Development of ISO Standard Methodology and tools for the validation of biometric methods for forensic evaluation

National Commission on Forensic Sciences Meeting #13
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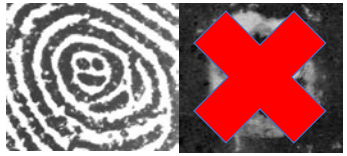
outline

- Biometrics and forensics
- Standards
  - Why, how, what of our technical approach
- ISO/IEC 19795-8 Information technology -- Biometric performance testing and reporting -- Part 8: Methodology and tools for the validation of biometric methods for forensic evaluation and identification application
- How to get involved
  - ISO biometrics and forensics
  - Subcommittees, development process (how to get involved)
- ISO TC 272 Forensic sciences

Biometrics vs. Forensics



The outcome of a forensic investigation process has to be often *verbally communicated* to a jury or a judge. The outcome of biometric recognition, is a numerical score used to declare a match/no-match decision.

The *quality* of the evidence data obtained in the case of forensics is typically lower than that of biometrics for which quality can be designed-in.

Forensic science predominantly involves the *manual* collection and examination of evidence, compared to biometric recognition which is by definition fully *automated*

Jain AK, Ross A. 2015 Bridging the gap: from biometrics to forensics. Phil. Trans. Royal Society B 370: 20140254. http://dx.doi.org/10.1098/rstb.2014.0254

NIST

BIOMETRIC FORENSIC

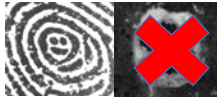
Without standards, a technology cannot become ubiquitous, particularly when it is part of a larger network.

The Economist - 8 May 2003.

Role of Standards

- Open specifications for interoperable and uniformly interpretable exchange of [biometric] data, or performance testing and reporting
- Prevents vendor lock-in. Or protocol lock-in
- Allows for a marketplace of off-the-shelf product
- Allows modular integration of products or processes without comprising architecture scope
  - Reduce cost of technology refresh
- Allows for uniform testing and reporting
  - repeatable and reproducible research, laboratory accreditation
- Allows for performance improvement (quality by design)
  - Prevent GIGO

NIST



IREX II - IQCE

Iris Quality Calibration and Evaluation

Performance of Iris Image Quality Assessment Algorithms

NIST Interagency Report 7820

E. Tabassi, P. Grother, and W. Salamon

Information Access Division

National Institute of Standards and Technology

NIST

Funded by DHS S+T

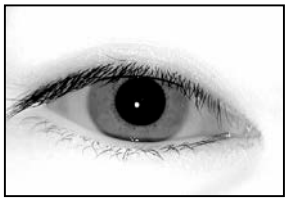
Project "Radical improvement in iris quality assessment and maturing multimodal biometric utilization"

September 30, 2011

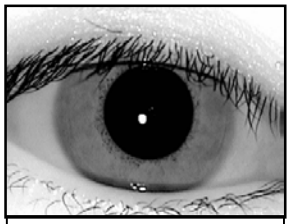
Iris Quality Calibration and Evaluation (IQCE)

An evaluation based program for development of clear, implementable, and interoperable iris image quality standard (ISO/IEC 29794-6).

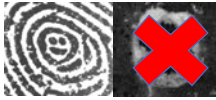
IQCE



raw image

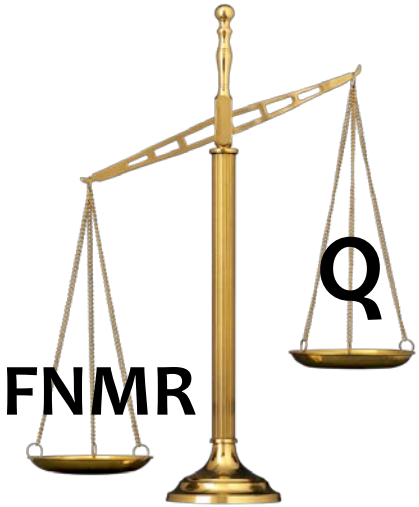


Cropped



VENDOR SUPPLIED IMAGE QUALITY ASSESSMENT ALGORITHM (IQAA)

QUALITY VECTOR



1 **Scalar quality**

2 .. 17 **Defined (standard) quality metrics**

18..32 **Reserved**

33..64 **Vendor-defined quality metrics**

Table 4. IQAAs output format.

