Quality Standards for Forensic Genetics: Current and Future Challenges

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ESRC Seminar

Durham 16 March 2016

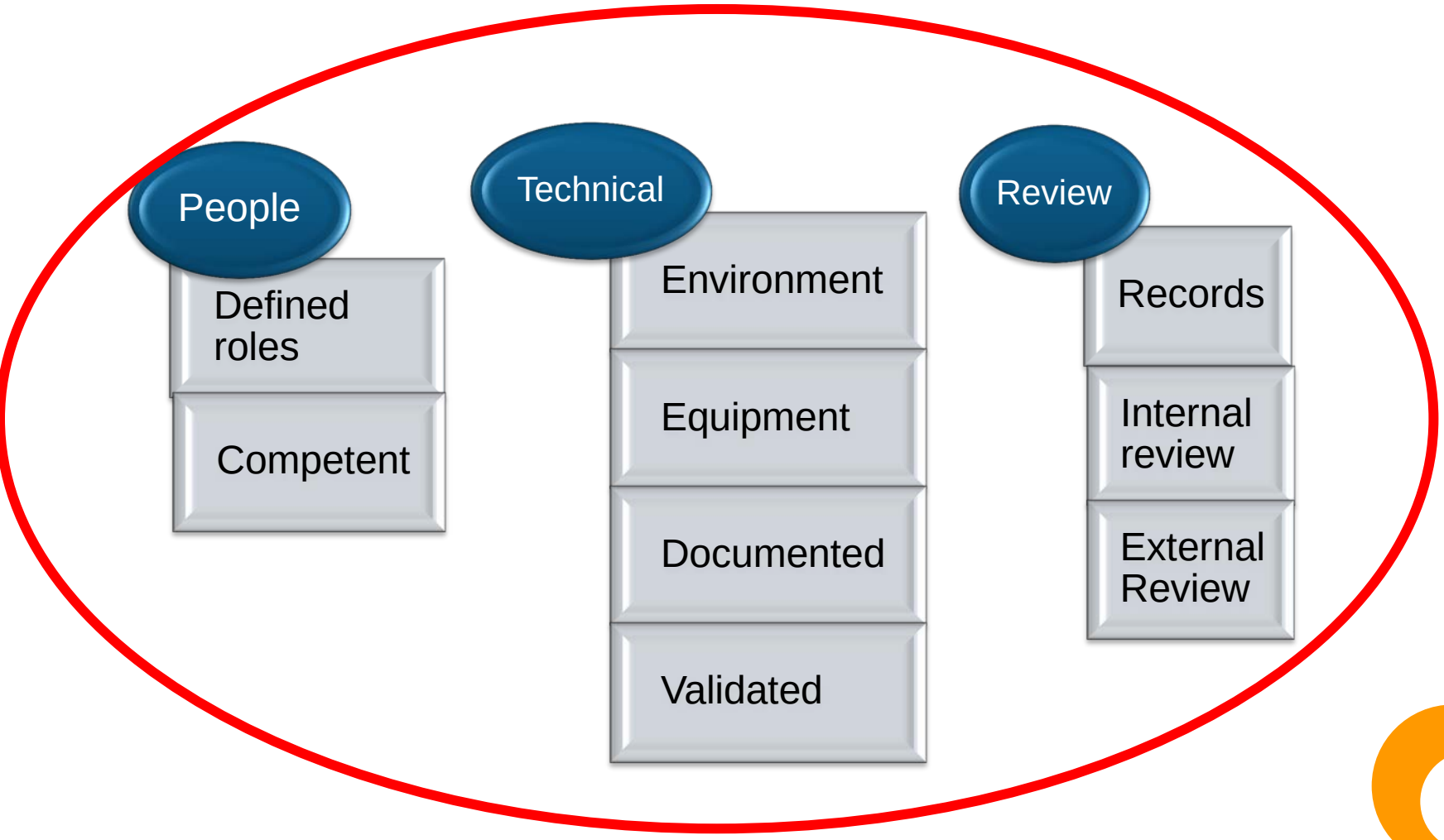
Forensic Science Regulator

Overseeing Quality

Outline

- Fundamental quality requirements
- Current challenges
  - Examples: Contamination and mixtures
- Future challenges
  - An example: sequencing approaches

