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Model forensic science

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This article provides an explanation of the duties and responsibilities owed by forensic practitioners (and other expert witnesses) when preparing for and presenting evidence in criminal proceedings. It is written in the shadow of reports by the National Academy of Sciences (US), the National Institute of Standards and Technology (US), the Scottish Fingerprint Inquiry and a recent publication entitled 'How to cross-examine forensic scientists: A guide for Lawyers'. The article examines potential responses to questions focused on the need for scientific research, validation, uncertainties, limitations and error, contextual bias and the way expert opinions are expressed in reports and oral testimony. Responses and the discussion is developed around thematics such as *disclosure, transparency, epistemic modesty* and *impartiality* derived from modern admissibility and procedure rules, codes of conduct, ethical and professional responsibilities and employment contracts. The article explains why forensic practitioners must respond to the rules and expectations of adversarial legal institutions. Simultaneously, in line with accusatorial principles, it suggests that forensic practitioners employed by the state ought to conduct themselves as *model forensic scientists*.

Keywords: expert; evidence; report; validation; disclosure; impartial; ethics; duties; professionalism

1. Introduction

The article 'How to cross-examine forensic scientists: a guide for lawyers' (hereafter 'HTCE') generated interest among forensic practitioners in Australia and beyond[1].

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†This essay was discussed at the annual meeting of the Evidence Based Forensics Initiative (EBFI) and an earlier version was presented as a workshop to the forensic scientists and managers of Victoria Police.

HTCE had several motivations, but the authors' primary aim was to place the legal reception of forensic science and medicine evidence on a firmer epistemological foundation[2]. That is, to improve legal analysis by directing the attention of lawyers and judges toward the most important dimensions of this evidence – e.g. validation, reliability, uncertainty, error rates, proficiency, and other human factors – and away from the kinds of considerations which often overshadow (or replace) them in routine legal proceedings[3]. The shift in focus – towards *demonstrable expertise in the specific domain*[4] – is intended to encourage a move from proceedings dominated by battles around the credibility of individual witnesses to a more consistent engagement with the 'specialised knowledge' that ought to underpin opinion evidence proffered by forensic practitioners[5]. This article, like HTCE, represents an attempt to intervene in a wider conversation around forensic science evidence[6].

While HTCE may appear provocative, it is intended to encourage lawyers to consider asking questions aimed at obtaining insight into the value of forensic science evidence through the facts, research and procedures supporting it. This approach is legally orthodox in the sense that it promotes the use of cross-examination to test the value of contested opinion evidence during the trial[7]. By extension, HTCE is also concerned with the presentation and comprehension of forensic science and medicine evidence in pre-trial processes – e.g. on the voir dire and in charge and plea negotiations[8]. Simultaneously, HTCE relies on mainstream scientific methods and norms, and so is directly relevant to forensic practitioners operating, or purporting to operate, within robust scientific frameworks. The questions posed are not merely susceptible to answer but generally should be answered with positive evidence – derived through scientific research. Forensic practitioners (and others allowed to express *expert* opinions in criminal proceedings) should provide information about the value of procedures, the foundations of claimed expertise and provide the means to rationally assess their opinions[9].

This essay is a follow-up to the cross-examination article. It is written as an explanatory resource for forensic practitioners confronted with the kinds of questions and issues originally posed in HTCE[10]. In this essay we aim to enhance forensic practitioners' understanding of legal, professional and institutional expectations in order to provide strategies that might help forensic scientists to respond to issues raised in HTCE and help lawyers, judges and jurors to improve decision-making around expert opinion evidence.

2. Disclosure, transparency, epistemic modesty and impartiality

The simplest advice we can offer to forensic practitioners is to use mainstream scientific methods and norms[11]. This is likely to: facilitate compliance with the formal requirements imposed by courts (e.g. admissibility standards and practice directions) and professional codes; improve performance; reduce mistakes and misrepresentations; and insulate practitioners and their institutions from criticism and external interference. One way to conceptualise the required (re-)orientation is through the rubric *disclosure, transparency, epistemic modesty* and *impartiality*. This orientation should inform the practice of forensic science and its institutional culture[12].

