Forensic Science Regulator

Guidance: Forensic Science Activities - Interpretation and communication

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Version 1

This document is issued by the Forensic Science Regulator in line with Section 9(1) of the Forensic Science Regulator Act 2021.

Contents

1. Introduction

1.1.1 This guidance sets out principles and expectations for interpretation and communication of observations in England and Wales. It has been drafted by a group that was convened by the Forensic Science Regulator (the Regulator) and comprised forensic practitioners and academic experts.

1.1.2 This group was established to address longstanding inconsistencies in the application and communication of interpretation within the forensic science community. The group's work reflects a collaborative effort to promote clarity, consistency, and scientific integrity across disciplines.

1.1.3 The guidance supports the delivery of balanced, robust, transparent, and logical expert opinion within the Criminal Justice System (CJS) and applies to:

a. All Forensic Science Activities (FSAs) subject to the Regulator's Code of Practice [1].
b. All practitioners, regardless of their role and whether they consider themselves to be expert witnesses or not, who carry out FSAs and provide evidence that would be expected to be outside the court's knowledge and experience.

1.1.4 This guidance supports that part of the Forensic Science Regulator's Code of Practice that sets out requirements for reporting results, including interpretation and opinion development (specifically section 31 in version 2 of the Code). It also supports compliance with obligations under the Criminal Procedure Rules and Criminal Practice Directions.

1.1.5 The guidance builds on previous work by the Regulator on the development of evaluative opinions [2] and describes four broad categories of interpretation, contextualising how each may be applied. Those categories are:

a. Investigative;
b. Evaluative;

c. Analytical; and

d. Categorical.

1.1.6 The guidance also considers circumstances in which the factual communication of observations, ie factual reporting, is appropriate

1.1.7 Whilst applicable to all FSAs, not all disciplines will utilise every interpretation type or level of issue. The Regulator will develop and publish further, discipline-specific guidance that will allow for overlap between related FSAs and will explain how the principles set out here apply within each discipline. This is intended to enable those principles to be adopted more readily across the forensic community. This discipline-specific guidance will be designed to be flexible, and to support this guidance document.

1.1.8 This guidance document supports the Code and is intended for use in the Regulator's jurisdiction of England and Wales. Whilst broadly compatible with international standard ISO 21043:2025 Forensic Sciences – Part 4: Interpretation, some recommendations in this guidance document are more specific than parallel requirements or recommendations in ISO 21043, and some do not have parallel requirements or recommendations in ISO 21043.

2. Scope

2.1.1 This document sets out guidance covering all types of interpretation of observations and communication of opinion in Forensic Science Activities (FSAs). It applies to all report types.

2.1.2 Not all FSAs utilise all interpretation types and/or levels of issue (See 2.3).

2.1.3 This document should be read in conjunction with the separate discipline specific interpretation guidance document for the FSA being undertaken where such guidance is available.

2.2 Categories of interpretation

2.2.1 This guidance considers four broad categories of interpretation, plus the factual communication of observations.

a. Investigative;
b. Evaluative;
c. Analytical;
d. Categorical; and
e. Factual communication of observations.

Investigative (See also 4.5)

2.2.2 Investigative interpretations are findings driven, and do not provide an indication of the probative value of the findings.

2.2.3 Investigative interpretation can address such open questions as:

a. What sequence of events has taken place?
b. How has material come to be at a certain place?
c. Where has material come from?

2.2.4 In this sense, the observations are given and explanations are derived for those observations.

Evaluative (See also 4.6)

2.2.5 Evaluative interpretation is driven by mutually exclusive propositions representing opposing (typically prosecution and defence) viewpoints. An evaluative approach is typically employed in a controlled environment, where scientific observations are evaluated to assess whether or not they provide a level of support for one proposition over an alternative. Evaluative interpretation provides for:

a. Interpretation of findings given a framework of circumstances in the case;
b. Evaluation of findings in the light of at least one pair of mutually exclusive propositions.
c. Conclusions typically to be expressed as a Likelihood Ratio (LR), either numerical or descriptive.

2.2.6 In this instance, it is the propositions that are the given and the observations are evaluated in the light of those propositions.

Analytical interpretation (See also 4.7)

2.2.7 Can address questions that can typically be answered directly by an analytical method, such as:

a. Is the material what it is alleged to be?
b. What is the material?
c. How much of the material is present?

Communication of a categorical opinion (See also 4.8)

2.2.8 A categorical opinion has limited application and is used when logic dictates the plausibility, or otherwise, of alternatives, such as:

a. Excluding materials, items, or people from being the origin of a questioned item;
b. When interpretation has classified a material to the exclusion of any reasonable alternative.

Factual communication of observations (See also 4.9)

2.2.9 Facts or observations are communicated without any inference or contextualisation applied. A factual report does not contain any opinion. It is important to recognise what amounts to opinion and ensure that if the statement contains opinion, or if it is likely that opinion evidence will be asked for at court, a report complying with the provisions for expert evidence is produced.

2.2.10 A factual report:

a. Communicates what has been done and observations made, eg, “I found none of the material” is a fact, whereas “None of the material was present” is not necessarily one;
b. Should include any uncertainty and assumption;
c. May provide technical explanations that are not case-specific;

2.3 Levels of issue

2.3.1 Observations help to address propositions that are developed to address specific issues, and these can typically be expressed at different levels. For example, addressing whether a trace material recovered from a person originated from a specified source is not the same as whether that person carried out a particular activity (that may have led to the deposition of trace material).

2.3.2 In interpreting and communicating observations, experts should be clear about the pertinent level of any given question or issue that may arise in criminal proceedings. When levels are confused or misinterpreted, this may engender:

a. Errors in evidence generation, analysis, interpretation and evaluation, potentially leading to the provision of misleading evidence and testimony; and/or
b. Errors by triers of fact, reaching an inappropriate verdict.

2.3.3 Experts should be clear in their own minds about the level(s) of issue that they are addressing in their casework. To mitigate risks of misinterpretation, expert reports should communicate effectively the level(s) of issue to which their observations are addressed.

2.3.4 It may also be helpful to the commissioning parties or courts for experts to specify in their report, which of the four level(s) of issue are not addressed.