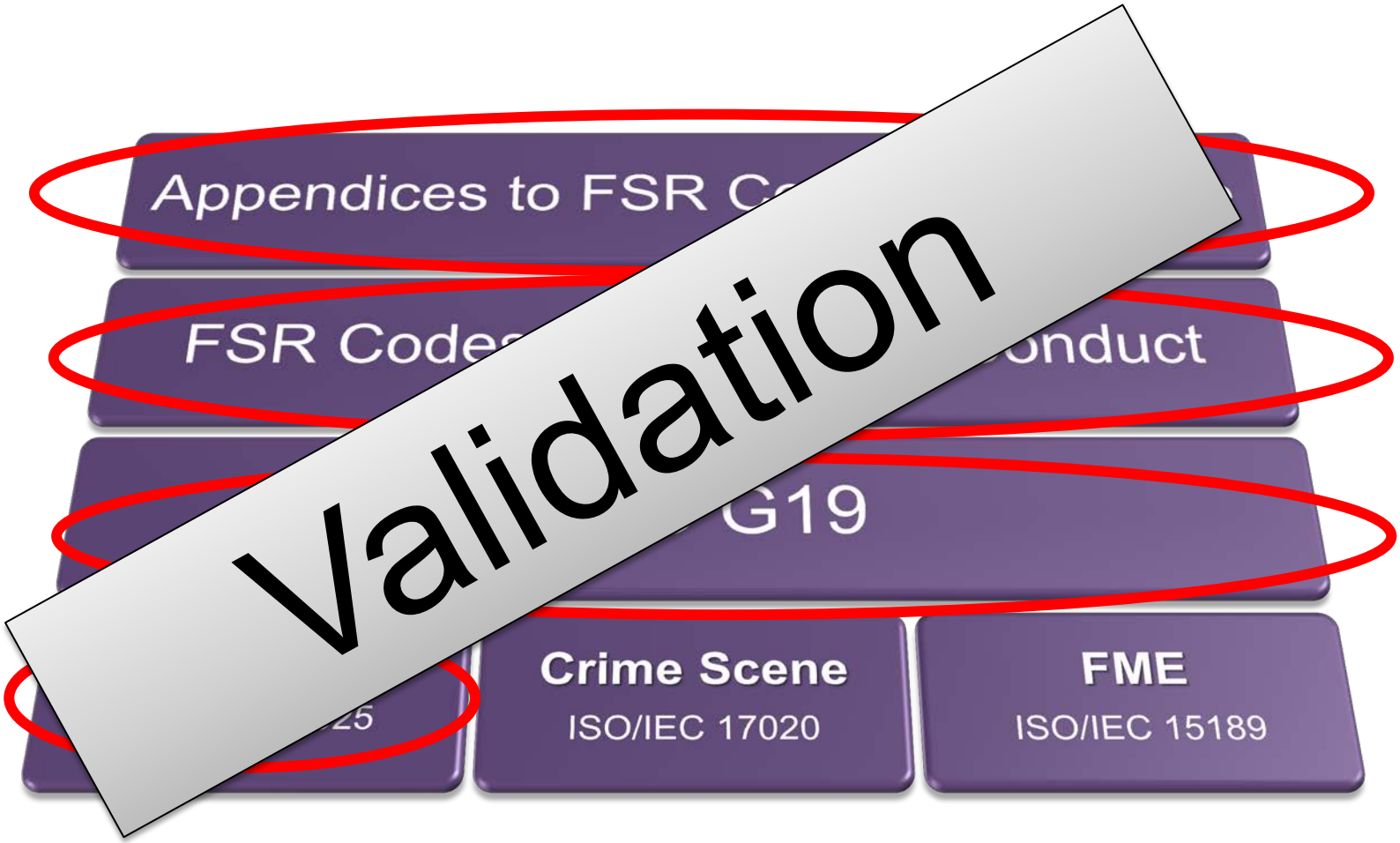
Fundamental quality requirements



Learning & Improvement

Roles and Competence

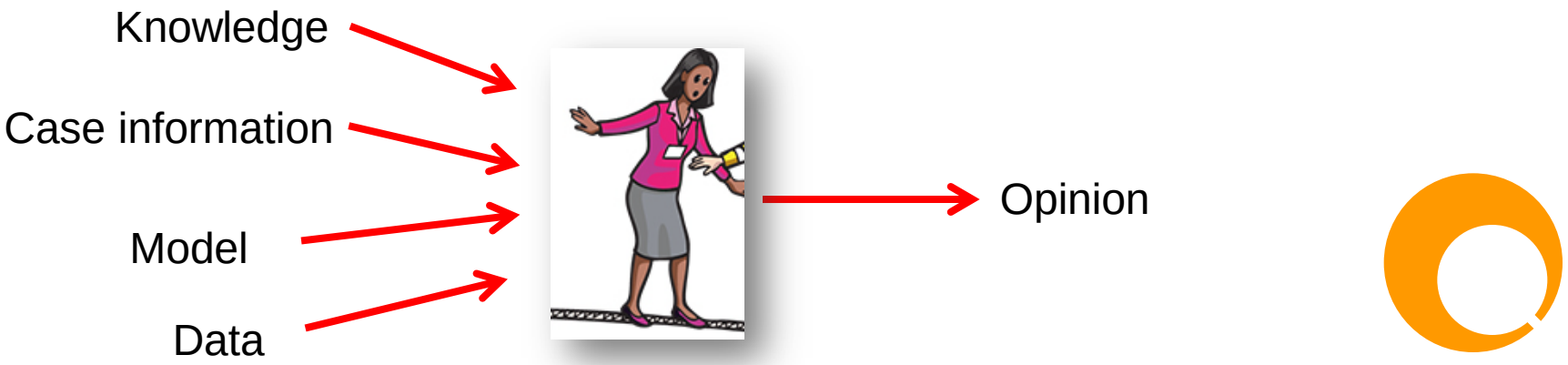
The UK Quality Framework



Validation

Analytical method ☑ but also...

Interpretation methodology and knowledge base

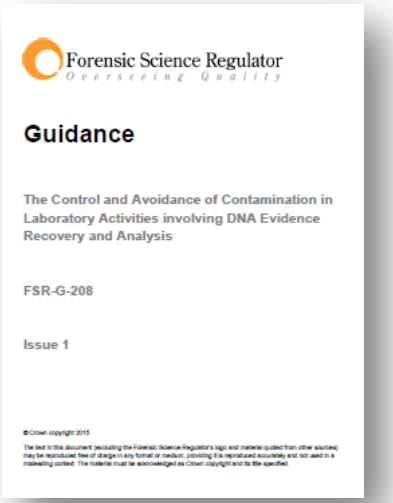


Quality needs collaboration

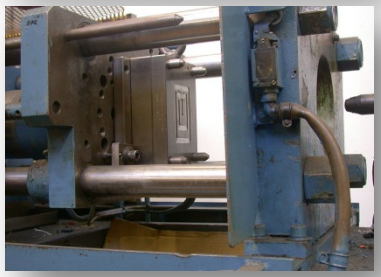
CPS

Current Challenges (1)