Transparency and *impartiality* should be central components of forensic science practice. They are embodied in professional codes as well as the rules that govern litigation and its preparation – see Sections 3.2 and 3.3. In ways that capture known capabilities and evidentiary limitations, forensic practitioners should disclose more information to prosecutors (and defence lawyers and judges) in their reports (and

testimony). Reports and testimony should be transparent. They should enable others, both the technically proficient and the technically challenged, to review and understand how the evidence was collected, processed and analysed, how particular conclusions were reached, and provide insight into uncertainties and limitations with these processes and conclusions[13].

At a minimum, reports should address the jurisdictional admissibility requirements, practice directions and professional codes of conduct. Forensic practitioners should make their routine practices, procedures, standards, and research fully available to the defence. When the state relies on forensic science or medicine to prove guilt, there are few situations where this information may be legitimately withheld from those being prosecuted[14]. Further, forensic reports should not omit or elide limitations, uncertainties and controversies[15] [Goudge Report]. It is the disclosure of these kinds of information that enables the court to determine admissibility and the tribunal of fact to evaluate the probative value of forensic science evidence and the impartiality (and credibility) of the practitioner[16]. Failure to provide this information makes it difficult, and in many cases impossible, to ascertain whether there is expertise and how probative opinions actually are[17]. Institutions responsible for producing forensic science and medicine evidence should standardise reporting practices, decide how to incorporate information about standards and protocols, validation studies, error rates, proficiency, and so forth, in the reports they generate.

In addition to enhanced disclosure and transparency, the opinions of forensic practitioners should be epistemologically modest. Practitioners should avoid 'being too proud or confident about abilities'[18]. Epistemic modesty is inconsistent with hubris, ignorance and arrogance. Practitioners should avoid over-claiming and exaggerating performance, by acting in ways that are consistent with demonstrated ability. Opinions should be grounded in what is known about the capabilities and limits of procedures and the proficiency of individuals[19]. Where there is limited knowledge, practitioners should concede uncertainties and limitations, and the strength of conclusions should be moderated accordingly. Opinions should be steeped in 'knowledge' rather than speculation, assumptions, subjective beliefs, traditions and past practices[20]. This means that: procedures should be formally tested and practitioners appropriately trained; reporting practices should accurately reflect the level of practitioner competence and the capabilities of procedures; and practitioners should be conversant with scientific research relevant to performance and the expression of results. In the absence of scientific research, there will normally be a widespread need for caution – a need to moderate confidence and the strength of opinion.

There is, as the National Academy of Sciences (NAS) recognised in *Strengthening the Forensic Sciences in the United States: A Path Forward* (2009), a need for greater 'epistemological humility' among forensic practitioners[21]. Research on the performance of latent fingerprint examiners affords a useful example. Recent validation studies confirm that fingerprint examiners possess genuine expertise[22]. These examiners possess pronounced abilities relative to laypersons in discriminating between fingerprints from the same people and those from different people, even under time-constrained and difficult conditions[23]. However, studies also reveal that highly trained and experienced fingerprint examiners occasionally make errors[24], disagree about the sufficiency of the information and number of features in the fingerprints when making decisions[25] and in some, perhaps atypical, contexts interpretation appears susceptible to contextual bias[26]. Research also questions widely held beliefs about the correlation between ability and experience as a latent fingerprint examiner[27]. These studies, in conjunction with

philosophical and empirical objections to the logic underpinning the identification paradigm[28] would seem to require fingerprint examiners to: provide more information about their practices; identify limitations and the risk of error in their reports and testimony; and modify the meaning they attribute to 'a match' – see Section 4.2[29].

Epistemologically-warranted opinions are required to facilitate the administration of justice through rational decision-making[30]. Such opinions improve charge and plea negotiation, admissibility decisions and (presumably) verdicts. They serve to prevent unnecessary exclusion of evidence and the misattribution of weight. Epistemic modesty is consistent with legal rules and professional obligations. As we shall see, forensic practitioners swear an oath (or make an affirmation) to tell the 'whole truth', have obligations to serve the court, and according to procedural rules should refer to 'specialised knowledge' and disclose limitations and controversies in reports and testimony.

