Laboratory Management: Quality Assurance and Inspection

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46.1 Inspection

- The molecular pathology laboratory has two main inspecting bodies and a laboratory must always be in a state of inspection readiness. These inspecting bodies are the individual state boards of health and the federal Clinical Laboratory Improvement Amendments of 1988 (CLIA) program. High complexity testing certification for laboratories from CLIA is obtained from inspections conducted by the College of American Pathology (CAP) and the Joint Commission. The information discussed regarding requirements for a molecular pathology laboratory is taken from the CLIA regulations and CAP checklist requirements
- CAP has designated checklists based on specialty. The CAP defines molecular testing as a laboratory performing DNA or RNA probe hybridization or amplification. The molecular pathology checklist covers clinical molecular genetics testing including
  - Oncology
  - Hematology
  - Inherited disease
  - HLA typing
  - Forensics
  - Parentage
- Laboratories performing molecular testing for infectious disease for both FDA-cleared and non-FDA-cleared tests may use the microbiology checklist for inspection
- The cytogenetic checklist may be used to inspect fluorescence in situ hybridization (FISH) in a cytogenetics laboratory division
- The anatomic pathology checklist may be used to inspect FISH testing or in situ hybridization (ISH) testing in an anatomic pathology laboratory section
- In 2011, due to each department or laboratory-defined section unit during a CAP inspection being inspected from multiple checklists, the CAP has started to eliminate redundancies in the checklists including creating an "all common checklist" to cover
  - Proficiency testing
  - Procedure manuals
  - Results reporting
  - Method performance specifications
  - Reference intervals
- CAP requires a self-inspection be conducted during the year when CAP is not on site for inspection

46.2 Supervision and Personnel

- CLIA regulations states there is a single laboratory director per CLIA site number
- In larger laboratories, the medical director of a molecular pathology laboratory may be considered as a technical supervisor under CLIA
- The CAP director (technical supervisor) must have one of the following qualifications
  - Pathologist
  - Board-certified physician in specialty other than pathology
  - Doctoral scientist in a chemical, physical, or biologic science with training or experience in molecular pathology
- The individual involved in technical operations oversight must have one of the following qualifications
  - Qualifies as a director
  - MB(ASCP), BS, BA, or MLS (ASCP)/MT (ASCP) with at least 4 years of experience; at least 1 year in molecular pathology under a qualified director
- The individuals involved in molecular pathology testing must have one of the following qualifications
  - Experience in the field under direct supervision by a qualified director; and for laboratories under the United States regulation, qualified to perform high complexity testing
  - MT(ASCP) certified or equivalent
  - BA or BS degree in biologic sciences and experience with molecular methods
- The supervisors of the laboratory must ensure all personnel working in the laboratory have a diploma of highest level of education on file
- CLIA requires a laboratory to have an up-to-date CMS-209 form on file at all times signed by the laboratory director and having all personnel job titles listed

- A new technologist in the molecular laboratory must have adequate training along with a training checklist for each method trained to perform and documentation must be on file
- Technologist must have access to continuing education programs
- Technologist must be assessed on yearly competency for methods they are currently performing and documentation must be on file
- Six elements must be assessed for yearly competency of nonwaived test
  - Direct observation of routine patient testing
  - Monitoring the reporting of test results
  - Review of intermediate test results or worksheets, quality control records, proficiency testing results, and preventative maintenance records
  - Direct observation of performance of instrument maintenance and function checks
  - Assessment of test performance through testing of previously analyzed specimens or external proficiency testing samples
  - Evaluation of problem-solving skills

