How to meet ISO 15189:2012 preanalytical requirements?

Pieter Vermeersch, MD PhD
Department of Laboratory Medicine, UZ Leuven, Belgium
Technical auditors spend only a small amount of the time auditing the preanalytical phase.

There are huge differences in how technical auditors interpret the preanalytical requirements of ISO15189:2012.
Overview

1) Accreditation Standards

2) ISO 15189:2012 Chapter 4: Management requirements

3) ISO 15189:2012 Chapter 5: Technical requirements
Overview

1) Accreditation Standards

2) ISO 15189:2012 Chapter 4: Management requirements

3) ISO 15189:2012 Chapter 5: Technical requirements
ISO-17025: General requirements for the competence of testing and calibration laboratories

- First edition 1999, revisions in 2005 and 2017

ISO-15189: Medical laboratories — Requirements for quality and competence

- Distinction between pre-examination, examination and post-examination phase.

ISO 22870: Point-of-care testing (POCT) – Requirements for quality and competence

- First edition 2016
- Section 5.4 Pre-examination procedures
  5.4.1 ISO15189:2012 5.4.1 and 5.4.4.2 and the following apply:
  5.4.2 The organization shall ensure identification of the sample and its clerical traceability to the patient

National accreditation standards
Is your laboratory accredited? Choose the first applicable answer.

1. ISO 15189 and ISO 22870
2. ISO 15189
3. ISO 17025
4. National Standard
5. No accreditation
## Results EFLM WG-PRE Survey

### European survey on preanalytical sample handling

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<th>Samples per day</th>
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**Is your laboratory accredited, certified or similar? (Multiple answers possible)**

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<th>Standard</th>
<th>Count</th>
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<tr>
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<td>44,0%</td>
</tr>
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<td>68</td>
<td>5,0%</td>
</tr>
<tr>
<td>ISO 22870</td>
<td>18</td>
<td>1,3%</td>
</tr>
<tr>
<td>National standard</td>
<td>232</td>
<td>17,2%</td>
</tr>
<tr>
<td>No accreditation/certification</td>
<td>289</td>
<td>21,5%</td>
</tr>
</tbody>
</table>

Cadamuro J et al. *Biochemia Medica* 2019 in press
Overview

1) Accreditation Standards

2) ISO 15189:2012 Chapter 4: Management requirements
   - Defining quality objectives
   - Continuous improvement
   - Internal audit and periodic review
   - Communication with stakeholders
   - External suppliers

1) ISO 15189:2012 Chapter 5: Technical requirements
4.1.2.4 Quality objectives and planning

Laboratory management shall establish quality objectives, including those needed to meet the needs and requirements of the users, at relevant functions and levels within the organization. The quality objectives shall be measurable and consistent with the quality policy.

4.14.7 Quality indicators

The laboratory shall establish quality indicators to monitor and evaluate performance throughout critical aspects of pre-examination, examination and post-examination processes.

EXAMPLE Number of unacceptable samples, number of errors at registration and/or accession, number of corrected reports.

- Laboratory can define its own quality objectives and quality indicators based on risk assessment.
Recommended: The IFCC working group Laboratory Errors and Patient Safety identified quality indicators for the extraanalytical phase.
Quality Indicators for the Total Testing Process

Mario Plebani, MD*, Laura Sciacovelli, Biol Sci, Ada Aita, Biol Sci

KEYWORDS
- Errors in laboratory medicine
- Quality indicators
- Extra-analytical phases
- Quality specifications
- External quality assurance program

KEY POINTS
- In laboratory medicine the extra-analytical phases have the highest error rates.
- ISO 15189:2012 requires the establishment of quality indicators to monitor and evaluate laboratory performance throughout critical aspects of pre-examination, examination, and postexamination processes.
- The use of quality indicators that meet requirements for effectiveness and harmonization is an important quality improvement tool.
- The participation in External Quality Assurance Program managed by the working group Laboratory Errors and Patient Safety of IFCC (www.ifcc-mqi.com) allows a laboratory to compare its performance with that of other participants.
## IFCC quality indicators