The range of each metric shall be [0,254], a value of 255 means that the quality metric is not computed.

Position	Metric
1	overall quality
2	Gray level spread
3	Iris size (iris radius in pixel)
4	diameter)
5	Usable iris area (percentage of usable iris area)
6	Iris-sclera contrast
7	Iris-pupil contrast
8	Iris sclera boundary shape (iris shape)
9	Iris pupil boundary shape (pupil shape)
10	Margin (image scale in N5331)
11	Sharpness (defocus)
12	Motion blur
13	Signal to noise ratio
14	Magnification
15	Head rotation
16	Gaze angle
17	Interlace
18- 32	Reserved for future standardized quality metric
33 ... 64	Vendor-defined quality measurements

7

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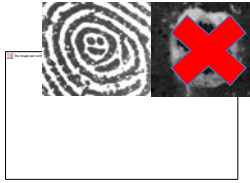

IQCE :: Outcome and impact

» Enabled scientific progress in iris image quality assessment

» Provided quantitative support to the development of international iris image quality standard

- Part of USG procurement

» Expand marketplace of products

- Standard compliant p available by the time the standard was published.

establishes methods to quantify the quality of iris images, and normative requirements on software and hardware producing iris images or measuring the utility of iris images.

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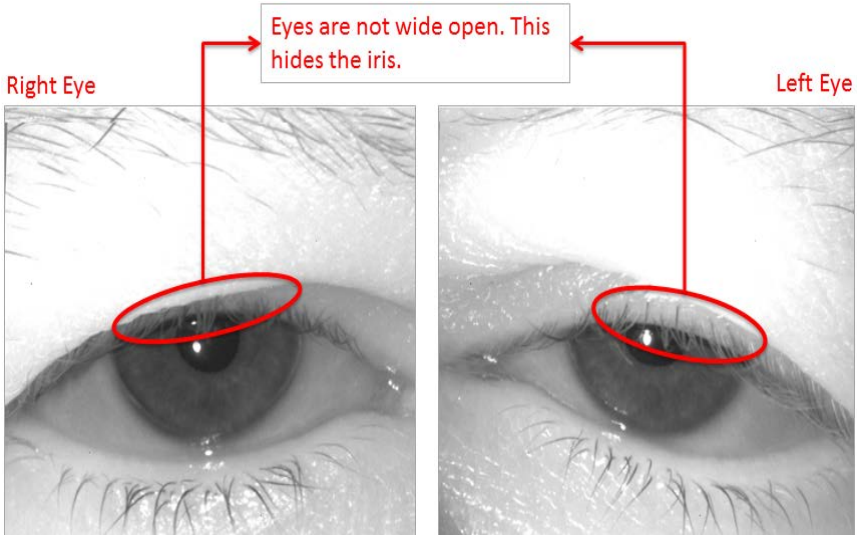
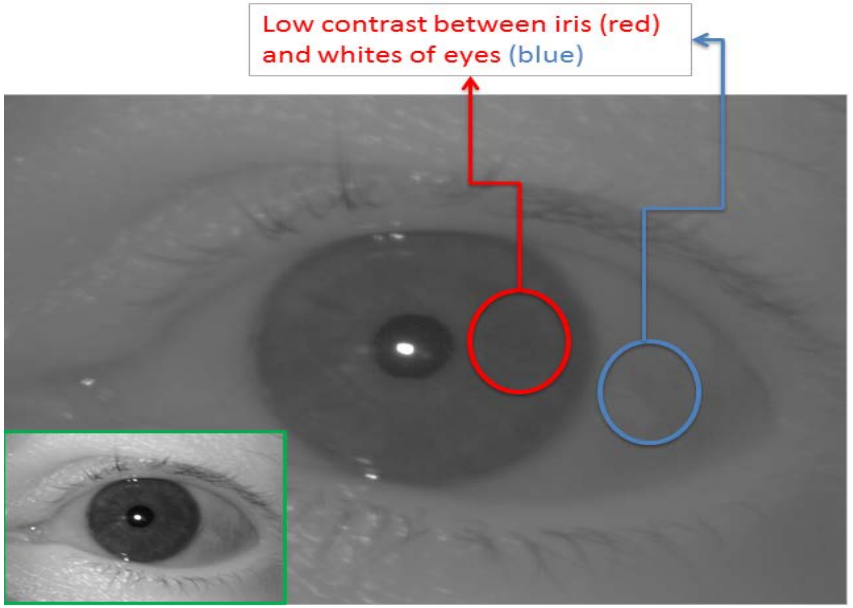
Improve acquisition quality by compliance to standard – required components