Four levels

2.3.5 Four levels of issue can generally be distinguished in forensic practice and criminal proceedings:

a. Offence level issues;
b. Activity level issues;
c. Source level issues; and
d. Sub-source level issues.

Offence level

2.3.6 Offence level issues relate directly to liability for criminal offences. They often predicate offence names or definitional elements of offences such as ‘wounding’, ‘bodily harm’, ‘harassment’ or ‘intent’. Offence level issues could also relate to elements of criminal law defences such as duress, loss of self-control, diminished responsibility or insanity.

2.3.7 Proof of any material offence element, as well as ultimate findings of guilt on any criminal charge, are always matters for the trier of fact in criminal trials.

2.3.8 Whilst there is no prohibition on addressing propositions at offence level, experts should not purport to:

a. Answer offence level questions, which typically incorporate legal concepts and principles on which scientific or medical experts are categorically unqualified to comment. For example, ‘wounding’ and ‘assault’ have technical legal definitions. Thus, an expert could provide evidence of a wound, but not infer a legal wounding, or evidence of striking, but not of a criminal assault; or

b. Resolve ultimate questions of criminal liability, which typically incorporate elements such as ‘recklessness’, ‘gross negligence’, ‘dishonesty’, ‘unlawfulness’ etc, and so lie beyond the remit of science.

2.3.9 Where offences contain elements of ‘strict liability’, such as driving under the influence of alcohol or drugs, a test to determine whether or not a certain legal limit of analyte has been exceeded might effectively settle an issue at offence level, but the ultimate determination remains a question for the trier of fact.

2.3.10 Insofar as an expert may be directly invited to express an opinion on any offence level propositions falling short of ultimate liability, they should ensure that their assistance to the Criminal Justice System (CJS), or the court, does not trespass beyond the limits of propositions securely rooted in science. Apologetic silence is preferable to giving misleading answers [3].

Activity level

2.3.11 Activity level issues address actions, which are generally forms of human conduct, often within a defined timeframe, including material elements of criminal offences. Such conduct could be active (eg striking someone) or passive, (eg standing nearby when someone is struck) or even conduct that is neither voluntary nor necessarily conscious, (eg producing a blood pattern distribution following an injury).

2.3.12 It is generally desirable for experts to express opinions at activity level and an expert may be directly invited to do so by investigators. If not directly requested to express an opinion at activity level, experts should advise investigators whenever it is possible to express such an opinion.

2.3.13 Activity level issues can be addressed only if sufficient information is available to support them. Activity level propositions for the development of evaluative opinion, are particularly susceptible to changes in conditioning information, potentially prompting changes of opinion.

2.3.14 Experts addressing activity level issues should ensure that:

a. The observations from any tests conducted, in the context of the information provided, are sufficient to justify an activity level opinion going beyond addressing simple issues of source; and
b. Opinions are expressed in appropriate and precise language and convey any limitations on the interpretation.

2.3.15 Conscious and sub-conscious biases [4] should be mitigated, so as to minimise their influence on the rigour and independence of expert interpretations.

2.3.16 Activities can often be described using alternative descriptions, but such descriptions are not necessarily semantically equivalent and they may convey different meanings to lawyers and courts (eg ‘gripped’ v ‘throttled’, ‘pushed’ v ‘shoved’, ‘coughed’ v ‘spat’). Experts should strive to employ neutral language to avoid unintentional misunderstanding.

Source level

2.3.17 Consideration of source level issues usually involves the comparison of traces to their purported physical (or digital) sources.

2.3.18 Variability between and within potential sources should be taken into account.

2.3.19 Such a comparison can address the issue of common origin between a trace and its alleged source, rather than a different source. This could be expressible as a likelihood ratio.

2.3.20 In certain instances, the opinion drawn from a comparison may be expressed in categorical terms (see section 2.2.8).

2.3.21 It may also be possible, on occasion, to indicate whether a trace derives from a generic type of item, without individualising its source. For example, a glass fragment might be categorised as typical bottle glass, without specifying any particular bottle as its source.

Sub-Source level

2.3.22 Sub-source level issues are addressed specifically in forensic DNA casework whenever it is necessary or informative to differentiate between DNA that can be attributed to particular biological material, such as blood, and DNA that cannot be attributed to any identifiable biological material. The discipline-specific guidance for human biological material will consider this further as the concept of sub-source and attribution of a material to a carrier medium applies only in that area.

3. Principles of communicating observations and opinions

3.1 General

The expert witness

3.1.1 The Code of Practice Version 2 (The Code) [1] defines an expert as: "A practitioner who is competent to provide evidence of fact and/or opinion in the CJS in relation to an FSA." This includes specialists from outside the forensic science profession, as set out in Part E of the Code, who may also provide expert evidence from time to time in relation to any FSA which is subject to the Code.

3.1.2 An expert can, contrary to the general prohibition, provide evidence of opinion. Part 19 of the Criminal Procedure Rules (CrimPR) [5] creates rules relating to the use of expert evidence in criminal proceedings. Related guidance is contained in Part 7.1.1 of the Criminal Practice Directions (CrimPD) [5], which states that expert opinion evidence is admissible in criminal proceedings if, in summary:

a. It is relevant to a matter in issue in the proceedings;
b. It is needed to provide the court with information likely to be outside the court's own knowledge and experience;
c. The witness is competent to give that opinion; and
d. The expert opinion is sufficiently reliable to be admitted.

3.1.3 Crim PR [5] places an obligation on an expert to set out why their opinion is sufficiently reliable to be admissible as evidence as well as anything that might undermine the reliability of that opinion, or of the expert's credibility or impartiality.

3.1.4 During the course of giving oral evidence, the expert may be asked to opine on an issue that they have not previously considered. If, to ensure that opinion meets the same standards of reliability as other expert evidence they

have provided, the expert believes it necessary to make use of resources at their place of work, then they should seek permission and sufficient time to do so.

3.1.5 If the court refuses permission, then the expert should make any limitations to their opinion clear.

3.2 Approach to interpretation

3.2.1 All interpretations should be balanced, robust, transparent and logical. [6]

Balance

3.2.2 The expert witness has a legal responsibility to consider opposing accounts of events, where these are available, to offer impartial and even-handed advice to the CJS.