Standards

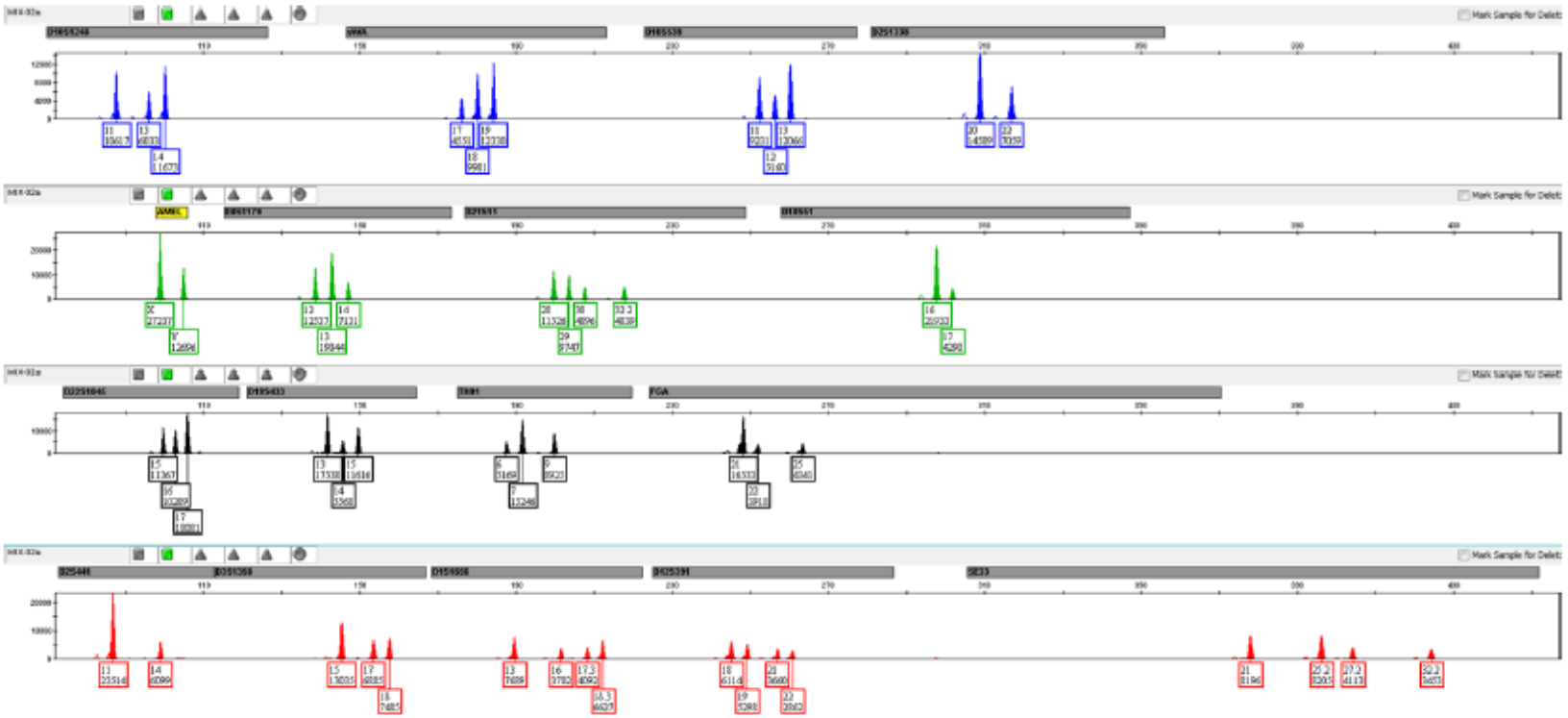


Anti-contamination measures



Elimination Databases

Current Challenges (2)



Mixtures

New DNA Mixtures Guidance (1)

Interpretation

- Structure and interpretation sections
- Specification of propositions
- Agreed nomenclature
- Checks
- Acceptable boundaries of interpretation
- Use and limitations of a qualitative opinion

DNA SG to consider draft in May 2016

New DNA Mixtures Guidance (2)

Software

- Principles and minimum requirements for interpretation model
- Performance parameters to demonstrate appropriateness of model
- Validation standards to demonstrate outputs from software are as expected, given the model.
- The routine quality checks and data input considerations, including minimum standards for a profile to be considered suitable for interpretation.

Future Challenges: sequencing approaches

Inaccuracy: raw sequence, bioinformatics-induced, S:N

Complexity of process

Wide variation in methodology