Disclosure, transparency and epistemic modesty are all consistent with the expectation that forensic practitioners will act impartially. The goal of the forensic scientist is not to win the case, or to assist the prosecution, or to thwart the defence, although that is how it may often feel to those in the 'trenches' of investigations and prosecutions. Forensic practitioners should not 'be enticed into a search for evidence to bolster the suspicions of an investigator', nor 'join in the celebrations of a conviction'[31]. In criminal proceedings, the role of the forensic practitioner is to assist the court to administer justice through the provision of impartial expert opinion and explanation[32]. This requires the provision of independent opinions derived using reliable procedures, which are susceptible to being understood and evaluated by the decision-maker – see Sections 3.2 and 3.3[33].

This article aims to encourage forensic practitioners and those managing them to think more about independence and impartiality, to disclose more, to be more transparent about their practices and reporting, and to make sure that opinions are expressed with appropriate qualifications[34]. Together, disclosure, transparency, epistemic modesty and impartiality embody good faith means of fulfilling the important social responsibilities invested in the state's forensic practitioners[35].

3. Admissibility standards, procedural rules and the professional responsibilities of expert witnesses and prosecutors

In this section we review a range of admissibility standards, procedural rules and formal responsibilities, directing attention to validity and reliability, independence and partisanship, error rates, limitations, controversies, uncertainties and so forth. Our goal is to direct attention to issues that will assist with the evaluation of forensic science evidence. Simultaneously, we aim to discourage speculative attacks on the credibility of forensic practitioners.

3.1. Admissibility standards

Several common law jurisdictions boast an explicit 'reliability' standard (e.g. US Federal Courts and many US state courts) or, like Canada, require lawyers to direct their attention to the reliability of expert opinion evidence[36]. In 2011 the Law Commission of England and Wales recommended a new admissibility rule requiring trial judges to consider whether forensic science evidence is 'sufficiently reliable' for criminal proceedings. The Commission's recommendation (and draft bill) was not adopted by the British government, although in its wake judges have taken it upon themselves to

import the need for reliability into English procedural rules[37]. A recent review of criminal justice reiterated the importance of reliable forensic science evidence in English courts[38].

The need to attend to reliability (really validity and reliability) has expanded and become widely accepted in common law jurisdictions, particularly Anglo-American practice[39]. While it has not led to the exclusion of much forensic science and medicine evidence, it has encouraged lawyers and judges to be more attentive to validity and reliability issues. Even jurisdictions that are yet to impose a formal reliability standard (such as Australia, New Zealand and some US states) have not been entirely inattentive to issues of validity and reliability[40].

In Australia, the admissibility of expert opinion evidence is regulated by uniform evidence legislation (the 'UEL' operates in NSW, Victoria, Tasmania, the Australian Capital Territory, the Northern Territory and the Federal Court of Australia) or common law (in South Australia, Western Australia and Queensland)[41]. The admissibility of opinion evidence is dependent upon the party proffering the evidence – usually the prosecutor in criminal proceedings – satisfying an exception to the exclusionary approach to opinion evidence[42]. In most Australian jurisdictions the primary exception for expert opinion states:

> 79 Exception: opinions based on specialised knowledge
>
> (1) If a person has specialised knowledge based on the person's training, study or experience, the opinion rule does not apply to evidence of an opinion of that person that is wholly or substantially based on that knowledge[43].

Australian courts have explained that s 79(1) has two basic requirements: '[t]he first is that the witness who gives the evidence "has specialised knowledge based on the person's training, study or experience"; the second is that the opinion expressed in evidence by the witness "is wholly or substantially based on that knowledge"'[44]. This approach requires forensic practitioners to present the opinion in a form that enables these questions to be answered and, in particular, requires the identification of relevant knowledge[45].