There may be circumstances in which the account of only one side is available and balance is lost. Annex A sets out in detail how experts should address circumstances such as these.

Robustness

3.2.3 The expert's evidence should be based on the observations from tests following validated methods and, where applicable, validated statistical models, as well as data that are fit for purpose.

Transparency

3.2.4 The expert's evidence should include sufficient information, including limitations, to enable scrutiny by other experts and effective cross-examination. It should also set out, in a manner that is comprehensible to legal professionals and juries, the expert's reasoning on how they reached their conclusion. Information provided should include, but may not be limited to:

a. Propositions addressed.
b. Test or examination results.
c. The background information used in arriving at their conclusion.

d. If required, the data used and its provenance.

e. If required, any statistical approaches used and the results of any validation tests.

Logic

3.2.5 A trial requires reasoning in the face of uncertainty. The expert witness should provide evidence that is supported by an established framework of logic.

Transposed Conditional

3.2.6 Evaluative opinions are expressed as a ratio of two conditional probabilities for the scientific observations.

3.2.7 The level of support (evidential strength) is assessed by considering how much more probable any observations would be if one proposition were true rather than the alternative. It does not logically follow from this that one proposition is more likely to be true than the other. That broader judgement depends on all of the evidence and falls to the trier of fact.

3.2.8 This type of logical fallacy is known as the transposed conditional, or the prosecutor's fallacy.

3.2.9 Experts should endeavour to convey clearly that their opinion does not indicate the likelihood of the truth of one proposition over the other. This can be achieved by inclusion of the following text, or text substantially the same:

3.2.10 The level of support has been assessed by considering how much more probable such observations would be if one proposition were true rather than the other. It does not logically follow from this that one proposition is more likely to be true than the other. This much broader question will be influenced by any other relevant evidence and circumstances, including information that is not available to the expert, or on which it would be inappropriate to comment.

4. Guidance

4.1 Standards

4.1.1 General requirements for the reporting of results are set out at Section 31 of the Code, which also sets out specific requirements when considering evaluative opinion at 31.4. Paragraph 31.4.2 of the Code sets out the following:

The policies and procedure for interpretation and development of opinions shall be part of the Quality Management System.

a. Validation of interpretive methods shall be according to this Code (section 24.9).
b. The policies and procedures shall require that there is clarity in any report as to the source(s) of data used in forming the evaluative opinion (Part 19 of the Criminal Procedure Rules).
c. Experts providing opinion shall be demonstrably competent to do so (see also section 22.2.3 of the Code).
d. The use of statistical models and any assumptions involved in the interpretation and opinion shall be set out in reports.
e. Processes for the peer review of evaluation shall be part of the QMS.

4.2 Competence

4.2.1 The Code sets out general competence requirements at section 22 and at 22.2 sets out more specific competence requirements for reporting. All elements of competence should be taken into account, including the use of statistics, both for routine and more complex casework, where applicable. If necessary, specialist statistical knowledge should be sought.

4.2.2 Where reporting requires interpretations and expressions of opinions, only practitioners authorised by, or on behalf of, the Senior Accountable Individual should present such evidence.

4.2.3 Competence should be objectively assessed and demonstrated both initially and thereafter at intervals that are appropriate to the evidence type under consideration. This enables practitioners to comply with their obligations under CrimPR 19.4 (b) and (f) [5].

Initial competence

4.2.4 Initial competence could be demonstrated in a variety of ways, including, but not limited to:

a. Successful completion of training courses, with appropriate assessment, or;
b. Practical assessment such as mock interpretations with opinions expressed within an expected range;

Ongoing competence

4.2.5 Ongoing competence could be demonstrated by means such as, but not limited to:

a. Continuous Professional Development;
b. Keeping up to date with developments related to the FSA undertaken.
c. Proficiency tests, or other external exercises with an expected outcome, but representative of the complexity encountered in their work.

4.3 Calibration of expertise

Key Aspects of calibration of expertise

4.3.1 Calibration involves the competence of an expert in carrying out a given FSA and the competence of the forensic unit in how the outputs from the carrying on of the FSA are communicated to the CJS.

4.3.2 Effective calibration of expertise provides assurance to the CJS that the courts are provided with consistent expert evidence regardless of which expert provides that evidence. It is a measure of the degree to which the opinion formed by an expert may differ from the opinion formed by another expert and/or the true value. It:

a. Identifies where opinions vary widely. ;
b. Improves the quality and credibility of forensic testimony;
c. Supports continuous professional development and accountability;
d. Enhances transparency and trust in forensic evidence;
e. Identifies training needs or systemic issues, and;
f. Supports quality assurance and accreditation processes.

Demonstration of calibration of expertise

4.3.3 Experts should participate in regular and robust calibration of their expertise, which can be achieved in a variety of ways.

Proficiency Testing

4.3.4 Proficiency testing measures the ongoing competence of an expert as well as organisational competence in how outputs from the carrying out of an FSA are communicated to the CJS.

4.3.5 Calibration can be empirically demonstrated using proficiency testing that incorporates ground truth and is representative of the work undertaken.

4.3.6 Proficiency testing addresses:

a. Ground Truth: The expected range of opinions is known to the test administrators but not to the expert.
b. Assessment: By comparing the expert's conclusions to the ground truth, evaluators can determine:
    i. Accuracy (how often the expert is within the expected range)
    ii. Calibration (the degree to which expert's opinion agrees with that of other experts.
    iii. Consistency (how stable the expert's performance is over time)

4.3.7 Where possible, proficiency testing should be carried out blind, where experts are tested without knowing that they are. This eliminates bias and simulates real casework conditions, but the Regulator recognises that such tests are difficult to administer.

4.3.8 In addition to proficiency trials, and/or especially where they are not available or feasible, then forensic units should consider other suitable methods for calibration of expertise. In order of the assurance they provide, such methods include:

a. Inter laboratory comparison (ILC);
b. Internal quality assurance;
c. Competence assessment; and
d. Peer review.

Inter Laboratory Comparison (ILC)

4.3.9 This provides a means to measure consistency between organisations. Whilst the element of blind testing may be missing for the organising laboratory, rotating that responsibility would allow each participating organisation to be tested blind at some point.