46.3 Test Validation

- Validations must be performed prior to assays being used for diagnostic testing and documentation of the validation must be available
- Manufacturers such as Life Technologies have developed software like the EZValidation™ to help laboratories design validations and conduct validations
  - Laboratories must validate the software before implementing the software in a clinical laboratory
- For FDA-cleared/FDA-approved assays, a laboratory must verify the manufacturers claims on
  - Analytic accuracy
  - Precision
  - Reportable range
  - Limit of detection
  - Linearity
  - Qualitative test, a comparison with another comparable method
- A laboratory may validate specimen types and collection devices not listed in a package insert. The validation study must document that the specimen type or collection device does not affect the performance of the assay
- During a validation of a laboratory-developed or modified FDA-cleared/FDA-approved assay, a laboratory must evaluate the following as applicable
  - Accuracy
  - Precision
  - Linearity
  - Analytical sensitivity = true positive/(true positive + false negative)
  - Analytical specificity = true negative/(false positive + true negative)
  - Interferences
  - Reference range
  - Specimen stability
  - Carryover
  - Correlation with a reference or other defined method
  - Clinical/diagnostic sensitivity and specificity should be determined either by the laboratory to the best of their ability and cite literature that addresses these
- If the laboratory makes clinical claims about a laboratory-developed test, all the claims must be validated by the laboratory, such as claims about diagnostic sensitivity, specificity, or clinical usefulness
- The validation study must include a reasonable number of samples determined by the medical director (technical supervisor)
- A summary of the validation must be filed in the laboratory before patient testing is performed. The summary must include a statement that "the validation study has been reviewed and the performance of the assay is considered acceptable for patient testing" then signed by the laboratory director
- Validation documentation must be retained by the laboratory while testing of the method is being performed and for at least 2 years after testing is discontinued
- CAP requires a document listing a test not FDA approved/FDA cleared being performed in the last 2 years for review of validation data

46.4 Procedure Manual

- A procedure manual must be available to be used at the workbench
- Package inserts from manufacturers are not acceptable for a procedure manual but is acceptable as a component of the overall procedure
- Card files or work cards that contain key reference information from the procedure may be used at the workbench if a complete manual is available for reference and the director has signed off on these materials for use
- An electronic version of the procedure is acceptable and must be readily available to the technologist when needed
- Each procedure must include
  - Principle and clinical significance
  - Patient preparation
  - Specimen collection
  - Labeling
  - Storage
  - Preservation
  - Transportation
  - Processing
  - Referral
  - Criteria for acceptability and rejection
  - Step by step performance of procedure
  - Analytical measurement range, if applicable
  - Control procedures
  - Calibration and calibration verification procedures
  - Corrective action when calibration or controls fail
  - Limitations
  - Reference intervals
  - Critical results, if applicable
  - Pertinent literature references
  - Laboratory's system for entering results
  - Description of action to take if test is inoperable
- Policies and procedures should be reviewed and approved by the CLIA-defined laboratory director before testing is performed on patient specimens
- Policies and procedures must be reviewed annually by the technical supervisor
- A laboratory must develop a system to show personnel are knowledgeable of the contents of a procedure such as signing off on the procedure before performing patient testing
- If there is a change in directors, the new director must review all procedures in a timely manner
- Policies and procedures must be kept on-site for at least 2 years after being retired

46.5 Proficiency Testing

- Proficiency testing is a peer group comparison of the technical performance of an assay to help monitor accuracy of an assay
- Proficiency testing must be performed at least twice per year for each analyte tested by the laboratory for clinical testing
- A laboratory must have a written procedure in place for handling and testing of proficiency specimens along with a protocol for investigating and correcting problems if proficiency testing results are unacceptable
- The CAP activity menu for a laboratory must be updated as testing changes to reflect current testing being performed
- The proficiency testing attestation statement must be signed by the director or designee along with the technologist performing the testing
- If CAP-approved proficiency testing is not available, an alternative performance testing must be performed at least twice per year. Examples of alternative proficiency testing
  - Split sample testing with other laboratories
  - Split sample testing with another in-house method
  - Assayed material
  - Regional pools
  - Clinical validation by chart review
- Proficiency testing samples must be incorporated in routine testing and handled in the same manner as patient samples
- CLIA regulations prohibit interlaboratory communications about proficiency testing and a policy must be in place

- CLIA regulations prohibit proficiency testing referrals to another laboratory, and a policy must be in place