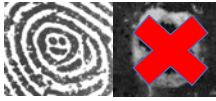
USABLE IRIS AREA



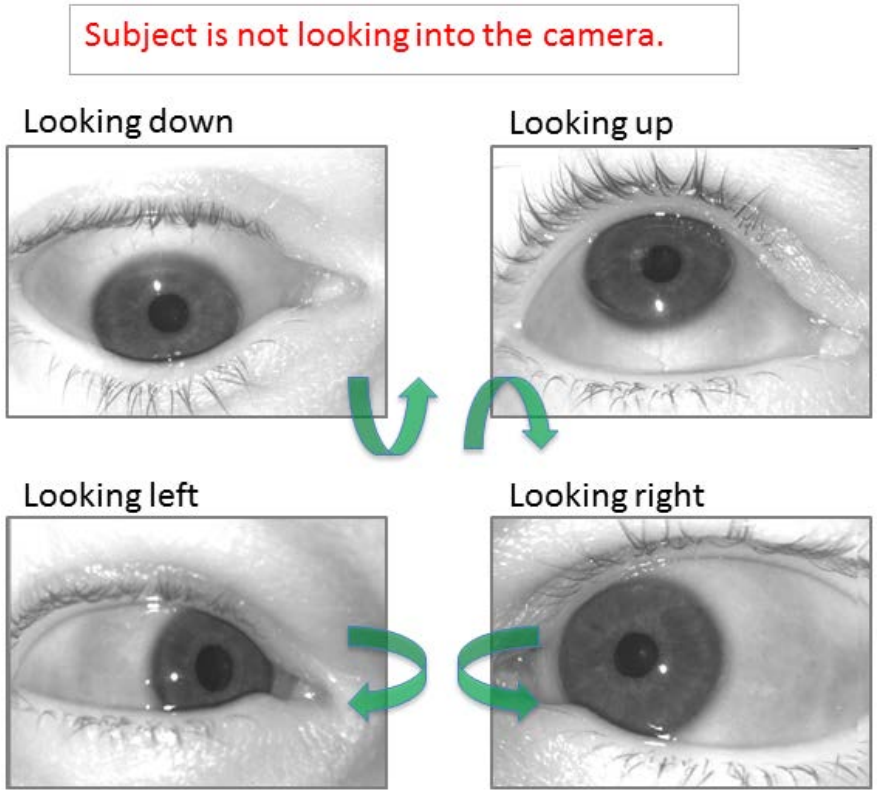
IRIS-SCLERA CONTRAST

specifies the normative quality requirements (standardize definition, computation method, units of measure, and acceptable range of values) for an iris image of sufficient utility. Quality metrics are ordered in terms of their effects on recognition error rates.