Internal quality assurance

4.3.10 This can measure consistency within a forensic unit. If a small number of experts in a forensic unit has participated in a PT or ILC exercise, then an internal QA exercise could be used to measure broader organisational consistency.

Competence assessment

4.3.11 This could also be used as a measure of consistency within a forensic unit, enabling an expert to demonstrate their individual competence.

Peer review

4.3.12 This provides a check that two competent individuals within an organisation have reached a consistent view within an individual case. If the interpretation peer review has been carried out without knowledge of the initial opinion, it has more value in demonstrating consistency than if it was an open check.

4.3.13 The Code [1] discusses peer review further at section 20.3.

4.4 Provision of information - minimising the risk of bias

4.4.1 The expert needs sufficient task-relevant information to select appropriate analyses and interpret the observations from those analyses. The expert does not need, and should not see, any task-irrelevant information. For example, task-irrelevant could include information on previous convictions, or any other extraneous information not relevant to the expert's task. The forensic unit should formulate and implement a policy to minimise the provision of task-irrelevant information whilst allowing task-relevant information to reach the expert.

4.4.2 In formulating opinions, the expert should:

a. Consider the questions being asked by the commissioning party in the case and identify the issue(s) that can be addressed; and
b. Consider all available, task-relevant information and, where necessary, request additional task-relevant information as may be needed to address those questions.

4.4.3 All forms of interpretation and opinion involve professional judgement, which is defined as the application of professional knowledge and experience to reach a conclusion or recommendation about a situation.

4.4.4 Specifically for evaluative opinions, the expert also needs sufficient task-relevant information to determine appropriate propositions.

4.5 Investigative opinion

Identifying the question to address

4.5.1 In adopting an investigative approach, a practitioner provides a range of possible explanations for findings. This approach may be taken when competing propositions are not available, or cannot be formulated.

4.5.2 Typically, an investigative approach is taken to address such questions as:

a. What sequence of events has taken place?
b. How has the event been initiated?

c. How has this material got here?

d. Where has this material come from?

4.5.3 Investigative opinions do not provide an indication of the likely probative value of the findings as they do not necessarily represent a balanced view; this should be made clear when communicating any findings. Nevertheless, by informing the investigation, they may shape appropriate propositions to consider for evaluation.

4.5.4 If a value of evidence is the desired aim, then another type of interpretation should be used.

Addressing the appropriate level of issue

4.5.5 Generally, investigative interpretation is carried out at activity level, though it could also be at source level.

Data collections

4.5.6 In some areas, the interpretation will employ data collections. Examples include:

a. Collections of data concerning the frequency of occurrence of fibres, glass, footwear undersole patterns and DNA alleles;

b. Experimental data on transfer and persistence of traces and;

c. Descriptive data, used primarily to identify possible sources for an unknown trace.

4.6 Evaluative reporting

Identifying the question to address

4.6.1 In adopting an evaluative approach, a practitioner considers the questions being asked by the commissioning party, formulating propositions to address those issues. The expert should:

a. Consider the questions being asked by the submitting party in the case and identify the issue(s) their analysis of the items/exhibits available can address;

b. Consider all available, relevant case-specific information and, where necessary, request additional information as may be needed to address those questions; and
c. Discuss the issues to be addressed and potential propositions with the relevant instructing party (e.g. police, defence, prosecuting authority) and, where possible and required, the other party.

4.6.2 On the basis of the case circumstances and any agreed key issue(s), the following should be identified.

a. The prosecution proposition(s).
b. The defence proposition(s).

4.6.3 There may be more than one pair of propositions, but the assessment should consider the propositions in mutually exclusive pairs.

4.6.4 The propositions should be at the level which will provide the most effective assistance with resolving the issues facing the decision-makers in the CJS. This will often involve the expert addressing propositions at the activity level.

4.6.5 The expert should consider:

a. Whether the relevant case circumstances allow them to specify the fact in issue at activity level;
b. Whether the items submitted and the tests available will enable them to formulate propositions at the activity level; and,
c. Whether they have the expertise and resources to provide opinion to help address that fact in issue.

4.6.6 If an issue cannot be appropriately addressed at activity level, the expert should explain any limitations clearly and explicitly to the commissioning party and the court. The explanation should:

a. Set out the reason that activity level cannot be addressed, such as the submission of an item that is irrelevant to the issue at hand; and
b. Explain the level, ie source or sub-source, that can be addressed.

4.6.7 If there are clearly defined propositions from both prosecution and defence sides that allow a balanced evaluation to be made of the observations, then an evaluation of the support for one proposition over the other, should be carried out.

4.6.8 The defence account should be set out to assist the expert with formulating an alternative proposition. However, if no account is put forward, such as in a 'no comment' interview, then the expert may not be able to make a meaningful evaluation of the observations as those findings cannot be contextualised.

4.6.9 Situations where no line of defence has been put forward are addressed at Annex A.

Case Assessment

4.6.10 The expert should establish if the examination and/or analysis of items submitted can assist by carrying out an assessment following the Casework Assessment and Interpretation (CAI) model [7].

4.6.11 Examinations and analyses commissioned should be those that most effectively address the issues in the case - whether the outcome would support either the prosecution or defence.

4.6.12 At the pre-assessment stage, the expert identifies potential observations and assigns a probability for each of these under the condition of each proposition.

4.6.13 Assignment of these probabilities should be informed by structured, published data where such data are available.

4.6.14 Where such data are not available, then probabilities may be assigned subjectively, based on the expert's experience. Where such subjective probabilities have been assigned, the expert should make it clear that this is the case.

4.6.15 If the assigned probabilities are very low for both propositions, the expert should reconsider whether the issue in the case can be usefully addressed using the identified propositions. The expert should:

a. Advise the instructing party accordingly; and
b. If appropriate and if safe to do so, develop an alternative set of propositions.

4.6.16 If alternative propositions cannot be developed, or if the assigned LR approximates to one (1) irrespective of what observations were obtained, then it may be the case that the issue at hand cannot be addressed through the method under consideration. The instructing party should be advised accordingly.