Australian courts have resisted the temptation to specify formal admissibility criteria – such as those advanced by the US Supreme Court in *Daubert v Merrell Dow Pharmaceuticals, Inc*[46]. Although, in its most recent decision on s 79(1) of the UEL, the High Court of Australia focused attention on the meaning of 'specialised knowledge'. In *Honeysett v The Queen*, a decision considering the admissibility of an anatomist's opinion about similarities between the body shape of the accused and a person of interest covered from head to toe captured by CCTV cameras during a robbery, the High Court concluded that the opinion evidence had been wrongly admitted[47]. In a narrow decision, avoiding the need to determine whether lawyers and judges should attend to validity and reliability, the Court accepted that while the specific witness possessed specialised anatomical knowledge (and some photographic experience), he was not an expert in image interpretation and comparison and so could not proffer an opinion relevant to identity[48].

Without submissions on the policy implications the High Court was reluctant to read reliability into s 79(1). The Court in *Honeysett* did, however, direct attention to the 'specialised knowledge' on which admissible opinions should be based[49]. In so doing the Court produced its most detailed exegesis on the phrase.

> 'Specialised knowledge' is to be distinguished from matters of 'common knowledge'. Specialised knowledge is knowledge which is outside that of persons who have not by

> training, study or experience acquired an understanding of the subject matter. … [T]he person's training, study or experience must result in the acquisition of *knowledge*. The *Macquarie Dictionary* defines 'knowledge' as 'acquaintance with *facts, truths, or principles*, as from study or in investigation' [emphasis added] and it is in this sense that it is used in s 79(1). The concept is captured in Blackmun J's formulation in *Daubert*: 'the word "knowledge" connotes more than subjective belief or unsupported speculation. … [It] applies to any body of known facts or to any body of ideas inferred from such facts or accepted as truths on good grounds'[50].

In UEL jurisdictions (and perhaps more broadly), those who are presented as, or claim to be, experts must have knowledge and abilities beyond the 'common knowledge' of ordinary persons. Moreover, their opinions must be more than 'subjective belief' and 'unsupported speculation'[51]. Mere training, study or experience, and even legal and investigative traditions, cannot sustain the admission of opinions under this interpretation of the Uniform Evidence Law. For, to be admissible, any opinion must be based on 'knowledge' not just a practitioner's 'training, study or experience'. Moreover, those proffering scientific and technical evidence should be conversant with relevant 'specialised knowledge' and the formal 'study or … investigation' underpinning it[52].

While the High Court is yet to consider whether s 79(1) embodies a reliability threshold, other courts have begun to insist on validity and reliability[53]. Recently, the Victorian Court of Appeal introduced a reliability standard for forensic science evidence when asked to balance the probative value of the evidence against the danger of unfair prejudice to the accused. When evaluating the probative value of forensic science evidence under UEL s 137, trial judges in Victoria are now expected to consider 'reliability' at that (later) stage[54]. In imposing the first substantial reliability test in Australia, the Court in *Tuite v The Queen* explained:

> The obvious risk in a criminal trial when expert evidence is led from a forensic scientist is that a jury will give the evidence more weight than it deserves. To prevent unfair prejudice of that kind, it is essential that the reliability of expert evidence be established to the court's satisfaction (under s 137) before it is led. We have concluded that the touchstone of reliability for this purpose is proof of appropriate validation, both of the underlying science (where necessary) and of the particular methodology being employed[55].

This approach requires the trial judge to attend to reliability and validity. In Victoria, at least, s 137 requires the trial judge to exclude forensic science evidence where the probative value is outweighed by the danger of unfair prejudice[56]. Where the probative value is uncertain there will normally be a real risk of misunderstanding, over-valuation or mis-use that, in most cases, can only be averted through the insights provided through validation. Cross-examination and judicial warnings – however skilled or careful – do not necessarily overcome the failure to validate and the risk that the tribunal of fact may mis-use forensic science evidence of unknown probative value[57].

