Role of Proactive Measures in the Clinical Laboratory Practice

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Objectives

- Review the milestones on risk management and quality control
- Identify the risk and risk management definitions
- Describe the sources of laboratory error
- Describe the implementation a quality control strategy
- Describe the stepwise approach to risk management
- Identify the quality control based on risk management and IQCP
- Perspectives for the future

Milestones - Evolvement of Quality Risk Management Over Time

**YEAR** | **1998** | **2000**
--- | --- | ---
--- | Australia, Canada, Japan, and the Global Harmonization Task Force have also embraced or are embracing risk management as part of the quality system. Global Harmonization Task Force, Risk Management as an Integral Part of the Quality Management System, Proposed Draft International Standards.
--- | January 1, 2014 the Center for Medicare and Medicaid Services (CMS) adopted an alternative Quality Control (QC) procedure that would allow laboratories – after appropriate assessment – to choose an electronic QC monitor instead of a traditional QC
--- | Effective 1/1/14, IQCP will no longer be available and laboratories will be required to follow either CLIA or IQCP. After 1/1/14, laboratories began to be cited for deficiencies under IQCP.

- combination of the probability of occurrence of harm (1.1) and the severity of that harm (1.2)
- The probability of occurrence includes the exposure to a hazardous situation (1.4), the occurrence of a hazardous event (1.3), and the possibility to avoid or limit the harm (1.5).

ISO 31000:2009

- effect of uncertainty on objectives
- An effect is a deviation from the expected — positive and/or negative.
- Risk is often characterized by reference to potential events (1.17) and consequences (1.18), or a combination of these.
- Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood (1.19) of occurrence.
- Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood.

Risk Management Definition

ISO 31000:2009: Risk management -- Principles and guidelines

- coordinated activities to direct and control an organization with regard to risk

ISO 14971:2009

Medical devices -- Application of risk management to medical devices

- systematic application of management policies, procedures and practices to the tasks of analyzing, evaluating, controlling and monitoring risk

Risk Management Definition

ISO 14971:2009: IVD RISK MODEL, depicts a sequence of

**HAZARD IDENTIFICATION**

1. Incorrect Result
2. Injury or Death
3. Defective IVD

**RISK ASSESSMENT**

1. Hazard identification
2. Risk analysis
3. Risk evaluation
4. Risk control
5. Risk monitoring

**RISK MANAGEMENT**

Reduction of error through risk management and continual improvement

Risk management according to ISO 14971 is a product "life-cycle" process, which means it continues as long as the product is being produced and is still in active use.

Risk management is not a new concept for laboratories to date

- Evaluation of the performance of new instruments.
- Troubleshoot instrument problems.
- Respond to physician and patient complaints.
- Estimate harm to a patient from incorrect results.
- Take actions to correct and prevent errors.
RISK ANALYSIS

Error grid analysis – developed by Clarke et al. (Diabetes Care 1987) to classify incorrect glucose results based on the degree of error and the physiological status of the patient.

Parkes et al. developed an error grid based on the consensus of a large number of medical practitioners. (Diabetes Care 2000)

An Error grid provides a logical basis for ranking the severity of harm on a scale of 1 (Zone A) to 5 (Zone E).

Achieving a 99% level of quality means accepting a 1% error rate

In France a 1% error rate would mean everyday:
- 14 minutes without water or electricity
- 50,000 parcels lost by postal services
- 22 newborns falling from midwives’ hands
- 600,000 lunches contaminated by bacteria
- 3 bad landings at Paris Orly airport

What could possibly go wrong?

Result: 1% failure

What are the Sources of Laboratory Error?
Sources of Post-analytical Error

- Transcription error
- Time to deliver the result to the clinician
- Error in transmitting the result over the phone (eg., was it BMP or BNP?)
- Failure to heed errors signaled by the instrument or the LIS/HIS/middleware

The pre-analytical, analytical, and post-analytical factors that are most likely to occur in a hospital setting are not the same as those that might typically occur during blood glucose testing in an outpatient setting. Plebani reported a series of hospital lab errors divided into pre-analytical, analytical, and post-analytical categories. The causes and distributions of that hospital’s errors are as follows:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Pre-analytical</th>
<th>Analytical</th>
<th>Post-analytical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Errors</td>
<td>10%</td>
<td>20%</td>
<td>70%</td>
</tr>
</tbody>
</table>

The FDA has categorized the most common blood glucose monitor errors in terms of their potential sources (eg., errors caused by monitor design, production, or use). Six error source categories and examples of each are:

- Calibration
- User interface design
- Error in the algorithm
- Measurement errors
- Software errors
- User interaction design

Table 2. Potential Sources of Error in Blood Glucose Monitors Based on FDA Experience

<table>
<thead>
<tr>
<th>Source of Error</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithm errors</td>
<td>Incorrect algorithm design, inaccurate calibration, or measurement errors</td>
</tr>
<tr>
<td>User interface errors</td>
<td>Poor design, difficult to read, or insufficient instructions for use</td>
</tr>
<tr>
<td>Error in the algorithm</td>
<td>Algorithm fails to work properly, or the display is incorrect</td>
</tr>
<tr>
<td>Measurement errors</td>
<td>Errors in the measuring device, such as sensitivity or range issues</td>
</tr>
<tr>
<td>Software errors</td>
<td>Software fails to communicate with the device, or the device fails to respond correctly</td>
</tr>
<tr>
<td>User interaction design errors</td>
<td>Inadequate warnings or instructions for use, or the device is not intuitive to use</td>
</tr>
</tbody>
</table>

Do we need a New Approach to Quality Control with Managing the Risks?

Milestones – Evolvement of Quality Control Over Time

Do we need a New Approach to Quality Control with Managing the Risks?

Today’s Quality Control Process

- Advantages
  - QC monitors the end product (result) of the entire test system.
  - QC has target values; if assay recovers the target, then everything is assumed stable (e.g., instrument, reagent, operator, sample).

- Disadvantages
  - When a problem is detected, one must go back and reanalyze patients since the last “good” QC.
  - If results are released, then results may need to be corrected.
  - For Point of Care devices, does traditional QC work for every test?

- Need to get to fully automated analyzers that eliminate errors up front
  - Until that time, need a robust QC plan (QCP)

Types of Quality Control

- “On-Board” or Analyzer QC – built-in device controls or system checks
- Internal QC – laboratory-analyzed surrogate sample controls
- External QC – blind proficiency survey
- Other types of QC – control processes either engineered by a manufacturer or enacted by a laboratory to ensure result reliability

Quality Control Limitations

- No single QC procedure can cover all devices, because the devices may differ.
- QC practices developed over the years have provided laboratories with some degree of assurance that results are valid.
- Newer devices have built-in electronic controls, and “on-board” chemical and biological controls.
- QC information from the manufacturer increases the user’s understanding of device’s overall quality assurance requirements.

Adapted from Poon S, Numerak G. Biomedical Diagnostics, Inc. 2001

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In October 2011, CLSI published EP 23 and introduced Laboratory Quality Control Based on Risk Assessment

- EP23 explains the strengths and weaknesses of the different QC processes, and helps the laboratory determine the right combination of tools.
- Each laboratory’s quality control plan is unique based on the device, the laboratory setting, and the risk to patients from inappropriate decisions based on incorrect or delayed test results.
- CLSI EP23 provides a template for laboratories to map their testing processes, identify weaknesses or hazards in the process map, define a control process that can detect failures and/or prevent reporting erroneous results, summarize the control processes in a quality control plan, implement and benchmark the effectiveness of their quality control plan, and modify a quality control plan as part of continual improvement.

The Quality Control Toolbox

- QC is not only about testing external QC samples, it is all the tools we can use to monitor test system performance.
- EP23 recognizes that a variety of QC tools exist and that no single QC tool is perfect.
- Analysis of QC samples is certainly a well established tool available to us.
- Key to effective use of QC samples is determining how often they need to be tested.

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QC Tools

- Intralaboratory QC
- Interlaboratory QC
- Integrated (built-in) QC
- Measuring system function checks
- Electronic system checks
- Calibration checks
- Repeat testing of patient samples
- Monitoring aggregated patient results
- Implausible values
- Delta checks
- Correlation of multiple analytes in same sample

The QC strategy using QC samples should include:

- The frequency of QC sample test events
- The type and number of QC samples tested per test event
- The statistical QC limits used to evaluate the results
- The frequency of periodic review for detecting shifts and trends
- The actions taken when results exceed acceptable limits

Improve of QC Practices

One – size – fits all QC vs Right QC

The concept was introduced in November 4, 2011.

- Every QC tool has its strengths and weaknesses (there is no perfect QC tool).
- QC frequency closely connected to managing risk of reporting inaccurate results.
- Implement a combination of tools in order to properly control a test.

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EP23, Section 5.1.1

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CLSI EP 23, Section 5.1.1
It's official: EQC is out and QC Plans are in!