4.6.17 All advice, and responses to that advice, should be documented on the case record.

4.6.18 If an instructing party insists upon an examination strategy that is unlikely to assist with addressing the issues in the case, does not enable the expert to take a balanced approach, or is overly specific such that it has the potential to result in misleading conclusions, then the party should be advised accordingly and the advice and conversations should be recorded on the case record. Any resulting limitations on the opinion developed should be described in the report.

4.6.19 If access to relevant items, or funds for additional examinations as identified through the assessment, is denied, then the instructing party should be advised as to the limits of any resulting interpretation. For example, if only a subset of the trace material collected were provided for analysis this might constitute a biased sample which could result in a misleading evaluative opinion.

4.6.20 Reference to any limitations on the opinion should be recorded in the case notes and in the report and advice provided as to the potential for any additional or alternative work that might inform the investigation.

Data collections

4.6.21 In some areas, the evaluation will employ data collections. Examples include:

a. Collections of data concerning the frequency of occurrence of fibres, glass, footwear undersole patterns and DNA alleles;
b. Descriptive data, used primarily to identify possible sources for an unknown trace and;
c. Experimental data on transfer, persistence, recovery and background occurrence of traces.

4.6.22 Judgement on the part of the expert is required in relation to, for example:

a. Which data to use;
b. The relevance of the data to the case; and
c. The quality, reliability and availability of data.

4.6.23 Published data of appropriate quality should be used, wherever possible, as a basis for assigning probabilities to the findings to generate the LR.

4.6.24 Data from unpublished sources may be used to supplement published data, or, if relevant published data are not available, as long as the provenance and quality of the unpublished data have been reviewed and deemed suitable by the expert and the source of the data is documented on the file. Unpublished datasets should be made available for inspection by an expert instructed by the other party if probability assignments based thereon relate to a contested issue in the case.

4.6.25 The reliability of a structured data set (including any local data set) from previous casework, a ‘knowledge base’, should be calibrated regularly by conducting studies using ground truth data as described by Evett [8].

4.6.26 Where the expert does not have relevant and robust experimental data, they may have sufficient personal, professional experience and knowledge to enable them to compare the probabilities of their observations given that each of the propositions were true. Expertise such as this should be calibrated regularly through collaboration and participation in activities such as proficiency tests.

4.6.27 In such an evaluation, which may be unquantified, the expert should record the basis on which they have reached their conclusion in the casefile in a transparent manner for another expert and the court.

Assigning the LR

4.6.28 For cases where probabilities have been assigned on the basis of a data set of sufficient relevance, quality and size, the LR should be reported to two significant figures when it is greater than or equal to 10 and one significant figure when it is less than 10.

4.6.29 For cases where probabilities have been assigned on the basis of structured data which are limited in their relevance, quality and/or size but are available for inspection by another expert, the LR should be determined at an order of magnitude level, alongside a verbal expression, in a way that enables the court to see where on a scale the opinion in the particular case lies.

a. The expert would be expected to consider their observations and evaluation in the 'Interpretation' section of their report, using wording such as "Overall, it is my view that my observations are between ten and one hundred times more probable if A were true rather than B".
b. In the 'Conclusion' section of their report, the verbal equivalent would be used.

4.6.30 For cases where probabilities have been assigned on the basis of unstructured observations from experience, which are not available for inspection by another expert, a narrative LR should be assigned. The expert should be explicit that their conclusion is based solely on experience and as such may differ from that of other experts with different experience. (See also 10.2)

4.6.31 If probabilities are assigned through a combination of these methods, then the method which is least precise should be used to guide the manner in which the LR is reported.

Reporting

4.6.32 The application of the CAI model is not influenced by the type of report or output expected by the commissioning body.

4.6.33 Evaluative activity level can be addressed in any form of written output including Streamlined Forensic Reports (SFR)s [9].

4.6.34 Streamlined forensic reporting lends itself to the CAI model in that it is possible to number opinions at source and activity level in an SFR1. In this way, they are clear for the defence to agree or challenge resulting in the appropriate/relevant issue being identified for the SFR2.

4.7 Analytical reporting

Identifying the question to address

4.7.1 Analytical methods may be used descriptively or numerically to address questions such as:

a. Is the material what it is alleged to be?
b. What is/are the material(s)?
c. How much of the material is present, inc. purity/concentration?

4.7.2 Key points for consideration in analytical interpretation (CPD 7.1.2d) include:

a. Uncertainty of measurement, limit of detection, limit of quantification, and interference from contaminants.
b. For numerical methods, in particular, it should be understood that the true value may lie in a range, which should be stated in the report.
c. In determining whether or not a particular legal limit has been exceeded, account should be taken of uncertainty of measurement. The legal limit cannot be said to have been exceeded unless it falls below the minimum of the interval of uncertainty of the observation.

4.7.3 Analytical interpretations may inform factual reports, or categorical, evaluative, or investigative opinions.

Data collections

4.7.4 Reference libraries of known materials

4.8 Categorical opinion

Identifying the question to address

4.8.1 A categorical opinion is not factual and, therefore, any report in which such an opinion is expressed should make that clear and should indicate the inherent level of uncertainty in that opinion. Categorical opinion can be expressed when:

a. Excluding materials, items or people from having been the source of a questioned item.
b. Classifying a material to the exclusion of any plausible alternative. For example, if an unknown substance reacted in the expected manner to multiple independent tests for it to be “X”, and no other substance is known to react in this way, it could be said that, in the practitioner’s opinion, there was no plausible explanation for the findings other than the unknown substance was the same substance as “X”.

Addressing the appropriate level of issue

4.8.2 Categorical opinions should be expressed only at source or sub-source level, but there may be occasions when activities can be excluded.

Data collections

4.8.3 Reference collections

Reference libraries of known materials (e.g. drugs)

4.9 Factual communication

Identifying the question to address

4.9.1 A fact is something that is directly known by the expert.

4.9.2 In this sense, a factual report communicates what the practitioner has done and their findings, but offers no interpretation or contextualisation of those findings. A factual report for example might take the form of “I have examined item A for material X using method Y and have found none of that material”. It is not a fact that none of that material is present, only that none has been found by the method employed.