<table>
<thead>
<tr>
<th>Code</th>
<th>Quality Indicator</th>
<th>Priority Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preanalytical Phase</td>
<td>Misidentification errors</td>
<td>1</td>
</tr>
<tr>
<td>Pre-MisR</td>
<td>Percentage of number of misidentified requests/total number of requests</td>
<td>1</td>
</tr>
<tr>
<td>Pre-MisS</td>
<td>Percentage of number of misidentified samples/total number of samples</td>
<td>1</td>
</tr>
<tr>
<td>Pre-Iden</td>
<td>Percentage of number of samples with fewer than two identifiers initially supplied/total number of samples</td>
<td>1</td>
</tr>
<tr>
<td>Pre-UnlS</td>
<td>Percentage of number of unlabeled samples/total number of samples</td>
<td>1</td>
</tr>
<tr>
<td>Inappropriate test requests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Quest</td>
<td>Percentage of number of requests without clinical question (outpatients)/total number of requests (outpatients)</td>
<td>2</td>
</tr>
<tr>
<td>Pre-OutReq</td>
<td>Percentage of number of inappropriate requests, with respect to clinical question (outpatients)/number of requests reporting clinical question (outpatients)</td>
<td>4</td>
</tr>
<tr>
<td>Pre-InReq</td>
<td>Percentage of number of inappropriate requests, with respect to clinical question (inpatients)/number of requests reporting clinical question (inpatients)</td>
<td>4</td>
</tr>
</tbody>
</table>

## IFCC quality indicators

<table>
<thead>
<tr>
<th>Test transcription errors</th>
<th>Pre-OutpTN</th>
<th>Percentage of number of outpatients requests with erroneous data entry (test name)/total number of outpatients requests</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-OutpMT</td>
<td>Percentage of number of outpatients requests with erroneous data entry (missed test)/total number of outpatients requests</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pre-OutpAT</td>
<td>Percentage of number of outpatients requests with erroneous data entry (added test)/total number of outpatients requests</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pre-InpTN</td>
<td>Percentage of number of inpatients requests with erroneous data entry (test name)/total number of inpatients requests</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pre-InpMT</td>
<td>Percentage of number of inpatients requests with erroneous data entry (missed test)/total number of inpatients requests</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pre-InpAT</td>
<td>Percentage of number of inpatients requests with erroneous data entry (added test)/total number of inpatients requests</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

## Unintelligible requests

| Pre-OutUn | Percentage of number of unintelligible outpatients requests/total number of outpatients requests | 3 |
### IFCC quality indicators

<table>
<thead>
<tr>
<th>Incorrect sample type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-WroTy</td>
<td>Percentage of number of samples of wrong or inappropriate type (ie, whole blood instead of plasma)/total number of samples</td>
</tr>
<tr>
<td>Pre-WroCo</td>
<td>Percentage of number of samples collected in wrong container/total number of samples</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incorrect fill level</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-InsV</td>
<td>Percentage of number of samples with insufficient sample volume/total number of samples</td>
</tr>
<tr>
<td>Pre-SaAnt</td>
<td>Percentage of number of samples with inappropriate sample-anticoagulant volume ratio/total number of samples with anticoagulant</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Samples clotted</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Clot</td>
<td>Percentage of number of samples clotted/total number of samples with an anticoagulant</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Inappropriate time in sample collection</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Pre-InTime</td>
<td>Percentage of number of samples collected at inappropriate time of sample collection/total number of samples</td>
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## IFCC quality indicators

<table>
<thead>
<tr>
<th>Unsuitable samples for transportation and storage problems</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Pre-NotRec Percentage of number of samples not received/total number of samples</td>
<td>1</td>
</tr>
<tr>
<td>Pre-NotSt Percentage of number of samples not properly stored before analysis/total number of samples</td>
<td>1</td>
</tr>
<tr>
<td>Pre-DamS Percentage of number of samples damaged during transportation/total number of samples</td>
<td>1</td>
</tr>
<tr>
<td>Pre-InTem Percentage of number of samples transported at inappropriate temperature/total number of samples</td>
<td>1</td>
</tr>
<tr>
<td>Pre-ExcTim Percentage of number of samples with excessive transportation time/total number of samples</td>
<td>1</td>
</tr>
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</table>