James O. Westgard, Sten A. Westgard
December 2011


Quality Control in the age of Risk Management, An Issue of Clinics in Laboratory Medicine by James O. Westgard

Year: 2013
Issue: Vol 33 | No. 1 | March 2013 | Pages 1-206

"The secret of all victory lies in the organization of the non-obvious."

-Marcus Aurelius
Roma Emperor and Philosopher

Why Quality Risk Management is Important for Laboratories?

- Risk management may be best proactive approach to design optimal overall Quality Control Plan for the laboratory.
- We analyze many samples from which we derive information.
- The information impacts upon decision making and health of others.
- Poor information can lead to poor outcomes.
- Our samples have some variables that we can control, and others that are difficult to control, and others that we can not either foresee or control.
- Regardless of contributing events, the laboratory is usually viewed as the source of the problem.

Using Risk Management to Develop a Quality Control Plan

- Hazard Identification
  - Identify potential failure in each process step
  - Determine if each failure is in place to prevent or detect a failure

- Risk Estimation
  - Assess the likelihood or probability of harm of each failure
  - Assess the severity of harm to a patient from each failure

- Risk Control
  - Determine what control processes are required to lower the risk to an acceptable level

- Risk Evaluation
  - To the realization of harm probability acceptance

The Laboratory’s Quality Control Plan

- Compliance with QC processes and QC
- Review QC for conformance to regulatory and accreditation requirements
- Document and implement the set of control processes as the laboratory’s QCP
Developing a Process Map

Where is the Risk in the Process?

Identify the Risks – Where is the risk in the process?

Risk Management Tools

An FMEA worksheet is created to record each process failure (hazard), failure cause, effect (harm), severity, existing process controls (to prevent the failure), probability of occurrence (of the failure), detectability (prior to harm), and comments explaining rationale.
Perform Risk Assessment

**RISK EVALUATION**

- Risk acceptability chart

<table>
<thead>
<tr>
<th>Probability</th>
<th>Catastrophic</th>
<th>Critical</th>
<th>Serious</th>
<th>Moderate</th>
<th>Minor</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent</td>
<td>Inconceivable</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
</tr>
<tr>
<td>Probable</td>
<td>Inconceivable</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
</tr>
<tr>
<td>Occasional</td>
<td>Inconceivable</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
</tr>
<tr>
<td>Remote</td>
<td>Inconceivable</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
</tr>
<tr>
<td>Inconceivable</td>
<td>Inconceivable</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
<td>Acceptible</td>
</tr>
</tbody>
</table>

- **SCORE**
  - **SEVERITY OF HARM (SEV)**
    - Catastrophic – Patient Death
    - Critical – Permanent injury of life-threatening injury
    - Serious – Injury or impairment requiring medical intervention
    - Minor – Temporary injury or impairment not requiring medical intervention
    - Negligible – Inconvenience or temporary discomfort

- **PROBABILITY OF OCCURRENCE (OCC)**
  - Frequent – ≥ 1/5,000
  - Probable – < 1/5,000 and ≥ 1/10,000
  - Occasional – < 1/10,000 and ≥ 1/100,000
  - Remote – < 1/100,000 and ≥ 1/1,000,000
  - Improbable – < 1/1,000,000 and ≥ 10,000,000

- **DETECTABILITY PRIOR TO HARM (DET)**
  - Inconceivable – Almost certain to be detected
  - Acceptible – High probability of detection
  - Medium probability of detection
  - Low probability of detection
  - Almost impossible to detect

The risks need to be evaluated against criteria approved by the lab director. Values 6 and above must be addressed. Detectability scale has an inverse relationship to the probability of detection.

**Common Terms**

- **Score**
  - Possible Description
    - Low
    - Control is ineffective
    - Control less likely to detect the failure
    - Control may or may not detect the failure
    - Control almost always detects the failure
    - High
    - Control can detect the failure
Multiply Frequency x Severity x Detectability

Example: Probable (4) x Catastrophic (5) x
High likelihood to detect failure (1) = 20

<table>
<thead>
<tr>
<th>Criticality</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Mid</td>
<td>10 – 20</td>
</tr>
<tr>
<td>High</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

Higher criticality numbers must have quality control actions in place.