46.6 Quality Management Plan and Quality Control

- A written quality management plan must be in place to evaluate and monitor the quality of the laboratory systems
- The quality management plan incorporates the quality assurance (QA) plan and the quality assurance assessment
- The quality assurance plan must include
  - Preanalytic systems
  - Analytic systems
  - Postanalytic systems
- The quality assurance assessment includes quality indicators that the laboratory determines a process or outcome measure to be used to determine the quality achieved by the laboratory
- Quality indicators determined by the laboratory may include monitoring
  - Patient/specimen identification errors
  - Accuracy of correctly ordering test into the computer system
  - Test turnaround time
  - Documentation of notification of critical values
  - Customer satisfaction
  - Percentage of specimens acceptable for testing
  - Corrected reports
- Quality indicators must be monitored monthly and reviewed by the medical director/technical supervisor
- Laboratory must have in place a documentation system to detect or correct clerical and analytical errors in a timely manner
- Correct storage conditions and specimen handling is essential for some molecular testing, and the laboratory must have a procedure in place to describe specimen preservation and storage before testing
- Laboratory must have a written policy for monitoring turnaround times and must define appropriate turnaround times for each test
- The laboratory must have a procedure in place for calculating statistics including thresholds for some molecular test to monitor and take corrective action if needed
  - Percentages of normal and abnormal findings
  - Allele frequencies
  - Percent positivity rates for some infectious disease test such as *Chlamydia trachomatis* and *Neisseria gonorrhoeae*
- A written procedure is in place to prevent carryover in the molecular laboratory. This includes adequate separation of areas, unidirectional workflow, dedicated materials for each area, and decontaminating work areas
  - Ideally, a molecular laboratory should have three areas which include a clean area to prepare master mix, processing area, and an amplification/detection area
  - Amplicon contamination should be monitored by laboratories by incorporating swipe test into a QA plan
- Procedures should contain information about any probe or primer used in the assay unless information is considered proprietary
- A specimen must be properly identified through all phases of testing such as from specimen receipt to extraction to amplification to detection to reporting and storage by either
  - Text
  - Numeric
  - Bar coded

46.7 Preanalytic Phase of Testing

46.7.1 Requisition

- The laboratory must have a written or electronic request for testing by an authorized individual
  - Genetic testing may require informed consent before molecular testing can be performed. There are no federal regulations on this matter; however, the state regulations should be reviewed before testing if offered by a laboratory

  - A pedigree or racial/ethnicity may be required for interpretation of some molecular testing; if required, it should be included as a part of the requisition form
- The requisition must include, as applicable
  - Patient identification information such as name
  - Patient sex
  - Patient date of birth or age
  - Name and address of physician or person ordering test if different than laboratory
  - Test requested
  - For gynecologic specimens, last menstrual period
  - For some testing, time and date of specimen collection is necessary
  - For some testing, source of specimen is necessary
  - Some testing requires clinical information to be included

46.7.2 Specimen Handling

- For proper identification of the primary collection container, the specimen must contain at least two identifiers such as
  - Patient name
  - Date of birth
  - Hospital number
  - Social security number
  - Requisition number
  - Accession number
  - Unique random number
- A written procedure must be in place describing specimen acceptability and patient preparation
- Laboratories should follow manufacturer guidelines on proper transportation conditions of specimens
- Written criteria should be established for rejecting specimens if unacceptable such as
  - Improperly labeled
  - Improper collection container
  - Inadequate volume
  - Improper specimen type
  - Possibly commingled specimen, such as a specimen received after the container had been entered by a sampling device
- Documentation must be kept of notification of rejection of specimen
- Some testing requires personnel to aliquot a sample before testing and a written procedure should be in place to prevent cross-contamination
  - An aliquot should never be returned to the original container
- Written procedure is in place to ensure specimens are processed and stored promptly to avoid nucleic acid degradation
- Proper storage conditions must be defined by specimen type and testing performed
- The laboratory should develop a system to easily retrieve stored specimens if further testing is requested
- When RNA or RNA-probes are used, a ribonuclease-free condition is maintained to prevent degradation
- Optimal laboratory design to prevent contamination (Fig. 46.1)