I've got deeper coverage than you...

Implementation issues: nomenclature, raw data retention, searching, engagement with Judiciary...

Reporting clarity

Interpretation challenges

So let's assume that ...

All the technical issues have been dealt with

The analytical systems are validated according to the requirements of ISO 17025, ILAC G19 and the Codes

Nomenclature has been agreed

We are left with the big questions:

How will the evidential strength of a “match” be evaluated?

What do the results tell us in the context of a particular case?

Evaluation of Evidential Strength

$$LR = \frac{\Pr(E \mid H_p, I)}{\Pr(E \mid H_d, I)}$$

Pr(*That particular combination of bands* $|H_p, I$)

Pr(*That particular combination of bands* $|H_d, I$)

Models for probabilistic evaluation of stutter, Hb, degradation etc
Frequency of occurrence

Evaluation of Evidential Strength

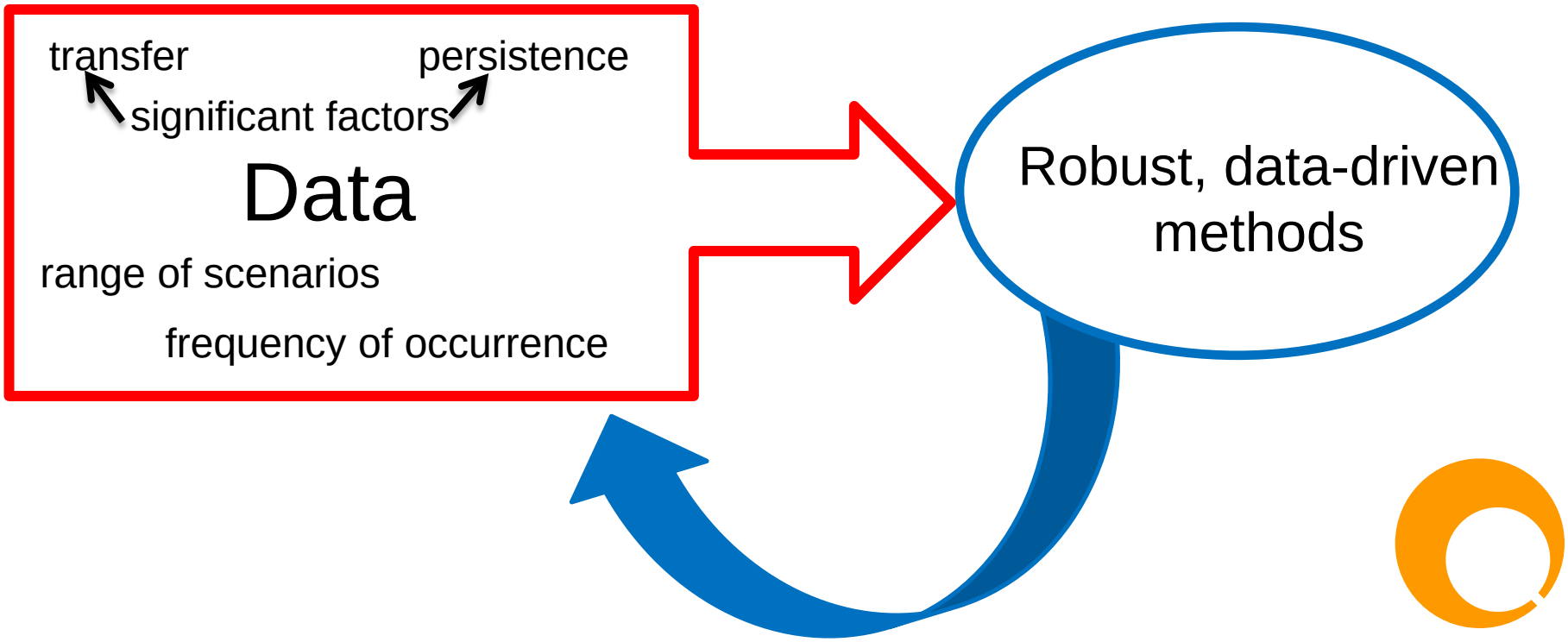
$$LR = \frac{\Pr(E \mid H_p, I)}{\Pr(E \mid H_d, I)}$$