4.9.3 A factual report should not be issued if inference is required to understand or use the information it contains

4.9.4 Non case-specific technical explanations may be provided.

4.9.5 Account should also be made of the impact of the inherent uncertainty associated with any method used and the reliability of any underlying assumptions made.

4.10 Communication

Reporting

4.10.1 Any level (e.g. source, activity…) or interpretation type (e.g. investigative, evaluative…) can be covered in any type of written output.

4.10.2 In a report which is to be used as evidence, the expert has an obligation to set out clearly their assessment of the likely range of opinion.

4.10.3 For some evidence types, such as analysis and identification of drugs, the range of any opinion is likely to be very low as it will ordinarily be based on the outputs of well-established analytical methods. Similarly, the comparison of fingerprints as a means of identity confirmation may give a very narrow range of opinion, whereas complex comparison of friction ridge detail recovered from an incident scene with prints from a suspect would be expected to produce a wider range of opinion.

Range of opinion

4.10.4 The possible range of opinion that could be reached should be assessed in each case.

4.10.5 There may be classes of cases where this could be assessed once, with the same assessment being used for that class of case going forward, and revisited as needed where outside the expected circumstances.

4.10.6 Indicative criteria for the assessment of range of opinion are given in table 1 below:

Source of potential variation in opinion	**Reference**	**Assessment**
Published data relied on in assigning probabilities	Any papers relied upon in the case should be referenced. It is not possible to list all papers an expert's knowledge is based on, but any that are specifically relevant to the case should be listed.	Size, relevance and quality of data set should be described. Any limitations in the data, and its relevance to the interpretation, should also be described.
Level of acceptance and/or criticism of the approach used	Any key peer reviewed papers supporting or criticising the approach taken. Any disagreements in published literature.	Is there general acceptance of the scientific basis of the approach taken? Are opposing approaches known to be taken?
Unpublished structured data relied on in assigning probabilities	Provenance of the data should be described. Is it available to other experts in the case?	Size, relevance and quality of data set should be described.

Source of potential variation in opinion	Reference	Assessment
Casework experience relied upon in assigning probabilities	Describe relevant experience.	Brief appraisal of the quality, size and relevance of the personally acquired data and its limitations (e.g. ground truth is unknown). Is it presented in a searchable and calibrated 'knowledge base' or is there no calibration of the data?
Expertise	Reference participation in activities such as blind proficiency testing to calibrate expert performance.	Brief appraisal of relevance and limitations of the calibration activities and the expert's performance.
Assumptions	Refer to any published paper(s) describing the assumptions underlying any model used (e.g. DNA degradation model, uniqueness of FRD), published or	Brief assessment of the impact of these assumptions on the conclusion and whether they are widely accepted or

Source of potential variation in opinion	Reference	Assessment
	unpublished validation studies. There may be case specific assumptions, for example, that the source of the DNA is not contested.	controversial in the field.
Overall assessment	Overall assessment of the likely range of expert opinion on the matter should be assessed (narrow/medium/broad). If there is little relevant, published data and the assumptions are controversial, the overall assessment would be that there is likely to be a broad range of expert opinion. If there is sufficient relevant, published data to enable a statistically robust evaluation and there is little or no controversy regarding the assumptions, then a narrow range of opinion would be expected.	

Table 1: Range of opinion

4.11 Expressing an opinion

4.11.1 The ideal of a single, universally applied verbal scale across all Forensic Science Activities (FSAs) offers clear benefits for consistency and comprehension within the Criminal Justice System (CJS).

4.11.2 However, it remains the case that different forensic disciplines will, by necessity, require different nuances in how any such scale is applied and

expressed - and this has historically resulted in widely different approaches being taken in some areas.

4.11.3 This guidance advocates for a combined approach, retaining the clarity of a core set of verbal expressions while allowing for FSA-specific nuance where necessary.

Key principles:

Primacy of the Likelihood Ratio

4.11.4 A calculated, numerical LR is the preferred, primary way to express evidential strength where sufficient data are available (see section 4.6.27).

No Back-Transformation

4.11.5 The verbal scale is a communication tool. Any verbal expression should be based on transparently balancing competing propositions, and it is illogical to infer or back-calculate a numerical LR from a verbal expression of evidential strength.

Core verbal scale with discipline-specific guidance

4.11.6 A core verbal scale, (see Annex B), should be adopted as a baseline. However, some disciplines may utilise a specifically developed scale tailored to the unique characteristics and reporting practices of that discipline. Crucially, each discipline must follow specific guidance on how the chosen scale (core or discipline-specific) is to be interpreted within that discipline. This discipline-specific guidance should include:

a. Anchoring examples:

   i. Concrete examples illustrating how the terms on the chosen scale correlate to demonstrable, but not necessarily quantifiable, criteria. Those criteria might typically be based on the observations made and the expert's experience.

b. Descriptive assessments:

i. Where LRs cannot be calculated, guidance on how to use the chosen scale (or a modified, descriptive version) based on expert experience, with a clear articulation of the reasoning and limitations. The guidance set out in this document applies still in instances where a discipline specific scale is used.

Transparency and Limitations

4.11.7 Regardless of whether a numerical LR or a descriptive assessment is used, the inherent uncertainty and potential for variance of opinion should be acknowledged. Even in seemingly categorical opinions, the basis for the opinion and any potential limitations must be clearly articulated.

4.11.8 Striving for a combined approach, which includes both a core verbal scale with discipline-specific interpretation and a strong emphasis on the primacy of the LR, should go some way to balancing the need for consistency with the realities of diverse forensic disciplines. It also emphasises the critical role of expert judgement and transparent communication in ensuring that the evidence is accurately and effectively conveyed to the CJS. Ongoing training and collaboration with legal professionals and statisticians are essential to the successful implementation of this approach.

Higher level inferences – combining results [10]

4.11.9 In order to provide the most effective assistance with resolving the issues facing the decision-makers in the CJS, the expert may consider combining evidence from two or more different FSAs, or aggregating evidence through multiple observations or opinions at a given level. Combining evidence is not straight forward, and may not always be appropriate.