A final, though fundamental, issue for admissibility reinforces recent Victorian interest in validity and reliability. Several Australian courts have emphasised the need to place the tribunal of fact (or decision-maker) in a position where they are capable of rationally evaluating the opinion evidence[58]. While the tribunal of fact ought to consider forensic science evidence in the context of the overall case, for each piece of evidence they should be placed in a position to make a credible assessment of its probative value[59]. This idea, captured (or endorsed) in several Anglo-Australian decisions, was clearly expressed in the influential Scottish case *Davie v The Magistrates of Edinburgh*[60].

> [It is a fundamental duty of the expert witness] to furnish the judge or jury with the necessary scientific criteria for testing the accuracy of their conclusions, so as to enable the

> judge or jury to form their own independent judgment by the application of these criteria to the facts proved in evidence. … [T]he bare ipse dixit of a scientist, however eminent, upon the issue in controversy, will normally carry little weight, for it cannot be tested by cross-examination nor independently appraised ...[61]

In *General Electric Co. v. Joiner*, the US Supreme Court similarly questioned the admissibility of 'opinion evidence that is connected to existing data only by the *ipse dixit* of the expert'[62].

As these extracts make clear, courts should not be confronted with bare assertions. Judges and jurors should not be expected to speculate about validity and reliability or distil probative value from the subjective beliefs of practitioners based on impressions of the apparent value of experience and independence, or their demeanour, confidence and resilience during cross-examination[63]. Rather, there should be information supporting reliability and facilitating evaluation.

3.2. Legal practice directions

The increased legal interest in reliability and enhanced disclosure in expert reports and oral testimony is not limited to admissibility requirements. A useful example of changing legal expectations can be found in a practice direction recently issued by the Supreme and County Courts of Victoria[64].

> **Practice Note: Expert Evidence in Criminal Trials**
>
> **Purpose**
>
> To enhance the quality and reliability of expert evidence relied on by the prosecution and the accused in criminal trials.
>
> …
>
> **Expert's duty to the Court**
>
> **2.1** An expert has an overriding duty to assist the Court impartially, by giving objective, unbiased opinion on matters within the expert's specialised knowledge.
>
> **2.2** This duty overrides any obligation to the commissioning party or to the person by whom the expert is paid.
>
> …
>
> **Content of all expert reports**
>
> **4.1** All expert reports to which this Practice Note applies … shall state the opinion or opinions of the expert and shall state, specify or provide –
>
> …
>
> (c) whether and to what extent the opinion(s) in the report are based on the expert's specialised knowledge, and the training, study experience on which that specialised knowledge is based;
> (d) the material, observed facts, reported facts, assumed facts and other assumptions on which each opinion expressed in the report is based …
> (f) (if applicable) that a particular question, issue or matter falls outside the expert's specialised knowledge;
> (g) any examinations, tests or other investigations on which the expert has relied, identifying the responsible laboratory by which, and the relevant accreditation standard under which, the examination, test or other investigation was performed; …

(i) any qualification of an opinion expressed in the report, without which the report would or might be incomplete or misleading;
(j) any limitation or uncertainty affecting the reliability of
  (i) the methods or techniques used; or
  (ii) the data relied on,
    to arrive at the opinion(s) in the report; and
(k) any limitation or uncertainty affecting the reliability of the opinion(s) in the report as a result of –
  (i) insufficient research; or
  (ii) insufficient data.

4.2 Where an expert is aware of any significant and recognised disagreement or controversy within the relevant field of specialised knowledge, which is directly relevant to the expert's ability, technique or opinion, the expert must disclose the existence of that disagreement or controversy[65].

These new procedural rules assist the court to identify relevant 'specialised knowledge' (see Practice Direction: 2.1, 4.1(c) and (f), above) and determine whether an opinion is based upon it, as required by the admissibility test in UEL s 79 (or the need to consider probative value in s 137 following *Tuite*). They require forensic practitioners to proactively disclose assumptions and underlying facts, limitations with their methods or underlying research, uncertainties in their conclusions, controversy in the domain, along with their qualifications and experience. Forensic practitioners have the responsibility to make sure that their testimony embodies what is 'known' and what can be legitimately claimed and to make that clear. Experts should not omit information or provide partial evidence on the basis that any elisions or limitations will be identified and corrected through the course of adversarial proceedings.