46.8 Analytic Phase of Testing

46.8.1 Calibration

- For quantitative assays, calibrators must have a matrix similar to what the laboratory is testing
  - Calibrators are used during the validation of the assay to verify the accuracy, linearity, limit of detection, and limit of quantification
  - Two calibrator points must be run at least every six months and the laboratory must establish acceptable criteria for accepting the accuracy
  - Calibrations must be performed whenever major system components change or lot numbers of reagents change, unless a laboratory can prove patient results are not affected by these changes
  - If the calibration fails, the laboratory must recalibrate
- Calibrator material may include
  - Calibrators used to calibrate the system
  - Materials provided by the vendor of the system

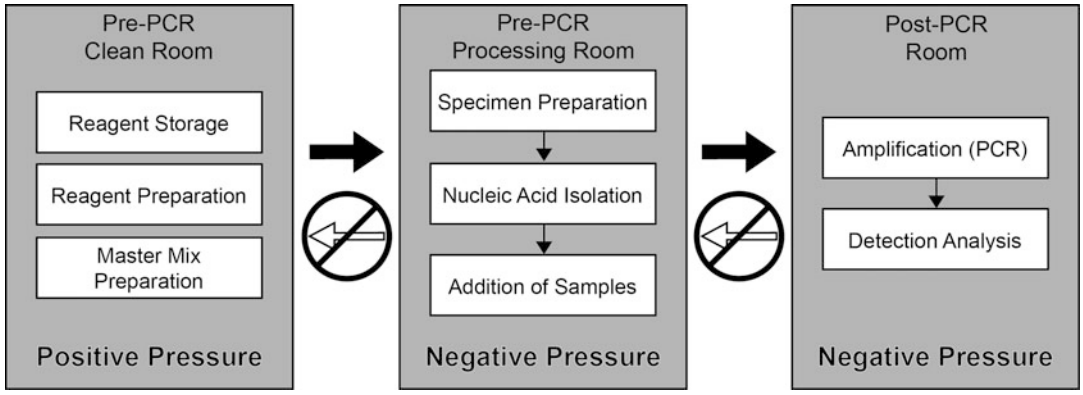

Fig. 46.1 Ideal molecular laboratory design to allow for unidirectional workflow and prevention of contamination with separate rooms

  - Previously tested patient specimens
  - Primary or secondary standards with appropriate matrix characteristics
  - Third party reference material if matrix is documented to be similar to patient samples
  - Proficiency testing material
  - Quality control (QC) material if appropriate matrix and has a mean established by peer group
- Calibrators should be separate from controls; however, if separate materials are not available, the calibrators and controls should be different lot numbers
- The analytical measurement range (AMR) must be checked at least every 6 months for quantitative assays
  - If the calibration performed includes points in the low, mid, and high range and passed established criteria by laboratory, the AMR is checked
  - If the range is not covered by the calibration or the laboratory extends the range from manufacturer recommendations, the AMR must be checked
  - AMR validation material used must be similar matrix to patient samples

46.8.2 Reagent Verification and Controls

- Reagents must be checked before placing in service for a new lot number or new shipment
- For qualitative assays, a positive and negative sample should be used to check reagent quality
- For qualitative assays, the reagent verification should include a negative and two levels of positives
- When possible multiplex assays should include each analyte detected to verify new lots and shipments
- To verify acceptability of new lot number, patient samples run previously with the old lot number should be tested
- QC material may be used to verify new shipments of the same lot number currently in service for patient testing. QC material may be used for verifying new lot number acceptability if a mean is established by a peer group; however, a laboratory should be aware of matrix interference
- Laboratories should have acceptable criteria to determine if reagent QC is acceptable and results should be documented
- Reagents should be properly labeled with
  - Content and quantity
  - Storage requirements
  - Date prepared or reconstituted
  - Expiration date
- Laboratories are not required to label reagents with a date received or open date
- Laboratories should not use reagents past the expiration date, and laboratories should assign an expiration date to reagents that the manufacturer has not assigned a date