4.11.10 Issues for the expert to consider before combining results include:

a. Whether or not they may be overreaching and straying into the remit of the trier of fact.
b. whether the observations are independent of one another or not. In the absence of a suitable expert to assign a combined evidential strength,

an investigator or trier of fact may not be able to make this distinction. Wrongly considering the observations and evidential strength of each FSA as independent of each other, risks 'double-counting' and overstating the overall evidential value.

4.11.11 The principles of balance, logic, robustness and transparency apply equally to a combination or aggregation of evidential strengths as they do to the individual evaluations.

Combining from separate FSAs

4.11.12 An investigation may involve the carrying out of more than one FSA to address the same issue, resulting in separate opinions being expressed. In considering whether or not those opinions can be combined, the expert should take into account:

a. Whether the various FSAs are being used to address the same issue and same proposition pair. For example, glass, fibres, and footwear mark evidence all addressing the issue of whether a forced point of entry at a residence was made by the suspect.
b. Whether the expert has appropriate knowledge and competence to evaluate an evidential strength based on the combined findings of the various FSAs. This is normally restricted to situations where the expert has experience in evaluating each of the relevant FSAs separately.
c. Whether the combined findings from two FSAs allows a higher-level issue to be addressed, such as Activity level (as opposed to Source level if the findings for each FSA were assessed separately). For example a fingermark made in blood, or blood pattern analysis with DNA.
d. Where observations from the various FSAs contradict one another such that the overall evaluation may be less than, or negate the value of its strongest element, the expert should make this clear in their report.

Aggregating evidence within the same FSA.

4.11.13 The investigation of an incident may result in a series of (usually) source level opinions being arrived at by an expert repeatedly carrying out the same FSA to address a given issue. This might be undertaken when considering the progress of an individual through a scene at activity level, by repeatedly considering footwear marks at source level at different successive locations, or by considering the location of a mobile device over time through multiple cell site analyses.

4.11.14 In such instances, the expert may consider whether multiple source level opinions on a given issue may be aggregated.

4.11.15 The expert should consider whether or not an aggregation of those source level opinions would address the same issue as the individual source level opinions address, or inform a new pair of propositions at a higher (activity) level.

4.11.16 Any aggregation should take into account instances where the individual observations might contradict one another.

5. Modification

5.1.1 This is the first issue of this document under section 9 of the Forensic Science Regulator Act 2021.

5.1.2 The PDF is the primary version of this document.

5.1.3 The Regulator uses an identification system for all documents. In the normal sequence of documents this identifier is of the form 'FSR-###-####' where (a) (the first three '#') indicate letters to describe the type of document and (b) (the second four '#') indicates a numerical code to identify the document. For example, this document is FSR-GUI-0004, and the 'GUI' indicates that it is a guidance document. Combined with the issue number this ensures that each document is uniquely identified.

5.1.4 If it is necessary to publish a modified version of a document (for example, a version in a different language), then the modified version will have an

additional letter at the end of the unique identifier. The identifier thus becoming FSR - GUI - 0004a.

5.1.5 In the event of any discrepancy between the primary version and a modified version then the text of the primary version shall prevail.

6. Review

6.1.1 This document is subject to review by the Forensic Science Regulator.

6.1.2 The Forensic Science Regulator welcomes views on this guidance. Please send any comments to the address as set out at the following web page: www.gov.uk/government/organisations/forensic-science-regulator or send them to the following email address: FSREnquiries@forensicscienceregulator.gov.uk.

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8. Glossary

Categorical opinion	The opinion that, in the expert's judgement, one proposition or explanation is true and it would be impossible to obtain the observations if

	any of the alternative propositions / explanations considered were true.
Discipline	An FSA which covers more than one evidence type, (such as FSA – MTP 500 – Examination and analysis of particulate trace materials), or group of FSAs with related activities, such as footwear (FSA – MTP200, FSA – MTP201 and FSA – MTP202).
Evaluative interpretation	Interpretation guided by a set of relevant propositions and aimed at generating likelihood ratios.
Explanation	A statement or statements which seeks to account for findings.
Investigative interpretation	interpretation guided by observations made and aimed at generating explanations.
Knowledge base	A structured database of information and assigned probabilities, ordered according to casework conditions. The knowledge base is calibrated through regular review of its content through experimentation under controlled conditions.
Likelihood ratio (numerical)	A numerical value, based on structured data, that expresses the probability of making a set of observations given the

	truth of one or other of two mutually exclusive propositions.
Likelihood ratio (narrative)	A verbal expression, derived from the expert's experience, with or without limited data, of the expert's opinion of the probability of making a set of observations given the truth of one or other of two mutually exclusive propositions.
Observation	The result of analysis of items or of the scene.
Proposition	An account put forward by one side or the other, which the observations test. Propositions need to be mutually exclusive, ie if one is true, then the other cannot be. A proposition is a statement that is either true or false, the truth of which is uncertain.

9. Annex A

9.1 Where no line of defence is offered

The 'No comment' scenario

9.1.1 If there is a clearly defined proposition from the prosecution side, but no clearly defined proposition from the defence, or a 'no comment' response in interview, the expert should generally adopt, in lieu of the defendant, one or more alternative, 'proxy' propositions, which should be relevant to the facts in issue. This can be achieved where there is:

a. Sufficient case information to allow derivation of a suitable defence proposition; and
b. Sufficient background information to allow a reasonable assessment of the proxy alternative.

9.1.2 In this scenario, the propositions should be clearly stated in the report. It should be made clear that this is not an alternative provided by the suspect/defendant, but it has been derived in order to allow a preliminary evaluation of the findings based on the case information.

9.1.3 On the assumption of 'innocence', it seems a proxy alternative would be, generally, 'He did not do the activity'. Where an alternative proposition is a simple negation of the prosecution proposition, which may tend to maximise the value of the LR, this limitation should be stated clearly within the expert's report.

9.1.4 The expert should set out clearly what propositions have been addressed so that the defence, or the court, can determine if the report addresses issues of relevance to the case.

9.1.5 The expert's report should contain an explicit offer to revisit their preliminary evaluation based on a proxy defence proposition, in the event that an alternative proposition is provided by the defence.