$$\frac{\Pr(\textit{That "sequence"} \mid H_p, I)}{\Pr(\textit{That "sequence"} \mid H_d, I)}$$

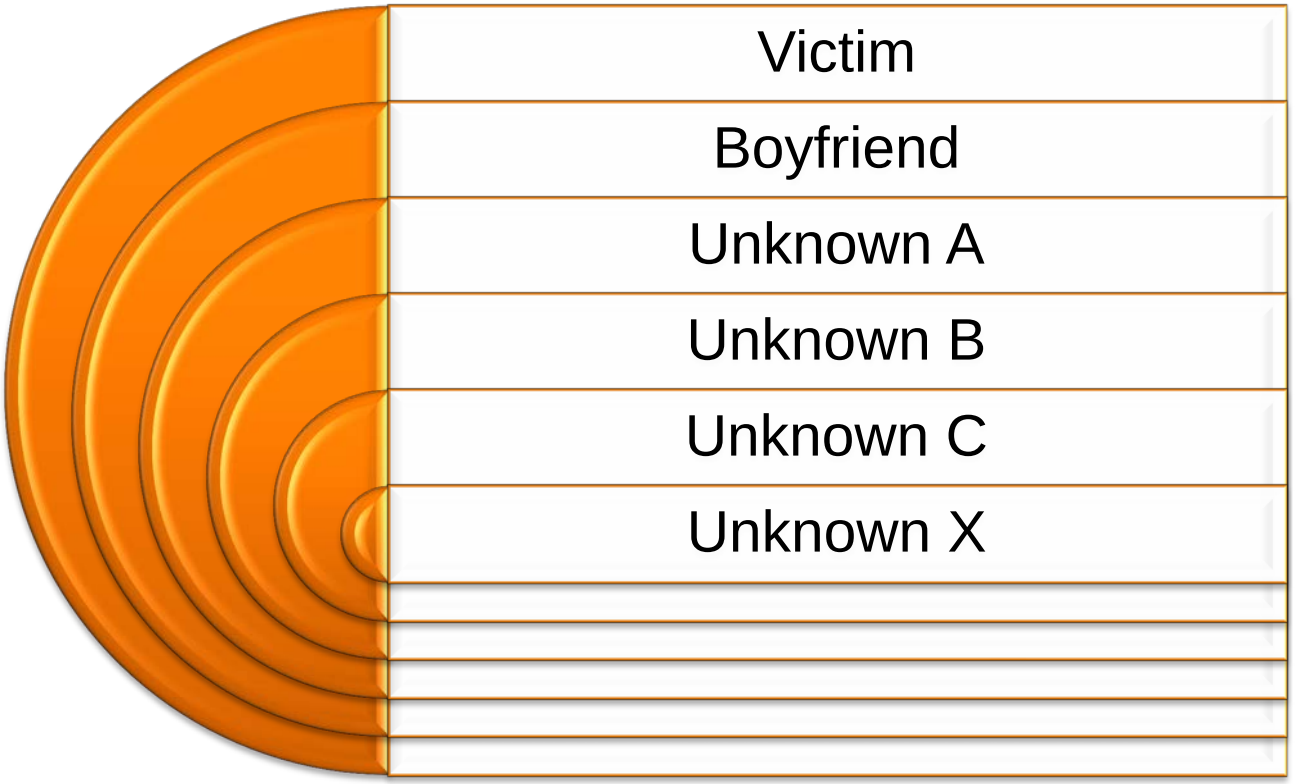
coverage depth, signal:noise, accuracy etc.
Frequency of occurrence

Contextual Interpretation

We are good at “who?” but not always “how?”