While the terminology in practice directions tends to be legal rather than scientific, much of the information that is required to be disclosed under existing rules is consistent with the kinds of issues that HTCE suggested might be profitably explored.

3.3. The professional responsibilities of expert witnesses

3.3.1. Professional codes

The obligations of expert witnesses find even stronger expression in professional codes, especially the need for impartiality in the production and provision of evidence. From a range of reasonably generic professional codes we have selected the Code of Professional Practice for Members of the Australian and New Zealand Forensic Science Society (ANZFSS) as an example – extracts are reproduced in Appendix 1. Its preamble affirms the need for 'forensic practitioners' to 'utilise knowledge and experience … without discrimination or prejudice, treating all with respect, honesty, equality and integrity'[66]. Members must 'act truthfully and objectively, and not knowingly provide misleading information, statements, reports, opinions or evidence, nor knowingly misrepresent a situation'. Of special interest, practitioners must:

- conduct and document all examinations and analyses using established protocols and fit-for-purpose or validated methods
- render opinions having a basis that is demonstratively valid
- not withhold any findings, where inculpatory or exculpatory, that would cause the facts of a case to be misrepresented or distorted, and,
- disclose or make available test methods if requested.

The Code also requires that forensic practitioners 'must, both orally and in writing, express opinions, make statements, or give evidence with fairness, honesty, and only on the basis of adequate knowledge'[67].

The Code raises disclosure in the context of conflicts of interest. Obligations include:

- fully informing the client as to any limitations or legitimate concerns that a forensic practitioner might have with regard to their competence relevant to the client's specific instructions, and/or,
- if competence is not fully established, organising for a person competent in the area to provide supervision of or advice to the forensic practitioner in relation to the task[68].

The Code also raises the issue of limitations, although primarily in the area of competence. Nevertheless, the general thrust of this Code is consistent with the issues raised in HTCE as well as the legal rules and practice directions discussed above. Indeed, the Code raises the need for 'demonstrably valid' methods. Again we see that it is imperative for forensic practitioners to act with impartiality and integrity. For the reasons we have explained, which are consistent with the terms and thrust of the Code, this requires more disclosure, greater transparency about what is done 'backstage', and clear articulation of the basis and limitations, including whether abilities (and current expressions) are supported through independent validation and rigorous proficiency testing.

Consideration of the Code confirms that the themes developed in HTCE are orthodox. It also confirms that current practices in some forensic science disciplines are not fully compliant with formal legal rules and professional duties. There is an onus on forensic practitioners to comply with the obligations owed to the criminal justice system, the community, employers and the profession[69].

3.3.2. Employment contracts and obligations to employers

Many forensic science and policing organisations have their own professional standards or codes of conduct (supplementing the other codes), which espouse integrity, impartiality and transparency. These policies require forensic practitioners (whether police or civilians) to conduct themselves in ways that promote institutional values and uphold the law. Employers and employment contracts insist that employees act with honesty and integrity, maintain impartiality and professionalism, and take personal responsibility for their performance, actions and decisions. Employees are publicly accountable for their behaviour, performance and work products. Many employment contracts require forensic practitioners to engage in professional development and to actively develop their knowledge and skills.

Breaches of legal rules and directions or professional codes may vitiate employment contracts. They may expose employees to disciplinary processes and, in some cases, dismissal. Breaches may also expose individual forensic scientists to civil suits (e.g. for negligence or vindictive prosecution) and in extreme cases criminal prosecution for criminal negligence or malfeasance in public office[70]. Of significance, in assessing performance when things go wrong, the conduct of forensic practitioners will be assessed against legal rules, practice directions, professional codes, and contractual obligations rather than local traditions and personal beliefs[71].