Improve acquisition quality by compliance to standard - recommended



FRONTAL GAZE



quality metrics that have been reported to affect recognition accuracy, but either their effect on recognition accuracy or the methods for computing them have not been quantitatively verified to be reliable or interoperable.

Technical Approach :: provide quantitative support

Test performance and interoperability of the standard

Identify gaps/outreach (NWIP,AMD)

Research + (large scale) evaluation

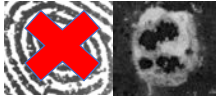
aimed at strengthening the science behind the claims or preventing overly prescriptive requirements

Submit comment + Technical contribution

Active participation Advocate for NIST/USG positions

Development of clear, robust, tested, and implementable content through extensive study and experiments, e.g. IQCE

Serve as Editor
Host workshops

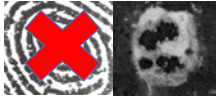


ISO/IEC 19795-8

Contents

- Information technology -- Biometric performance testing and reporting -- Part 8: Methodology and tools for the validation of biometric methods for forensic evaluation and identification application
- Established February 2017 as a new part to multipart standard ISO/IEC 19795
- It may become a separate project, or a Technical Report.

ISO/IEC 19795-8 Methodology and tools for the validation of biometric methods for forensic evaluation and identification application



3 Terms and definition (normative)

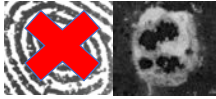
empirical probability, subjective probability, Bayes' Factor, Likelihood ratio

4 Conformance (normative)

5 Forensic evaluation (informative - TR)

Approaches for forensic evaluation:

Strength (or Weight) of evidence, or Strength (or Weight) of hypothesis



ISO/IEC 19795-8
6 Methods for forensic evaluation (informative)

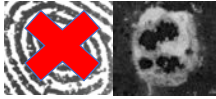
Bayesian

``Posterior = LR x priors''

Non-Bayesian

Fisher's Likelihood, The Turing-Good factor, The DET/ROC curve, Kullback-Leibler Divergence

ISO/IEC 19795-8
7 Validation of methods (normative)



Performance characteristics (what to measure)

Primary(Accuracy, Discrimination power, Calibration)

Secondary(Robustness, Generalizability, Monotonicity

Performance metrics (how to measure)

Decision Cost Functions, Empirical Cross Entropy, and Cost of Log-Likelihood Ratios

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Graphical representation

Receiver Operating Characteristic (ROC) curve, and

ROC Convex Hull (ROCCH): isotropic performance lines

Meuwly D., Ramos D., Haraksim R., A guideline for the validation of likelihood ratio methods used for forensic evidence evaluation, Forensic Science International 2016