~~My analysis shows the presence of a low level of DNA that is consistent with Mr X being a contributor to the DNA sample~~

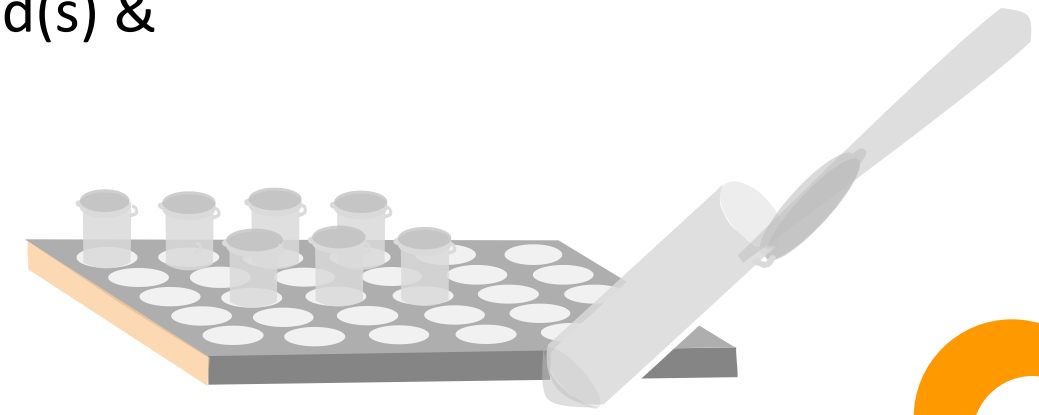


Structured Studies

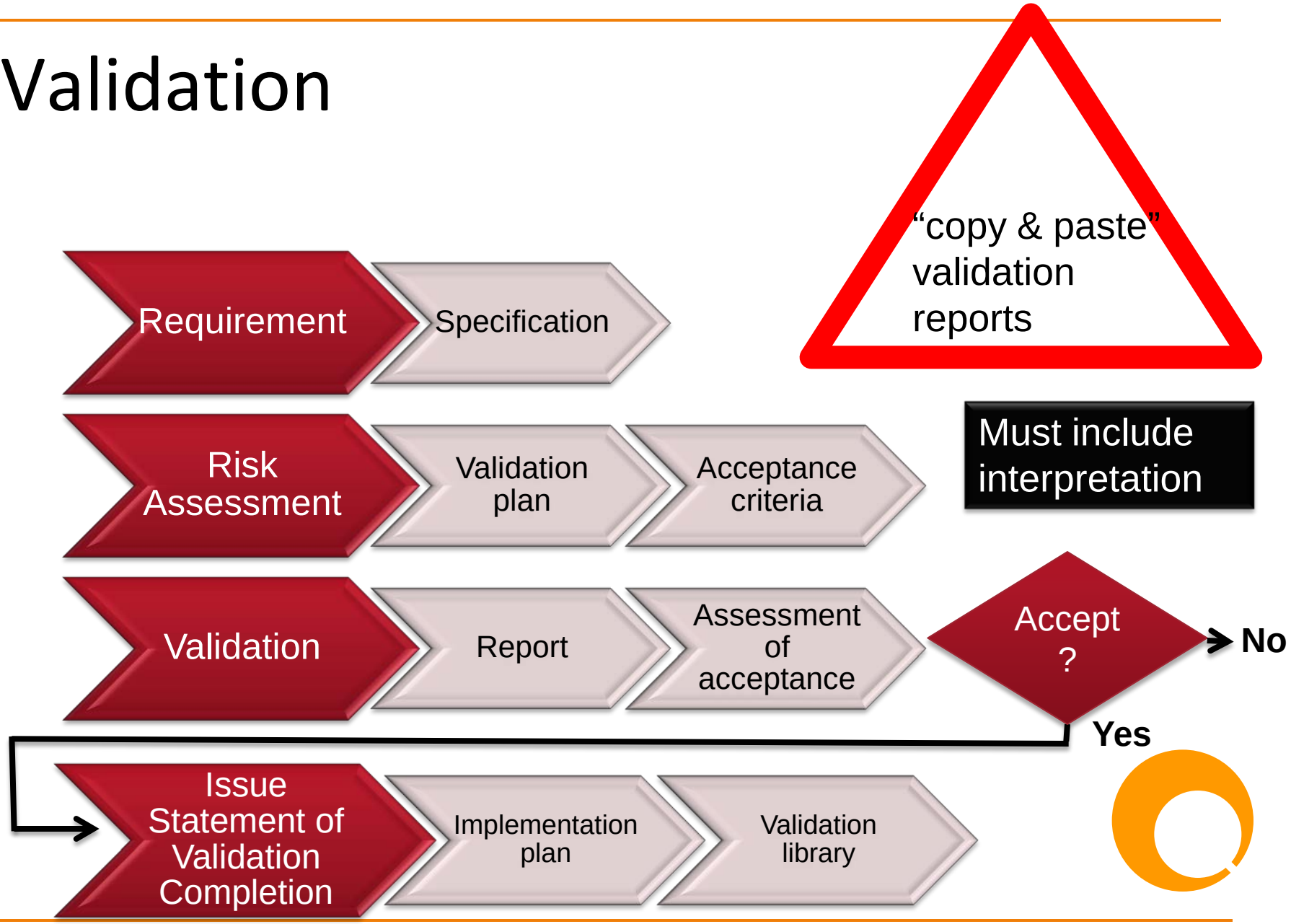
- Transfer: 1º, 2º, 3º
- Persistence
  - What are the significant factors that affect Transfer and persistence?
- TSI studies
  - Guidance for FMEs
  - Interpretation