9.1.6 Occasionally, where there is no other option, it may be reasonable for an investigative opinion to be described for a court. However, it is essential that the limitations of such an interpretation are made clear. While several possible explanations have been discussed, they cannot be used to provide probative evidence. Other explanations, which have not been considered, may also be possible. The fact that an explanation is possible says nothing about the probability of the findings given that scenario.

9.1.7 On occasion, it may be appropriate to decline to offer an opinion.

Reporting where only one proposition is available

Suggested wording for reports

9.1.8 The following list contains suggestions of how an expert might report in the situation where only one proposition is provided. The list is not exhaustive, and the suggestions are not intended to inhibit any individuality, or professional differences in writing style, but provide a thematic guide as to structure and intent:

a. These findings may be probable in a number of different scenarios. The prosecution proposition is that [proposition] but, at the time of writing, no alternative proposition has been put forward by the defence. It is feasible that the findings could also be more, less or equally probable if a proposition other than the prosecution's were true, but in the absence of any such proposition, it is not possible to evaluate the evidential strength of my findings.

b. The findings may be probable in a number of different scenarios. One such scenario is represented by the proposition put forward by the prosecution side, but the findings may also be more, less, or equally probable in the light of other propositions. In the absence of an alternative to the prosecution proposition, it is not possible for me to carry out a meaningful evaluation of the evidential value of my findings. Such an evaluation could be carried out if an alternative proposition were to be provided.

c. These findings may be probable given a number of different propositions including, but not limited to, the proposition put forward by the prosecution. To evaluate the findings or assess their significance it is necessary to consider an alternative/defence proposition which, at the time of writing, is not available given that [Suspect] has made no comment in response to the allegations against them. Should [Suspect] make a comment, or a defence statement be provided, it may be possible to evaluate the findings.

d. Without an alternative proposition [and information if relevant], it is not possible to make a balanced evaluation of the findings or assess any evidential strength.

e. These findings may be probable in various scenarios, including but not limited to [Activity level prosecution proposition]. To conduct a balanced evaluation of the significance of the findings it is necessary to also consider an alternative proposition representing the view of the Defence, which, at the time of writing, is not available given that [Suspect] has made no comment in response to the allegations against [them]. Should Defence provide an alternative proposition, it may be possible to determine the significance of these findings.

Suggested phrases/terminology to avoid

9.1.9 Similarly to above, phrases which might be considered misleading, along with reasons for why they may be considered so, are given in table 2. Again the list is not intended to be exhaustive, but the examples provide a thematic guide as to what should be avoided and why:

Phrase to avoid	Reason to avoid
This is what I would/might/may expect if the prosecution proposition were true.	this is unbalanced, offering no alternative and prejudicing the reader.
This is within my range of expectations	without defining the range of expectations this has no significance as it may be that an alternative proposition could also be within that same range.
The findings are consistent / commensurate / in keeping with	The findings may be consistent with a range of propositions, including the alternative.
The findings suggest/indicate….	Has some value in investigative mode, or as an intermediate step in evaluation when drawing inferences from the findings. The phrase should be avoided in “no comment” situations and when considering the outputs of tests.
The findings provide support for …	It is not appropriate to suggest any level of support for a proposition if only one proposition is available. To retain balance, support should only be expressed in terms of one proposition over another.
Should (Suspect) provide any statement or version of events, or should any	It is misleading to offer to re-evaluate findings, when they were not evaluated in the first place as it

additional information come to light, then I will re-evaluate my findings in light of that.	infers that consideration of only one proposition is an evaluation.

Table 2: Phrases to avoid when reporting in the circumstance of a ‘no comment’ interview

10. Annex B:

10.1 Conclusions for LRs determined with limited data

10.1.1 Because of the potential for lay jurors and other court participants to equate a numerical value with a level of precision that the expert has not intended, conclusions based on LRs determined by a combination of expert judgement and some limited but structured data set(s) should be presented at an order of magnitude level, alongside a verbal expression, in a way that enables the court to see where on a scale the conclusion in the particular case lies.

There is always a danger that words are not understood in the manner they were intended. It is therefore important to give as much context as possible with the conclusion, including by presenting the full scale and the placing of the conclusion within that scale. A verbal scale that may be used is given below.

LR Order of Magnitude	Verbal Scale
c. 1 - 3	In my opinion the observations are no more probable if [proposition A] rather than [proposition B] were true. Therefore, the observations do not assist in addressing which of the two propositions is true.
c. 3 - 10	In my opinion the observations are slightly more probable if [proposition A] rather than [proposition B] were true.
c. 10 – 100 (tens)	In my opinion the observations are more probable if [proposition A] rather than [proposition B] were true.

c. 100 – 1000 (hundreds)	In my opinion the observations are much more probable if [proposition A] rather than [proposition B] were true.
c. 1000 – 10,000 (thousands)	In my opinion the observations are very much more probable if [proposition A] rather than [proposition B] were true.

Notes:

a. This scale reflects, and builds on, earlier published work from the Regulator [2]. It diverges from the terminology used in BS EN ISO 21043-4:2015 [11].
b. Where the LR is close to one of the boundaries, e.g. around 2 – 4 or around 900 – 1100, the expert will need to use their judgement in assigning a verbal conclusion.
c. It seems unlikely that, in the absence of a relevant, high quality data set, a LR of >1000 would be obtained for a single observation.
d. Multiple observations in combination, such as the sole pattern, size, and wear represented in a footwear mark may give rise to higher LR values, as, for instance, may multiple fingerprint features.
e. It is, however, also likely that in some instances, a combination of features would give rise to LRs in the order of 1000 or less.

10.2 Conclusions where no data are available

10.2.1 Where no structured data are available, the expert may evaluate the probability of the observations under each proposition based on their experience. (See also 4.6.29)

10.2.2 The verbal scale in section 10.1.1 should be used to express the expert's conclusion. The expert shall be explicit that their conclusion is based solely on experience and as such is likely to differ from that of other experts. Where

the expert's knowledge has not been meaningfully calibrated, this limitation shall also be explicit in the report.

10.2.3 The selection of a term on the verbal scale can not be used to imply a likelihood ratio. (See also 4.11.5)

10.2.4 The full verbal description scale used and the expert's recollected experience of the occurrence of the observations under each proposition shall be provided in the report for reference.

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