3.3.3. *'Independent' consultants*

Forensic practitioners who act in the capacity of consultants may not be (as) constrained by formal obligations to employers[72]. They nevertheless owe substantial obligations to courts and relevant professions (e.g. medicine). They must comply with formal legal rules – such as practice directions – as well as applicable professional codes. To the extent that the evidence of consultants is based on new or emerging procedures and claimed capabilities they are also obliged to disclose information and to make their practices and reasoning transparent. In general, they should avoid trying to conceal capabilities (and limitations) in commercial-in-confidence or intellectual property claims[73]. They should also study their analytical methods, offer evidence to confirm the possession of relevant expertise, and be careful about undertaking case-based inquiries to confirm the suspicions of investigators. In particular, and this may be a real challenge for 'independent' consultants, they must endeavour to avoid the influence of suggestion and other contextual biases.

Ironically, isolated consultants are potentially the least independent (i.e. institutionally insulated) of the many different types of expert witness in criminal proceedings. Consultants engaged by the state may be particularly vulnerable to a range of biases in their largely unregulated exposure to information about the case and the suspect(s)[74]. There may, in addition, be a perceived need to meet the expectations of those engaging them (in relation to particular results or the potential for future work)[75]. Those contemplating forensic science and medicine work beyond the state's institutions should explain how these and other risks are avoided or managed. Police and prosecutors should have strategies in place to manage risks when they instruct forensic consultants engaged in sole or small practices.

3.4. *The professional responsibilities of prosecutors: it's not all about winning*

Forensic practitioners may enhance their understanding of the duties they owe by comparing some of the professional responsibilities of prosecutors[76]. Prosecutors owe a range of obligations, starting well before the trial, to the courts, the legal profession and the community. Decisions to prosecute (including the particular charges to lay, whether there should be joint trials, what to disclose, and what evidence to adduce – e.g. tendency evidence where there are heightened admissibility standards and notice provisions) are just a few of the many issues they must navigate.

Some of the formal legal norms supposedly guiding prosecutions may be lost in the adversarialism to which forensic practitioners are exposed through their socialisation, interactions with police and prosecutors, and experiences in court[77]. Nevertheless, in relation to prosecutors, two issues are fundamental: (1) obtaining a conviction is not the prosecutor's primary purpose; and, (2) the prosecutor has an obligation to act in a way that is fair to the accused (while representing the interests of the state and the community)[78]. These sentiments are embodied in a series of important judgments by the highest courts in the common law world. Half a century ago, in one of the most famous and widely reproduced statements on the topic, the Supreme Court of Canada wrote:

> It cannot be over-emphasised that the purpose of a criminal prosecution is not to obtain a conviction, it is to lay before a jury what the Crown considers to be credible evidence relevant to what is alleged to be a crime. Counsel have a duty to see that all available legal proof of the facts is presented: it should be done firmly and pressed to its legitimate

> strength but it must also be done fairly. The role of prosecutor excludes any notion of winning or losing …[79]

Similar sentiments form part of the Office of the Director of Public Prosecutions (NSW) guidelines for prosecutors.

> A prosecutor is a 'minister of justice'. The prosecutor's principal role is to assist the court to arrive at the truth and to do justice between the community and the accused according to law and the dictates of fairness[80].

These commitments are also embodied in a range of more detailed professional and institutional rules such as criminal procedure and bar rules. The New South Wales (NSW) Barristers' Rules, for example, state:

> Rule 83. A prosecutor must fairly assist the court to arrive at the truth, must seek impartially to have the whole of the relevant evidence placed intelligibly before the court, and must seek to assist the court with adequate submissions of law to enable the law properly to be applied to the facts.
>
> Rule 84. A prosecutor must not press the prosecution's case for a conviction beyond a full and firm presentation of that case.
>
> Rule 85. A prosecutor must not, by language or other conduct, seek to inflame or bias the court against the accused.
>
> Rule 86. A prosecutor must not argue any proposition of fact or law which the prosecutor does not believe on reasonable grounds to be capable of contributing to a finding of guilt and also to carry weight.
>
> Rule 87. A prosecutor must disclose to the opponent as soon as practicable all material (including the names of and means of finding prospective witnesses in connection with such material) available to the prosecutor or of which the prosecutor becomes aware which could constitute evidence relevant to the guilt or innocence of the accused other than material subject to statutory immunity, unless the prosecutor believes on reasonable grounds that such disclosure, or full disclosure, would seriously threaten the integrity of the administration of justice in those proceedings or the safety of any person[81].