Structured Studies

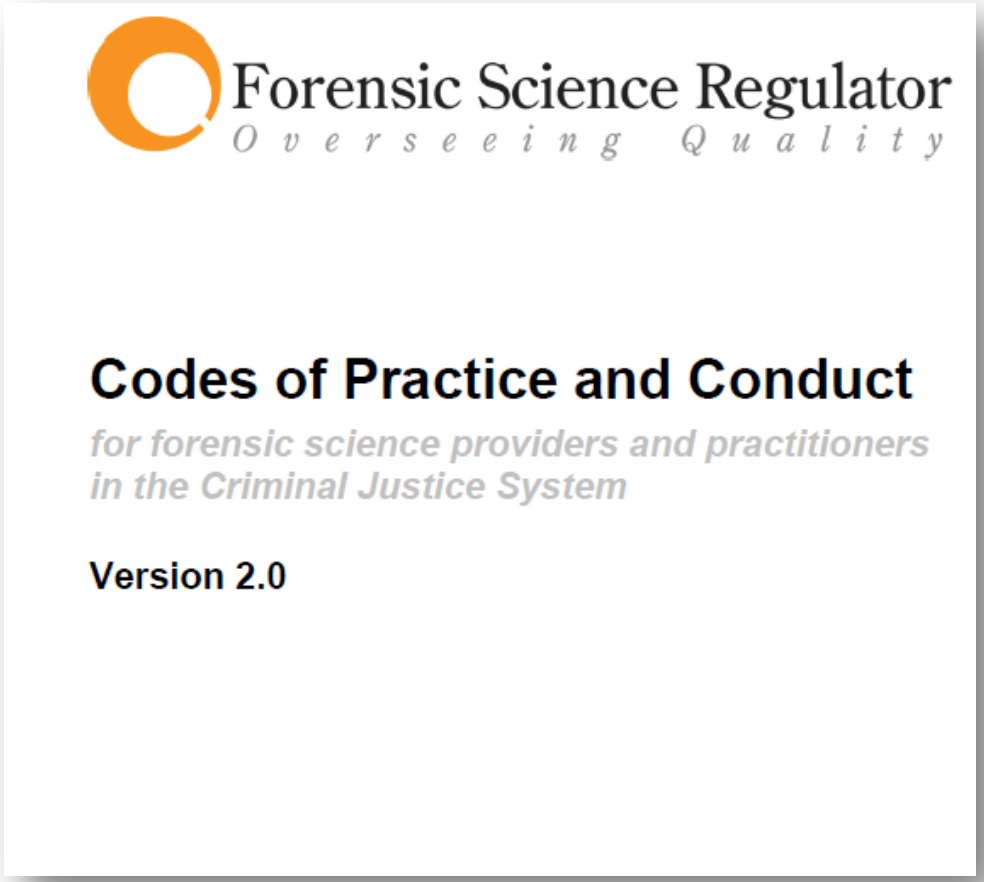
- Mixtures
  - N = 2 ➔ N = ?
  - Degradation of one or more components
  - Impact of body fluid(s) & other substrates
  - Limits



