Quality in Environmental Analysis

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Goldwater Center Room 487
Quality in Environmental Analysis

Value of Quality Control

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Value of Quality Control

- General QC principles.
- Sources of error.
Value of Quality Control

General QC Principles

- Terminology and Definitions.
- Quality Control vs. Quality Assurance.
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QC Terminology and Definitions

Principle Data Quality Indicators (DQIs):

- Precision
- Bias
- Accuracy
- Representativeness
- Comparability
- Completeness
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QC Terminology and Definitions

**Precision:**

- The agreement between the numerical values of two or more measurements that have been made in an identical fashion.

- Calculated as range or standard deviation.

- Intralaboratory & interlaboratory precision.
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QC Terminology and Definitions

Bias:

- The systematic or persistent distortion of a measurement process that can cause errors in one direction.
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QC Terminology and Definitions

Accuracy:
- The measure of how close an individual or average measurement is to the true value.
- Combination of precision and bias.
- A reference material must be used in determining accuracy.
Figure 1 - Measurement of Bias and Random Measurement

A) High bias + low precision = low accuracy

B) Low bias + low precision = low accuracy

C) High bias + high precision = low accuracy

D) Low bias + high precision = high accuracy
Representativeness:
- A measure of the degree to which data accurately and precisely represents a sampling point or process condition.
- A measure of how closely a sample is representative of a larger process.
Comparability:

- A qualitative term that expresses the confidence that two data sets can contribute to a common analysis.
Completeness:
- A measure of the amount of valid data obtained from a measurement system, expressed as a percentage of the valid measurements that should have been collected (i.e., measurements that were planned to be collected).
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Quality Control vs. Quality Assurance

- QC is a component of QA.
- QC measures and estimates errors in a system.
- QA is the ability to prove that the data is as reported.
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Sources of Error

- Sample errors
- Reagent errors
- Reference material errors
- Method errors
- Calibration errors
- Equipment errors
- Signal registration and recording errors
- Calculation errors
- Errors in reporting results
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Sources of Error

Sample Errors

- Sample container contaminated.
- Incorrect sample location.
- Non-representative sample.
- Incorrect sample container.
- Sample mix up.
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Sources of Error

Reagent Errors

- Impure reagents or solvents.
- Improper storage of reagents.
- Neglect of reagent expiration date.
- Evaporated reagents.
- Consideration of different purities or grades.
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Sources of Error

Reference Material Errors

- Impurity of reference materials.
- Errors from interfering substances.
- Changes due to improper storage.
- Errors in preparing reference material.
- Using expired reference material.
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Sources of Error

General Method Errors

- Deviating from the analysis procedure.
- Disregard for the limit of detection.
- Disregard for a blank correction.
- Calculation errors (dilutions, mixtures, additions).
- Not using the correct analytical procedure.
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Sources of Error

Calibration Errors

- Volumetric measuring errors.
- Weighing errors.
- Inaccurate equipment adjustments.
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Sources of Error

Equipment Errors

- Equipment not cleaned
- Maintenance neglected.
- Temperature, electrical, and magnetic effects.
- Errors in using auto-pipettes (not calibrated, pipette tip not correctly attached, contamination).
- Errors in using glass pipettes (damaged, bad technique, contamination).
Equipment Errors (continued)

- Cuvette errors (defects not considered, unsuitable cuvette glass, not filled to minimum, wet on the outside, air bubbles, contamination).
- Photometer errors (wrong wavelength, insufficient lamp intensity, dirty optics, drift effect ignored, incorrectly set zero, light entering the sample chamber).
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Sources of Error

Signal Registration and Recording Errors

- Incorrect range setting.
- Reading errors.
- Recording errors.
- Switching of data.
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**Sources of Error**

**Calculation Errors**

- Arithmetic errors, decimal point errors, incorrect units.
- Rounding errors.
- Not taking into account the reagent blank values.
- Error in dilution factor.
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**Sources of Error**

**Errors in Reporting Results**

- Omitting a sample error.
- No quality assurance implemented.