## Contaminated samples

| Pre-MicCon Percentage of number of contaminated samples rejected/total number of microbiologic samples | 1 |

## Sample hemolyzed

| Pre-Hem Percentage of number of samples with free Hb >0.5 g/L (clinical chemistry)/total number of samples (clinical chemistry) | 1 |
**Monitoring quality indicators**

**4.14.7 Quality indicators**

... The process of monitoring quality indicators shall be planned, which includes establishing the objectives, methodology, interpretation, limits, action plan and duration of measurement.

*The indicators shall be periodically reviewed, to ensure their continued appropriateness.*

**4.15.2 Review input**

The input to management review shall include information from the results of evaluations of at least the following:

f) *use of quality indicators* (see 4.14.7);

- The frequency for monitoring quality indicators is not defined, but yearly can be considered the minimum since results of quality indicators should be included in the management review.
- Best in class: monthly evaluation of IFCC quality indicators priority 1.
Question 2

Do you regularly monitor preanalytical key performance indicators for the preanalytical phase?

1. Monthly at least misidentification, incorrect sample type, incorrect filing, clotted samples, hemolyzed samples
2. Monthly set of predefined indicators
3. At least annually set of predefined indicators
4. Not or not regularly
# Results EFLM WG-PRE Survey

## European survey on preanalytical sample handling

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Is your laboratory accredited, certified or similar? (Multiple answers possible)

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</tr>
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<td>1</td>
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Similar to the traditional approach to improve the quality of the analytical phase, the preanalytical phase requires monitoring of the quality and continuous improvement.
Continual improvement

4.12 Continual improvement

The laboratory shall continually improve the effectiveness of the quality management system, including the pre-examination, examination and post-examination processes, through the use of management reviews to compare the laboratory’s actual performance in its evaluation activities, corrective actions and preventive actions with its intentions, as stated in the quality policy and quality objectives. Improvement activities shall be directed at areas of highest priority based on risk assessments.

- Risk assessment of the preanalytical phase should be handled in accordance with the general laboratory policy and at least the most critical step should be documented.

- Recommendation: risk assessment of the preanalytical steps in the total testing process including identification, patient preparation, sample preparation, sample collection, transport, reception, and sample storage should be performed.
Dealing with non-conformities

4.9 Identification and control of nonconformities
The laboratory shall have a documented procedure to identify and manage nonconformities in any aspect of the quality management system, including pre-examination, examination or post-examination processes.

4.10 Corrective action
The laboratory shall take corrective action to eliminate the cause(s) of nonconformities. Corrective actions shall be appropriate to the effects of the nonconformities encountered.

4.11 Preventive action
The laboratory shall determine action to eliminate the causes of potential nonconformities in order to prevent their occurrence. Preventive actions shall be appropriate to the effects of the potential problems.

- Non-conformities regarding the preanalytical phase should be handled in accordance with the general laboratory policy.
Hemolysis index: What action do you take if the rate of hemolysis worsens or is out of predefined cutoffs?

1. We do not systematically measure hemolysis index
2. We systematically measure and document hemolysis index, but we do not monitor hemolyzed samples as an indicator
3. We monitor hemolyzed samples as an indicator, but do not investigate any deterioration
4. We investigate any deterioration and subsequently attempt improve quality
For which analyses do you monitor hemolysis / lipemia / icterus?

