will indicate if there is accuracy or precision issue<br>Detailed Daily Verification Report- QC data should plot within bolded lines |
| • BCQM$^h$<br>  ○ Summary Report<br>  ○ Activity Log<br>  ○ Service Log | BCQM$^h$ will check for random and systematic errors, and issues that occur will be tracked in Summary Report, Activity Log and Service log if issue not resolved |
| • BCQM$^h$<br>  • Reviewed Documents | Reviewed reports within the BCQM$^h$ application log the reviewer, date/time of review, and notes during the review. A log of the review can be found in Activity tab under Reviewed Documents. |

## 8.4 Corrective Action Process when QC fails

When laboratory intervention is necessary, the BCQM$^h$ application provides dynamic step-by-step instructions that are easy to follow. All actions are documented in the activity log. If QC passes specifications after corrective actions, the failed QC run(s) are automatically unmanaged, or removed from the cumulative statistics. The analyzer status on the Dashboard turns green and is ready for patient samples. If analyzer status is yellow, this indicates that more

QC information is needed to determine if the analyzer is ready to run patient samples. When QC remains outside of specifications after completing all corrective actions, BCQM$^h$ dashboard will turn red and automatically escalate the issue to the Sysmex service team. All service events are logged in the Service History tab. The BCQM$^h$ does not allow deletion of QC data points.

| Area of Compliance | What to look for within the BCQM$^h$ application |
|---|---|
| Activity Log<br>Service Log | Activity Log- All troubleshooting action items will be documented showing action, sample date/time, and the user.<br>Service Log- The Service History tab provides a list of Sysmex service reports for analyzers enrolled in the BCQM$^h$ Application. |
| BCQM$^h$ Application<br>Activity Log | BCQM$^h$ Application- Resolve button will appear on dashboard screen and walks the operator through corrective action |
| BCQM$^h$ Application | BCQM$^h$ Application- Service History |
| Dashboard Analyzer Status<br>Activity Log | Dashboard Analyzer Status- Will display yellow with bolded ”Resolve” button. The ”Resolve” button walks the user through proper corrective actions. Patient samples should NOT be analyzed if status is yellow.<br>Activity Log- All troubleshooting action items will be documented showing action, sample date/time, and the user. |
| BCQM$^h$ Application<br>○ Summary Report<br>○ Activity Log<br>○ Service Log | Summary Report- Will display yellow status if more QC information is needed and it will display red if corrective actions did not resolve troubleshooting<br>Activity Log- All troubleshooting action items will be documented showing action, sample date/time, and the user.<br>Service Log- The Service History tab provides a list of Sysmex service reports for analyzers enrolled in the BCQM$^h$ Application. |
| BCQM$^h$ Application | Dashboard Analyzer Status- Will display yellow with bolded ”Resolve” button. The ”Resolve” button walks the user through proper corrective actions when QC falls outside total allowable limits. Patient samples should NOT be analyzed if status is yellow. |
| Dashboard Detailed Daily Verification Report | Dashboard Analyzer Status- Will display yellow with bolded ”Resolve” button. The ”Resolve” button walks the user through proper corrective actions when QC falls outside total allowable limits. Patient samples should NOT be analyzed if status is yellow.<br><br>Detailed Daily Verification Report- Will display red X at the upper or lower limit on chart if QC value exceeds limits.<br>Summary Report- Will display yellow status if more QC information is needed and it will display red if corrective actions did not resolve troubleshooting |
| • Activity Log<br>• Service History | Activity Log- All troubleshooting action items will be documented showing action, sample date/time, and the user. |

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| • Summary<br>• Dashboard | Service Log- The Service History tab provides a list of Sysmex service reports for analyzers enrolled in the BCQM$^h$ Application.<br>Summary- Summary report will show if corrective actions resolved issue by turning green with P, indicating QC falls within total allowable limits.<br>Dashboard- will appear green if corrective action resolved issue |

## 8.5 Peer Comparison

The ***Insight*™** IQAP provides a report of approximately 40 days of analyzer performance. Each analyzer is compared to the peer group for on-average accuracy. A cumulative review of past performance over 12 months is also available for both SDI and CV statistics.

The Parameter report is a consolidated view of each parameter's clinical and peer performance. The mean value of each parameter is displayed according to each parameter's clinical performance goal. The Parameter report can be accessed in the Manage QC tab.