RISK EVALUATION

<table>
<thead>
<tr>
<th>SEVERITY ≥ 6 (or ≥3)</th>
<th>Require an Essential Control Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCCURRENCE ≥ 6 (or ≥3)</td>
<td>Require an Essential Control Point which must be an effective method of detection</td>
</tr>
<tr>
<td>DETECTABILITY ≥ 6 (or ≥3)</td>
<td>Require an Essential Control which must be a process control that prevents failures</td>
</tr>
<tr>
<td>OCCURRENCE ≥ 6 and DETECTABILITY ≥ 6</td>
<td>The process activity lacks adequate controls and corrective action must be initiated, either to reduce the failure rate or to increase the ability to detect a failure or both.</td>
</tr>
</tbody>
</table>

Does your laboratory currently have a risk assessment plan?

1. Yes
2. No
The “Individualized Quality Control Plan” (IQCP) is the Clinical Laboratory Improvement Amendments (CLIA) Quality Control (QC) policy as an alternative QC option for all laboratory tests on January 1, 2016.

What is IQCP?
IQCP is the new QC option for non-waived test devices in US. CMS states that an IQCP is specific for a testing device and testing situation. The intent is to eliminate failures and detect nonconformities before reporting incorrect results.

What is the basis for IQCP?
CMS structured IQCP on the risk management concepts presented in the CLSI EP23-A guideline.

When is IQCP useful?
Manufacturer’s instructions for QC are absent or less stringent than CLIA.

Eligible for IQCP
- Syphilis serology
- General Immunology
- Routine Chemistry
- Urinalysis
- Endocrinology
- Toxicology
- Hematology
- Immunochemistry
- Clinical cytogenetics
- Radiobiology
- Histocompatibility
- Microbiology
- Bacteriology
- Mycobacteriology
- Mycology
- Parasitology
- Virology

Not Eligible for IQCP
- Pathology
- Histopathology
- Oral Pathology
- Cytology

Joint Commission and CAP developed their own requirements for IQCP. COLA has adopted as it stands.

IQCP without agony at the point of care
Anne Paxton
April 2016—For many point-of-care testing coordinators, the prospect of developing Individualized Quality Control Plans is far from enticing. But there has never been much chance that laboratories could opt out of the Centers for Medicare and Medicaid Services’ new quality control framework for much of their nonwaived testing.
IQCP Development Process

- Gather Information – IQCP is based on facts
- Medical, regulatory, testing device and situation
- Risk Assessment – know processes; identify potential risks

<table>
<thead>
<tr>
<th>Preanalytical</th>
<th>Analytical</th>
<th>Postanalytical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Patient</td>
<td>Right Specimen</td>
<td>Right Result</td>
</tr>
<tr>
<td>Right Sample Handling</td>
<td></td>
<td>Right Patient Record</td>
</tr>
</tbody>
</table>

Must assess – samples, operators, test environment, testing systems, reagents

Review policies; remove/handle all significant risks

Developing an IQCP

IQCP considers the entire testing process: pre-analytic, analytic, and post-analytic.

1. Risk Identification
   - What can go wrong?

2. Risk Evaluation
   - Is it working?

3. Risk Mitigation
   - How do we prevent or detect?

Risk identification
Risk evaluation
Risk mitigation

IQCP ACT: Data Gathering

- ACT (eg., C-reactive protein) every day for 10 days
- Blood gas – 2 levels GC every 24 hours, with 1 level each 6 hours
- Cardiac Cath lab with testing performed by RN (non-CLIA)

IQCP ACT: Risk Assessment

Severe of harm

- High
- Medium
- Low
- Critical
- Catastrophic

- Probable
- Possible
- Remote
- Inevitable
- Incomparable

- ISO 14971
The Quality Control Plan

• Construct the QCP.
• A QCP is necessary for result quality, and each QCP is unique.
• Include each of the identified QCP actions in the QCP.
• A QCP is the industry standard. It depends upon the extent to which the device’s features achieve their intended purpose in union with the laboratory’s expectation for ensuring quality results.

• Monitor QCP for Effectiveness - Once implemented, the QCP is monitored for effectiveness and modified as needed to maintain risk at a clinically acceptable level.


QuExit?
We're in the era where a Quality Exit – QuExit – is being proposed. Some labs may not realize the consequences of such a significant change.

IQCPexit?
It appears that IQCP is simply a very time-consuming paperwork exercise that allows laboratories to maintain the same QC that they were doing back in the EQC era. It's mostly been a "waste of time", an exercise of paperwork to justify current practices, with very little change occurring in QC practices.

TEexit?
The campaign to eliminate Total Error, despite what has been nearly half a century of widespread utility, continues at the hands of a few aggrieved metrologists.
THANK YOU

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