- Hemolysis
- Icterus
- Lipemia
- No HIL Check
- Analyses not performed in my lab

Cadamuro J et al. *Biochemia Medica* 2019 in press
Results EFLM WG-PRE Survey

Cadamuro J et al. *Biochemia Medica* 2019 in press
Internal audit

4.14 Evaluation and audits

4.14.1 General

The laboratory shall plan and implement the evaluation and internal audit processes needed to:

a) demonstrate that the pre-examination, examination and post-examination and supporting processes are being conducted in a manner that meets the needs and requirements of users;

4.14.5 Internal audit

The laboratory shall conduct internal audits at planned intervals to determine whether all activities in the quality management system, including pre-examination, examination, and post-examination:

- Minimum: The pre-examination phase should be evaluated every year (the cycle for internal auditing should normally be completed in one year).
- Best in class: a specific internal audit covering exclusively all aspects of the preanalytical phase is recommended.
4.14.2 Periodic review of requests, and suitability of procedures and sample requirements

The laboratory shall periodically review its sample volume, collection device and preservative requirements for blood, urine, other body fluids, tissue and other sample types, as applicable, to ensure that neither insufficient nor excessive amounts of sample are collected and the sample is properly collected to preserve the measurand.

- Minimum: Blood collection conditions and test catalogue information should be reviewed whenever instruments, methods or sample collections systems change.
- Best in class: blood collection conditions and test catalogue information should be reviewed at least every 2 years and whenever instruments, methods or sample collections systems change.
4.1.2.6 Communication

Laboratory management shall have an effective means for communicating with staff (see also 4.14.4). Records shall be kept of items discussed in communications and meetings.

Laboratory management shall ensure that appropriate communication processes are established between the laboratory and its stakeholders and that communication takes place regarding the effectiveness of the laboratory’s pre-examination, examination and post-examination processes and quality management system.

- Minimum: Any deterioration of the quality objectives shall be communicated and documented.
- Best in class: At least half-yearly meetings with all stakeholders to discuss expectations, internal audit results, quality indicators and non-conformities.
4.6 External services and supplies

The laboratory shall select and approve suppliers based on their ability to supply external services, equipment, reagents and consumable supplies in accordance with the laboratory’s requirements;...

Criteria for selection shall be established.

The laboratory shall monitor the performance of suppliers to ensure that purchased services or items consistently meet the stated criteria.

4.15.2 Review input

The input to management review shall include information from the results of evaluations of at least the following:

j) performance of suppliers (see 4.6);

- The laboratory must monitor the performance of external transport periodically (preferably on a yearly basis).
- Minimum recommended: transport temperature and time within predefined criteria, reporting and follow-up of non-conformities.
Question 4

Sample transport performed by external suppliers (e.g. external company, hospital): do you have criteria for selection and evaluation?

1. We do not ask external suppliers to perform sample transport
2. We have external suppliers, but no criteria for selection or evaluation
3. We have criteria for selection and evaluation, and evaluate external suppliers at least once per year
4. We have criteria for selection, but do not perform an evaluation at least once per year
1) Accreditation Standards

2) ISO 15189:2012 Chapter 4: Management requirements

3) ISO 15189:2012 Chapter 5: Technical requirements
   • Training and competence assessment
   • Information for patients and users
   • Sample reception
5.1.2 Personnel qualifications
Laboratory management shall document personnel qualifications for each position. The qualifications shall reflect the appropriate education, training, experience and demonstrated skills needed, and be appropriate to the tasks performed.

5.1.5 Training
The laboratory shall provide training for all personnel ...

The effectiveness of the training programme shall be periodically reviewed.

5.1.6 Competence assessment
Following appropriate training, the laboratory shall assess the competence of each person to perform assigned managerial or technical tasks according to established criteria.

Reassessment shall take place at regular intervals. Retraining shall occur when necessary.
Venous blood sampling

Ana-Maria Simundic*, Karin Bölenius, Janne Cadamuro, Stephen Church, Michael P. Cornes, Edmée C. van Dongen-Lases, Pinar Eker, Tanja Erdeljanovic, Kjell Granqvist, Joao Tiago Guimaraes, Roger Hoke, Mercedes Ibarz, Helene Ivanov, Svetlana Kovalevskaya, Gunn B.B. Kristensen, Gabriel Lima-Oliveira, Giuseppe Lippi, Alexander von Meyer, Mads Nybo, Barbara De la Salle, Christa Seipelt, Zorica Sumarac and Pieter Vermeersch, on behalf of the Working Group for Preanalytical Phase (WG-PRE), of the European Federation of Clinical Chemistry and Laboratory Medicine (EFLM) and Latin American Working Group for Preanalytical Phase (WG-PRE-LATAM) of the Latin America Confederation of Clinical Biochemistry (COLABIOLCLI)