| Area of Compliance | What to look for within the BCQM$^h$ application |
|---|---|
| Traceability Report<br>***Insight*™** IQAP Report | Traceability Report- reports shows the target value which is plotted in comparison to the reference value. This ensures that the target is traceable to be within reference range limits.<br>***Insight*™** IQAP Report- Can compare analyzer to peer group in terms SDI |
| Continuous Calibration Verification Certificate | Continuous Calibration Verification Certificate- Continuous Calibration Verification (CCV) Certificate provides an on-demand report for accuracy and precision of the test method. CCV follows CLIA §493.1255 requirements for calibration verification of automated cell counters using material approved for calibration verification. Each parameter's mean (your mean) is plotted on the graph for each level of QC in a percentage of range format: (Your Mean – Target)/(Target*Limit) 0% = Target value from the peer group mean 100% = Upper Limit (3SD from the target) -100% = Lower Limit (-3SD from the target) |
| Traceability Report | Traceability Report- The traceability report shows the target value which is plotted in comparison to the reference value. This ensures that the target is traceable to be within Reference Method limits. The Reference Method limits are assigned based on Sysmex Assay Lab analyzers traceable to International Conventional Reference Measurement Procedures (see Sysmex Calibrator Uncertainty and Traceability Customer Communication 62-1203). If the target lies within Reference Method limits, then the target is traceable to reference methods considering the uncertainty that is inherent to the reference methods. |
| Parameter Report | The Parameter report is a consolidated view of each parameter's clinical and peer performance. The mean value of each parameter is displayed according to each parameter's clinical performance goal. The Parameter report can be accessed in the Manage QC tab. |

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| BCQM$^h$ Application | BCQM$^h$ application- Dashboard will alert user whether controls passed within allowable limits |
| BCQM$^h$ Application | BCQM$^h$ - Analyzer specific control limits are established in accordance with §493.1253 and §493.1256. BCQM also automatically uses the Peer group mean information and defines the limits around this using Evidence Based QC limits. |

## 8.6 QC Trend review

The BCQM$^h$ automatically monitors analyzer performance in real-time and detects any abnormal QC performance. When an issue is detected the application provides corrective actions to the laboratory or creates a service repair ticket to Sysmex. The Summary report is a high level log of activity that documents when controls are within specifications with a P and service events with a S.

The BCQM$^h$ application allows several reports to manually review QC trending. Each of the reports can be electronically reviewed to document the name of the reviewer, date/time of review, and any comments. These electronic reviews can be found in the Activity tab or any report that was reviewed by selecting the History button in the lower left corner of the screen.

| Area of Compliance | What to look for within the BCQM$^h$ application |
|---|---|
| Summary Report | Review date and time of patient sampling should be green with a P indicating all QC requirements were met during that period. |
| ***Insight*™** Report | Review for bias codes, SD, and CV. Historic trending of analyzer to group for CV and SDI can be found in the History section of the report. |
| Parameter Report | Provides current SDI and historic SDI which is the average of the last 6 periods for an analyzer. The report also includes parameter performance relative to the CLIA Analytical Quality Requirements and the clinical goals derived from Dr. Carmen Rico's (Ricos C, 1999) "Desirable Biologic Variation Specifications database". The precision of the parameter is also provided in the CV column. |
| Detailed Daily Control Chart | Report that standardizes the control concentrations into one chart for trending review. Review to see like performance between the control levels with P for each day of patient testing. |
| Service History | The BCQM$^h$ application monitors analyzer performance for analytical and random error and opens a service ticket when an issue is detected. |
| Activity Log | This log documents corrective actions when an error is detected. |
| Reviewed Documents | Documents laboratory review of QC trending. Look for monthly review of QC reports. |

## 8.7 Background Log

The Background Log provides a history of results of background checks from the selected analyzer. The log includes model specific acceptable limits and judgment if the background check passed or failed the acceptable limits.

| Area of Compliance | What to look for within the BCQM$^h$ application |
|---|---|
| Background Log | Review for passing backgrounds |

## 8.8 Calibration Verification

The process for checking the accuracy and precision of an analyzer at regular timed intervals is known as calibration verification. Historically, a calibrator has been used on a semi-annual basis as a “check” of analyzer calibration. Laboratories also needed to document the results of calibration verification activities.

The CLIA requirement states that calibration verification requirements are met when:

1. The lab follows manufacturer’s instruction for instrument operation
2. The lab tests two levels of control materials each day, whereby the control results meet the laboratory’s criteria of acceptability.

With BCQM$^h$, calibration is verified each time two levels of QC are analyzed and the results fall within algorithm specification guidelines developed for the BCQM$^h$ program. For most labs, this means calibration will be verified every 24 hours; more often if QC frequency occurs 2-3 times daily. There is no longer a 6-month gap between calibration verification events to verify that an analyzer is accurate and precise. Additionally, this analysis is performed for all parameters contained in the QC product. Traditional hematology calibrators used for calibration verification evaluate a limited number of parameters. The control package inserts are also aligned with this continuous calibration verification process. In the “Intended Use” section of the control package inserts, it states that the controls are intended for quality control and calibration verification (not calibration).

If data from the last two different levels of controls recover within BCQM$^h$ specifications, calibration verification passes. A green analyzer status is displayed on the dashboard page and the Summary report will show a “P” (pass) for that QC run. The Detailed Daily Verification report will also show a “P” (pass) if the last two levels of QC analyzed that day are within calibration verification specifications.