- Qualitative assay should include a negative and positive control for each analyte in the run
  - For multiplex assays containing a large panel test, rotating the positive controls is acceptable
  - When a cutoff value is used to interpret a positive from a negative, the value must be verified at least every 6 months or change in lot number
- Quantitative assays should include a negative and two positives at different levels
- Control acceptability must be verified before patient results are reported and corrective action must be documented when the controls do not pass established criteria
- Controls must be run in the same manner as patient specimens
- Daily controls may be limited to electronic/procedural/built-in controls for tests meeting the following criteria established by CAP
  - Quantitative test - the system includes two levels of electronic/procedural/built-in internal controls that are run daily
  - Qualitative test - the system should include an electronic/procedural/built-in internal control that is run daily
  - The system should be FDA approved/FDA cleared and not modified by the laboratory
  - Laboratory must validate the accuracy of limiting daily QC to the electronic/procedural/built-in controls by a daily comparison of external controls to built-in controls for at least 20 days when patient samples are tested. Laboratory director must determine if acceptable before limiting daily QC to built-in controls
  - External surrogate sample controls must be run for new lot number, new shipment, major system maintenance, and software upgrades
  - External surrogate samples controls should be run at the frequency recommended by the manufacturer or at least every 30 days
- Controls for quantitative assays are monitored monthly for trending
- QC data must be reviewed by the director or designee monthly
- QC materials are available from several commercial companies (Table 46.1)

46.8.3 Extraction

- Commercially available kits or instruments for extraction of nucleic acids should be used or a laboratory must validate a method developed in-house
- A laboratory must measure nucleic acid concentration when the accuracy of an assay depends on the concentration
- RNA quality should be measured for human RNA targets due to the degradation of RNA
- Laboratories performing assays similar to KRAS and KIT using paraffin-embedded tumor should keep specimen documentation of the assessment of neoplastic cell content
- If the internal control does not go through extraction, then an extraction control must be included in each run
- If organic nucleic acid extractions are performed, a chemical safety cabinet should be available

46.8.4 Restriction Endonuclease Digestion

- Internal controls should be used in nucleic acid amplification assays to prevent release of false-negative results due to extraction issue or inhibition
- Laboratories using restriction endonuclease digestion should have a written procedure for application

46.8.5 Sequencing, Electrophoresis Agarose, and Polyacrylamide, Capillary Electrophoresis

- Laboratories performing sequencing should have
  - Literature documenting the wild type sequence and known mutations/polymorphisms
  - Sequence throughout the length of the target sequence should be readable