Joint EFLM-COLABIOLCLI Recommendation for venous blood sampling

v 1.1, June 2018
Venous blood sampling

- EFLM WG-PRE offers online resources

Most preanalytical steps occur:

1. In the laboratory reception process
2. During sample processing in the laboratory
3. Outside of the laboratory
4. During the reporting process
Information for patients and users

5.4.2 Information for patients and users

The laboratory shall have information available for patients and users of the laboratory services. The information shall include as appropriate:

a) the location of the laboratory;

b) types of clinical services offered by the laboratory including examinations referred to other laboratories;

c) opening hours of the laboratory;

d) the examinations offered by the laboratory including, as appropriate, information concerning samples required, primary sample volumes, special precautions, turnaround time, (which may also be provided in general categories or for groups of examinations), biological reference intervals, and clinical decision values;

e) instructions for completion of the request form;

f) instruction for preparation of the patient;

g) instructions for patient-collected samples;
5.4.2 Information for patients and users

h) instructions for transportation of samples, including any special handling needs;

i) any requirements for patient consent (e.g. consent to disclose clinical information and family history to relevant healthcare professionals, where referral is needed);

j) the laboratory’s criteria for accepting and rejecting samples;

k) a list of factors known to significantly affect the performance of the examination or the interpretation of the results;

• Minimum: The laboratory should have a test catalogue (with version control) which contains at least information on available tests, sample type and volume, stability, transport conditions, and TAT. The laboratory offers advisory services on request for these issues.

• Best in class: searchable (online, app, paper) laboratory guide containing in addition to minimal requirements also information on test indication, test utilization and guidelines where relevant.
5.4.4 Primary sample collection and handling
The laboratory shall have documented procedures for the proper collection and handling of primary samples. The documented procedures shall be available to those responsible for primary sample collection whether or not the collectors are laboratory staff.

5.4.4.2 Instructions for pre-collection activities

5.4.4.3 Instructions for collection activities
The laboratory’s instructions for collection activities shall include the following:

e) instructions for labelling of primary samples in a manner that provides an unequivocal link with the patients from whom they are collected;

f) recording of the identity of the person collecting the primary sample and the collection date, and, when needed, recording of the collection time
Venous blood sampling

Joint EFLM-COLABIOCLI Recommendation for venous blood sampling

v 1.1, June 2018
Patient identification and tube labeling

EFLM Position Paper

Patient identification and tube labelling – a call for harmonisation

EFLM WG-PRE recommends

• Healthcare institutions should have zero tolerance to patient identification errors;
• A minimum two and preferably three unique patient identifiers (one of which is the full name of the patient) should be used for patient identification;
• Patient and sample identity should always be checked in the presence of the patient;
• The institution should have a system in place to continuous monitor and hopefully reduce the frequency of the identification error rate;
• A system should be in place for a continuous education for all professions involved in phlebotomy;

5.4.6 Sample reception

The laboratory’s procedure for sample reception shall ensure that the following conditions are met.

a) **Samples are unequivocally traceable**, by request and labelling, to an identified patient or site.

b) **Laboratory-developed and documented criteria for acceptance or rejection of samples are applied.**

c) **Where there are problems ... the final report shall indicate the nature of the problem and, where applicable, that caution is required when interpreting the result.**

- Minimum: relevant rejection criteria for suitability of the sample should be defined in the QMS. Samples not fulfilling these criteria should be rejected.

- Best in class: The laboratory has an automated system which provides information about the impact of the sample problem on a test by test basis on the final report.
How do you use information about hemolytic/lipemic/icteric samples in your lab?

- The whole sample is rejected
- Only some affected tests are rejected (along with an appropriate comment)
- All tests are released with general information on hemolysis/lipemia/icterus
- All tests are released. No reporting of hemolysis/lipemia/icterus - only documented (e.g. for statistical reasons)
Thank you