The Continuous Calibration Verification (CCV) Certificate provides an on-demand report for documenting accuracy and precision of the test method. Accuracy or trueness of the test method to a standard following a similar method as CLIA proficiency survey target. Using this method reduces accuracy error associated with uncertainty of assayed commercial blood calibrators. The test method is accurate when “Your Mean” is within the Upper and Lower limits on the CCV certificate. When “Your Mean” exceeds the CCV certificate limits, suspect the presence of systematic error which is affecting accuracy.

The CCV certificate also assesses precision or the repeatability of the test method. The test method passes precision checks when “Your CV” is equal to or less than the CV Limit% on the CCV certificate. “Your CV” will be bolded along with a “1” appearing in the Notes column if “Your

CV" exceeds the CV Limit%. When "Your CV" exceeds the CV Limit%, the lab should review the analyzer's control data for anomalous data or suspect random error in the test method affecting precision.

### 8.8.1 Pipettor and Diluter Verification

The sample aspiration and dilution functions of Sysmex hematology analyzers are performed by components integrated into the analyzer. This also applies to the components used for the diluent dispense function on the XN-L Series analyzers. It is not possible or practical for the end user to directly verify the accuracy or reproducibility of these aspiration and dilution system components.

Verification of system accuracy and reproducibility is performed by routine analysis of quality control material. Routine calibration verification with the BCQM*h* application further verifies the accuracy and reproducibility of the system.

| Area of Compliance | What to look for within the BCQM*h* application |
|---|---|
| Continuous Calibration Verification Certificate | Review for passing performance in the Notes section with a P. The P indicates precision and accuracy of the test parameter is within specifications. |
| Calibration Verification Procedure | Calibration Verification procedures for each model are located in the CLSI Managed Calibration Procedure Template and in the BCQM*h* application in the Calibration History screen. |

## 8.9 Calibration

Calibration is the process of testing and adjusting the instrument or test system readout to establish a correlation between the instrument's measurement of the substance being tested and the actual concentration of the substance. This process is performed by a Sysmex Service Engineer or by a Sysmex Technical Assistance Center representative by performing an Evidence-based Calibration. Each time that a calibration is performed, a Calibration Certificate is produced for laboratory records.

Sysmex automated hematology cell counter calibration does not expire and is not reagent lot dependent. Sysmex does not recommend adjusting the calibration of analyzers when QC recovery is within specifications and calibration verification is passing. Calibration adjustments when not required increase test method result variability and may mask underlying analyzer or reagent issues.

Calibration of an analyzer should only be completed during installation activity, major hardware repairs, or when calibration verification fails and troubleshooting indicates that there is no major underlying problem with the analyzer, reagents or quality control materials.

| Area of Compliance | What to look for within the BCQM*h* application |
|---|---|

| | |
|---|---|
| Sysmex Calibrator Uncertainty and Traceability 62-1340 | Traceability Flow Chart and Uncertainty of the assigned values for Sysmex calibrators XN CAL™, XN CAL™ PF and X-CAL™ |
| Calibration Certificate | When calibration is required a certificate of calibration using an approved commercial calibrator material is located in the Calibration History tab. |
| Calibration Process | Calibration procedures for each model are located in the CLSI Managed Calibration ProcedureTemplates. |

### 8.9.1 Comparability of Different Sampling Modes and Multiple Analyzers

The Sysmex® XN-Series and XN-L Series uses one sampling pathway or "mode" and does not require open to closed mode verifications.

Laboratory sites that use multiple analyzers to test for a given analyte should periodically check for comparability of results between analyzers as required by regulatory agencies. There are several methods to check for comparability between analyzers.

#### 8.9.2 Commercial Quality Control

The BCQM$^h$ Parameter report can be generated for a single parameter or for all parameters. The report includes all analyze models associated to an ***Insight*™** site or laboratory group. Use of this report allows a method to verify comparability on-demand for analyzers within a laboratory or dispersed in remote laboratories.

NOTE: Some regulatory agencies allow for use of quality control material for periodic analyzer-to-analyzer comparability checks when comparing results generated by identical models of analyzers. Follow the guidance of your regulatory agency and local laboratory procedures.

#### 8.9.3 Whole Blood Analyzer-to-Analyzer Comparison

The purpose of the cross-check procedure is to ensure multiple analyzers within the same site are calibrated to ensure reproducibility of patient data across all analyzers. This procedure is only applicable to comparisons with analyzers at remote laboratories if testing of samples can be completed on both the reference and comparison analyzers within four hours of each other. Product Notification Analyzer-to-Analyzer Correlation 62-1457 provides recommended procedure and specifications.

| Area of Compliance | What to look for within the BCQM$^h$ application |
|---|---|
| Parameter Report | Provides current SDI and historic SDI which is the average of the last 6 periods for an analyzer. The report also includes parameter performance to clinical goals derived from CLIA and (Ricos C, 1999)The precision of the parameter is also provided in the CV column. |
| Analyzer-to-Analyzer Correlation 62-1457 | Recommend procedure and specifications |