Table 46.1 Commercial sources for control materials

Company	Contact information	Products available	Analytes available
Life Technologies AcroMetrix	www.acrometrix.com	Infectious disease controls, validation kits, linearity panels	Adenovirus, Influenza H1N1, KRAS, Hepatitis B (HBV), Hepatitis C (HCV), HIV, BKV, Epstein-Barr virus (EBV), Cytomegalovirus (CMV), Herpes Simplex virus 1 & 2 (HSV), Varicella Zoster virus (VZV), Human papillomavirus (HPV), Enterovirus (EV), MRSA/MSSA, Group B *Streptococcus* (GBS)
Advanced Biotechnologies, Inc	www.abionline.com	Infectious disease native source DNA and RNA controls, purified virus/virus lysates, antigens, antibodies, native and recombinant viral proteins	Adenovirus, BK virus, CMV, *Chlamydia*, EBV, HCV, HIV, Human papillomavirus (HPV), *Helicobacter pylori*, Human herpes virus 6 (HHV6), HHV7, HHV8, HSV 1, HSV 2, HPV, Human T-lymphotropic virus, JC virus, *Mycobacterium tuberculosis*, *Mycoplasma pneumonia*, *Neisseria*, SV-40, VZV
American Type Culture Collection	www.atcc.org	Bacteria, bacteriophages, cell lines, hybridomas, filamentous fungi, yeast, tissue cultures, viruses, and so on	
Boston Biomedical, Inc	www.bbii.com	Genotype panels, linearity panels, qualification panels	*Chlamydia*, CMV, HBV, HCV, HIV, HPV, Parvovirus, WNV
Coriell Institute of Medical Research	www.coriell.org	Cell cultures and DNA derived from cell cultures for use as positive controls for many genetic disorders	Repositories included are National Institute of General Medical Sciences, National Institute on Aging, National Institute of Neurological Disorders and Stroke, American Diabetes Association, Autism Research Resource, U.S. Immunodeficiency Network, Center for Disease Control and Prevention, Leiomyosarcoma Cell and DNA Repository
Maine Molecular Quality Controls	www.mmqci.com	Synthetic DNA for inherited disease, infectious disease, pharmacogenetics	Cystic fibrosis (CF), Factor II G20210A, Factor V Leiden G1691A, MTHFR C677T, MTHFR A1298C, Warfarin, Hereditary hemochromatosis
SeraCare Life Sciences	www.seracare.com	Performance panels, verification panels, linearity panels	HBV, CMV, HCV, HIV, HPV, Cystic Fibrosis, *Chlamydia*, *Neisseria*, CYP2C9, VKORC1, EBV, HSV, Lyme Disease, MTHFR, *Toxoplasma*, West Nile virus
ZeptoMetrix Corporation	www.zeptometrix.com	Infectious disease controls, linearity panels	BKV, *Chlamydia*, *Clostridium difficile*, CMV, EBV, HSV 1 & 2, *Escherichia coli* O157:H7, HIV, HBV, HCV, HHV-6, 7 & 8, Norovirus, Rotovirus, Parvovirus, Influenza A H1, Influenza A H1N1 2009, Influenza B, *M. tuberculosis*, MRSA, MSSA, *Mycoplasma pneumonia*, *Neisseria*, Respiratory Viral Panel, VZV, West Nile Virus

  - Acceptance and interpretation of primary sequencing data should be established by the laboratory
  - Sequence of sense and antisense strands should be included in the procedure for heterozygous templates, rare alleles, or rare combinations of alleles
- Autographs and gel photographs should have quality resolution to accurately interpret
- Laboratories running agarose and polyacrylamide gel electrophoresis should
  - Load standard amounts of nucleic acid
  - Run molecular weight markers spanning the range of expected bands
  - Use visual/fluorescent bands to determine endpoint of electrophoresis
  - Establish objective criteria to interpret

46.8.6 Real-Time Polymerase Chain Reaction

- Real-time polymerase chain reaction (PCR) assays where results are interpreted based on a melting temperature, a temperature range must be defined and monitored
- Quantitative PCR calibrators should fall in the determined range for each run
- If multiple amplification runs do not include the extraction control, then an amplification control must be run

46.8.7 Arrays

- Array quality is verified with each change in lot

46.8.8 Fluorescence In Situ Hybridization and Brightfield In Situ Hybridization

- An anatomic or clinical pathologist must evaluate the corresponding hematoxylin and eosin slide for ISH testing to ensure invasive tumor cells are used in the study
- The laboratory must have a procedure in place for scoring of FISH results, and control loci must be included in each analysis
- *HER2* gene amplification by ISH must be validated by the laboratory on a minimum of 25 cases
- The laboratory procedure for *HER2* gene amplification by ISH includes the length of fixation and includes guidelines to report results using the ASCO/CAP scoring criteria
- Brightfield ISH for each sample should have a positive control probe against endogenous target to verify assay conditions and tissue pretreatment. For assays that detect RNA in target tissue or use an RNA probe, the laboratory must maintain a ribonuclease-free condition

46.9 Postanalytic Phase of Testing

- The laboratory should have a system in place to ensure test results are sent reliably from laboratory to final destination
- If a laboratory releases preliminary reports, they should be released in a reasonable amount of time, and discrepancies with the final report should be investigated
- Molecular reports should include the methodology, loci or mutations tested, and analytical interpretation
- Federal regulations and CAP require for laboratories testing using class I analyte-specific reagents (ASRs) that a disclaimer be attached to the report
  - "This test was developed and its performance characteristics determined by (laboratory name). It has not been cleared or approved by the US Food and Drug Administration. FDA does not require this test to go through premarket FDA review. This test is used for clinical purposes. It should not be regarded as investigational or for research. This laboratory is certified under the CLIA of 1988 as qualified to perform high complexity clinical laboratory testing."