Validation


"copy & paste" validation reports
Requirement
Specification
Risk Assessment
Validation plan
Acceptance criteria
Must include interpretation
Validation
Report
Assessment of acceptance
Accept ?
No
Yes
Issue Statement of Validation Completion
Implementation plan
Validation library

Guidance



Evaluative Interpretation Standard in preparation

Standards of Admissibility

Criminal Practice Directions 2015

Part 19 – admissibility

- Extent & quality of data
- Validity of methods
- Safety of inference
- Uncertainty, accuracy, reliability
- Peer review
- Expert's field of expertise
- Completeness of information
- Following established practice

Reporting Clarity

Agreed terminology

“Primer” before implementation

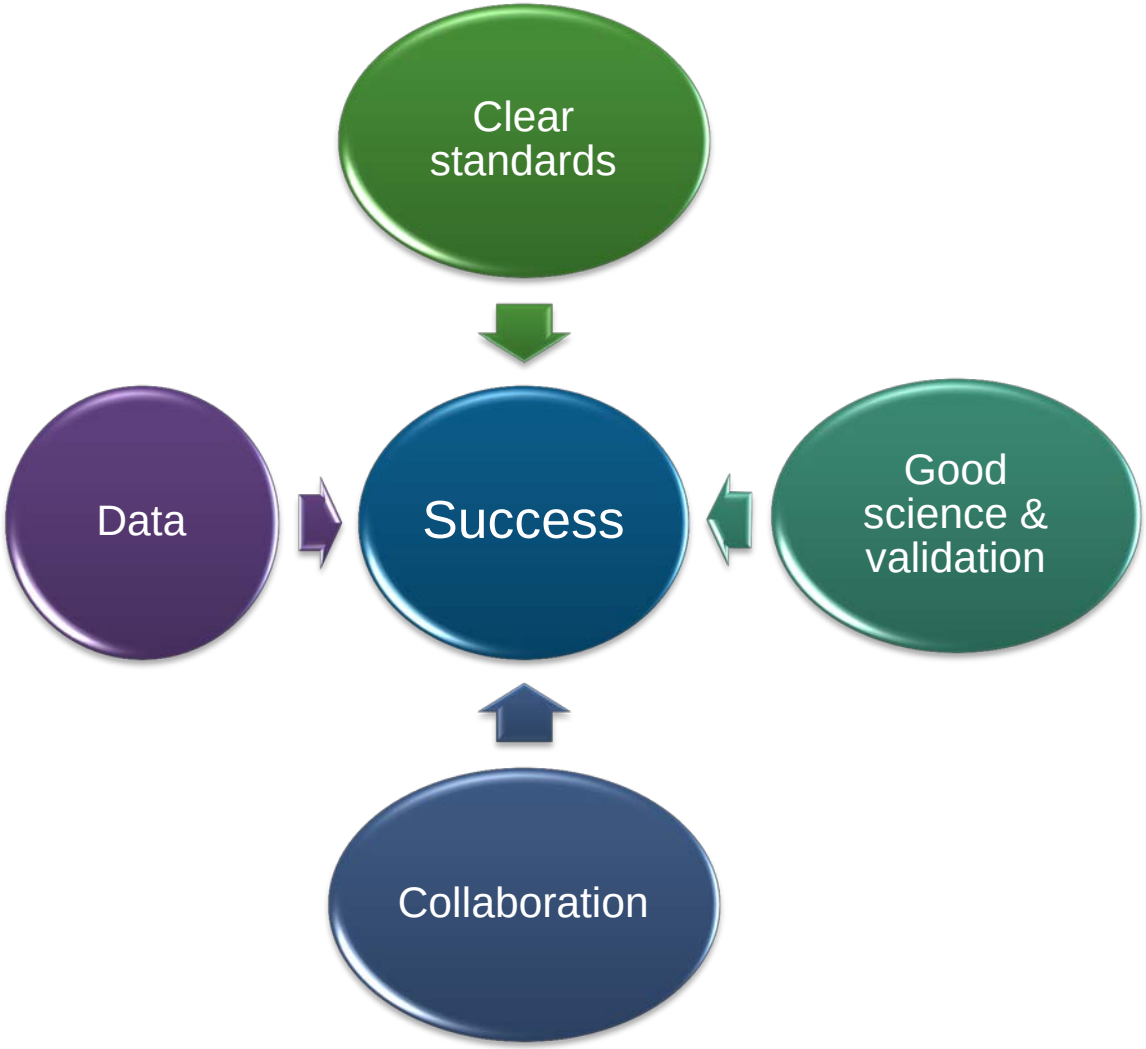
Interpretation standard

Avoiding drift from source to activity

Narrowing down issues ahead of trial: case management

So can it be done?

Of course!



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