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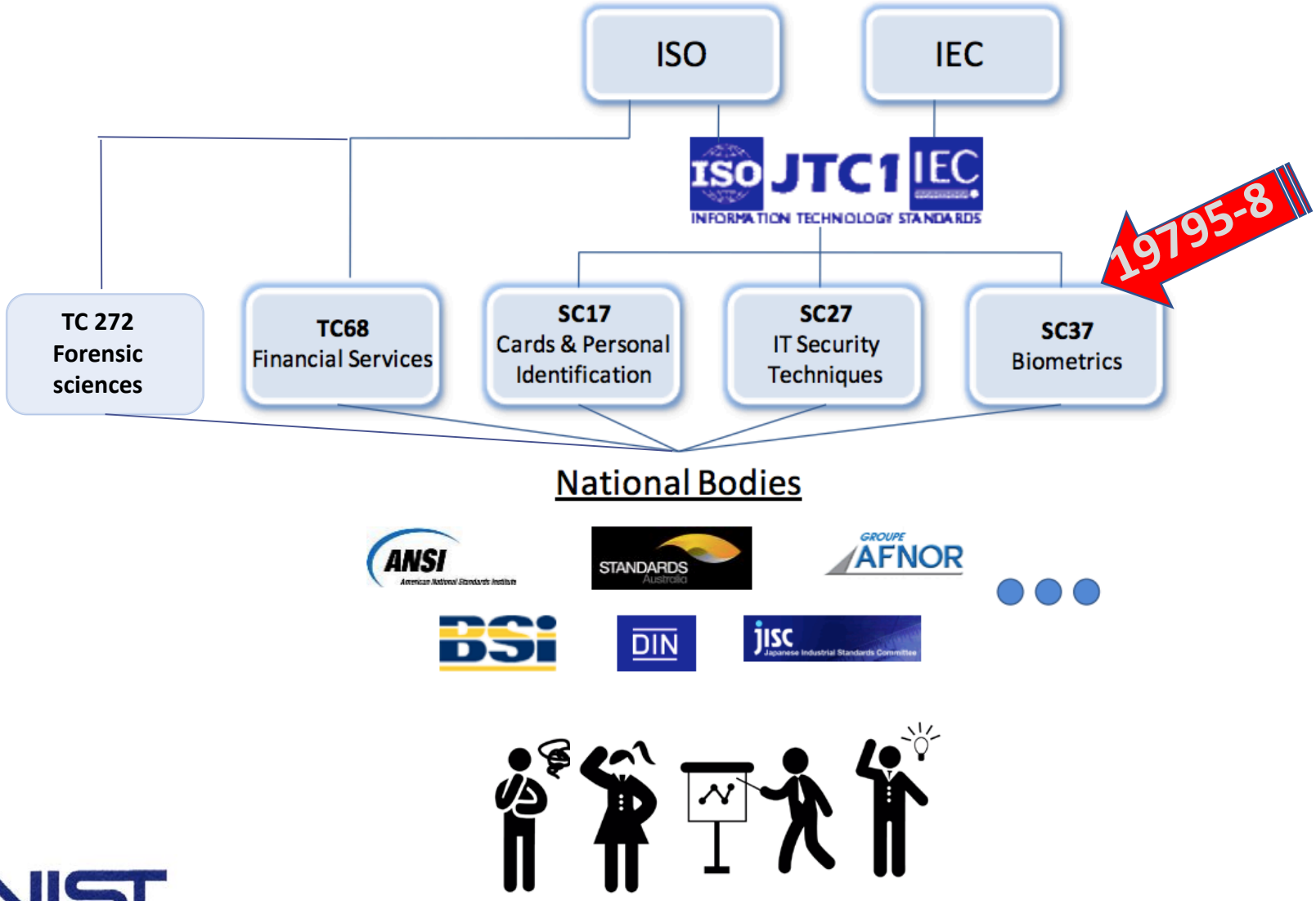
ISO/IEC 19795-8 timeline (ISO Standards Development)

ISO Biometrics/Forensics subcommittees



Issues and Challenges (in general)

- standardization process does not always proceed as planned or intended
  - Consensus building process
  - Delays may occur since limited number of meeting per year
- Protocol protection
- Remedy: Engage community (workshops, perform more large scale study e.g. IREX), provide actionable comments backed by empirical data

- Data collection + privacy issues

Often studies need "proper" data, or need dedicated data collection

- Remedy: actively seek [operational] data + get involve in data collection efforts + use the available data. Get the community involved.

In summary

- Standard development process does not have to be boring!
  - Syntax and format are important, so is comma.
  - But that is not the core of an standard.
- Standards are a positive stimulus for innovation
- To ensure `interoperability', requirements shall be stated in a clear, implementable, sufficient and testable manner.
- Standard development process is a consensus building process
  - Majority is not always right!
    - Remedy: provide actionable comments backed by empirical data to re-enforce your position
  - Get to know the stakeholder, engage them early and often.

Be a part of it!