- Patient confidentiality must be maintained during the release of molecular genetic test reports
- Reports must include standard nomenclature to designate genes and mutations; however, a laboratory may also choose to include the common name to help with clarification of testing
- Reports for ISH results must include interpretation of the ISH results
- Federal, state, and local regulations must be followed for retention of final report, result records, membranes, autoradiographs, gel photographs, and ISH slides
- Reports must be reviewed and approved every two years by the laboratory director
- Laboratory should maintain records of individual assays performed containing information of list of specimens, assay conditions, reagent lot numbers, serial number of instruments, and any other variable condition

46.10 Equipment

- When multiple instruments or methods are used to detect the same analyte, the laboratory must check the correlation of results at least twice a year when under a single CAP number
  - Manufacturer controls may be used to check correlation if the same control and reagent lot number are used on both instruments
- The laboratory should follow at least manufacturer guidelines for instrument maintenance and function checks
- Instrument maintenance and functions check should be well documented
- Temperatures should be recorded daily for refrigerators and freezers used to store reagents, controls, and patient specimens. The initials of the person checking the temperature must also be documented
  - A frost-free freezer may be used in a laboratory only if the maximum/minimum temperatures are recorded daily or it is equipped with a continuous monitoring system
- Temperatures should be checked and recorded daily if used for patient testing on those days for
  - Water baths
  - Heating blocks
  - Incubators and ovens where temperature control is necessary for a procedure
- Thermocycler wells should be checked for temperature accuracy before putting into use and at least yearly thereafter
  - Detected circuit breakers should be available to avoid electrical fluctuation
- Pipettes used for quantitative dispensing should be checked for accuracy and reproducibility before putting into use and at least annually thereafter
- Laboratory must check centrifuge speed at least annually
- Documentation of instrument maintenance/function checks and temperatures are reviewed monthly by the technical supervisor/director
- Procedures must be in place for personnel to accurately operate and set-up testing on instrumentation
- Procedures should describe minor troubleshooting and repairs of the instrument
- Laboratory should have maintenance, repair, and service records available to the personnel using the instrumentation
- A regular schedule should be established for checking critical operating functions of all instruments in use for patient testing
- When tolerance limits are established for instruments, these limits should be documented
- Laboratory should routinely service and repair film-processing equipment
- Proper protective equipment should be available to personnel when using ultraviolet light
- For scintillation counters, luminometers, and densitometers, the background level is compared each day of testing to established criteria
- Laboratory using instruments that measure multiple fluorochromes should have a protocol in place to identify and correct for bleed-through signal

- Spectrophotometer filters should be checked at least annually
- Spectrophotometer wavelength calibration is checked regularly following manufacturer criteria

46.11 Safety

- Laboratory must establish a policy for properly handling and processing samples
- A fume hood must be available for when using volatile chemicals
- A biological safety cabinet should be available and certified at least annually to ensure the filters function and airflow rates are within specifications
- Refrigerators should not contain improper materials such as food, externally contaminated specimens, or volatile materials
- For laboratories handling radionuclides
  - Radiation safety manual is up to date
  - Benches and sinks are decontaminated each day of use
  - Policy is in place for handling of radionuclides including authorization or restriction of personnel
  - Written procedure for notifying if damaged or leaking radionuclide shipment is received
  - Written procedure for proper storage of radionuclide
  - Documentation is kept for regular radiation surveys and wipe test
  - A sign is posted in areas where radioactive material is used or stored
  - Personnel have proper training documentation of decontamination, handling, and disposal
  - Documentation is maintained for proper disposal of radioactive waste, and waste is stored separate from normal trash

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