- Participating in standard development process is a social activity
  - requires coordination within organization (NIST), national body (stakeholders in USG and US industry), and international members
  - requires a whole lot of `hallway' discussion
  - to gain support and momentum, and to prevent surprises at ballot results!
- ISO/IEC 19795-8 is at a very early stage of development
  - Its development and progression depends on technical contributions
- You can participate by
  - reviewing and commenting on the drafts
  - Even better, by contributing technical content that is supported by *data*

Become a member of INCITS M1, participate at meetings and advocate for yourself/your research/your organization!

NIST

Thanks.
Questions?

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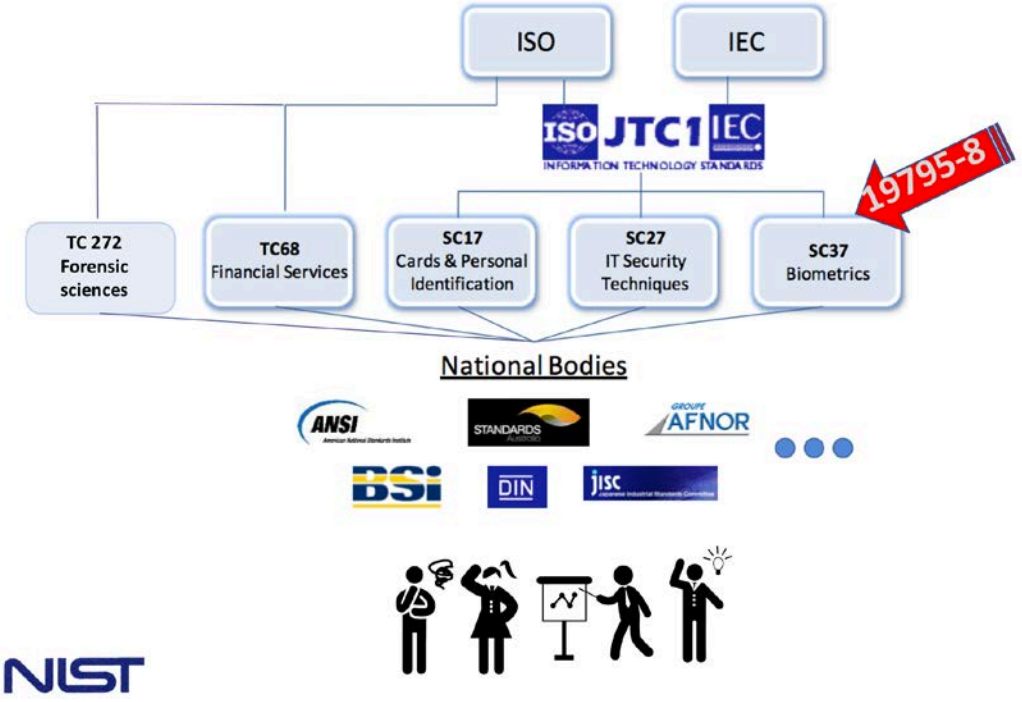
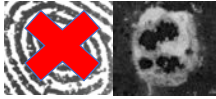


EXTRAS

22



ISO TC 272 Forensic sciences

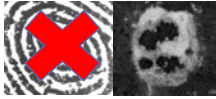
Scope

development of standards that pertain to laboratory and field based forensic science techniques and methodology in broad general areas such as the detection and collection of physical evidence, the subsequent analysis and interpretation of the evidence, and the reporting of results and findings.

Out of scope

Generic quality management standards dealt with by ISO/TC 176;

Conformity assessment guidelines dealt with by the ISO committee on conformity assessment (CASCO).



ISO TC 272
Forensic sciences

WG1 Vocab

⦿ ISO/CD 20962 Forensic sciences – Vocabulary

WG2 Process

⦿ ISO/CD 21043-1 Forensic Analysis– Part 1: Recognition, recording, recovering, transport and storage of material

WG3 Products

✓ISO 18385:2016 Minimizing the risk of human DNA contamination in products used to collect, store and analyze biological material for forensic purposes -- Requirements