It is clear that, acting as a 'minister of justice', the prosecutor is obliged to seek truth fairly by prosecuting only as vigorously as the evidence *and* the system allow. The prosecutor cannot ignore the frailties of the evidence, the actual constraints and limitations of the system and personnel, or the circumstances attending the individual trial (or appeal). Forensic practitioners, as objective independent witnesses, self-evidently have an obligation to be more impartial than prosecutors, who have the burden of advancing the case against the accused. Forensic practitioners should not consider prosecutors (or police, or victims or complainants) as their clients, and should not aim to secure guilty verdicts. Instead their roles and responsibilities are better understood as serving the courts and justice through the impartial provision of reliable evidence, regardless of where it leads.

Conventionally, prosecutors have exhibited a tendency to adduce forensic science and medicine evidence and leave the defence – through cross-examination and, perhaps, rebuttal evidence and requests for directions and warnings – to identify and explain weaknesses and limitations. Directly or indirectly (e.g. through suggestion and a failure to disabuse), prosecutors may encourage forensic practitioners to assist in this endeavour through imagined alignment and support for non-disclosure, non-transparency, and even a degree of partisan obtuseness. In relation to forensic science and

medicine evidence, legal rules and professional obligations are inconsistent with this kind of approach. Prosecutors should obtain information about limitations and oversights with expert opinion evidence, insist that expert reports are compliant with jurisdictions rules (e.g. practice directions and codes of conduct) and disclose these compliant reports to other parties[82]. Prosecutors should not omit non-trivial limitations or leave them to the defence to tease out and explain during the course of adversarial proceedings[83].

Forensic practitioners must assist prosecutors to fulfil these important responsibilities. Prosecutors and forensic practitioners have shared obligations to provide more comprehensive accounts of the evidence in reports and, where appropriate, in oral testimony. The fact that prosecutors (and solicitors and others advising police) may not require forensic practitioners to comply with the terms of practice directions and codes is not a credible excuse for non-compliance. Forensic practitioners should comply with formal rules regardless of prosecutorial suggestion or importunity[84].

If prosecutors and forensic practitioners do not clearly refer to validation studies, limitations, error rates and controversies, then the defence, judges and the tribunal of fact will probably not find out about them[85]. In many cases, defence lawyers are not adequately resourced, and perhaps not sufficiently technically literate to recognise, let alone convey, significant frailties with forensic science and medicine evidence. Even where defence lawyers are sensitised to methodological limitations, current rules make clear that it is not their responsibility to raise them unilaterally[86].

Prosecutors are conventionally understood as *model* litigants. As a representative of the state and the community, there are special (i.e. high) expectations regarding their conduct[87]. It is not conventionally stated but there must be analogous expectations on forensic practitioners working for (or consulted by) the state. Forensic practitioners working for the state should be *model expert witnesses*. They must comply with practice directions and professional codes and maintain the highest professional standards.

4. The practical implications of disclosure, transparency, epistemic modesty and impartiality

In order to provide satisfactory answers to many of the questions posed in HTCE, in most instances what is required is simply research or additional research. The possibilities for research are endless, so it is imperative to undertake or identify research that addresses fundamental issues – such as whether or how well a procedure works, and how much better forensic practitioners perform at specific tasks relative to ordinary persons. This is the kind of information that ought to provide grounds for determining whether opinions are based on 'specialised knowledge' and whether they can actually assist the tribunal of fact. Beyond admissibility, this information provides the judge and jury with a means of assessing the probative value (i.e. weight) of the evidence. The jury are unable to do much with *ipse dixit* – regardless of the practitioner's confidence, experience or historical legal practice.

In the following sub-sections, in the shadow of the need for greater disclosure, transparency, epistemic modesty and impartiality, and underpinned by legal rules and professional obligations, we endeavour to consider responses to the kinds of questions raised in HTCE. We consider responses ranging from circumstances where validation studies have been undertaken, and some kind of indicative error rate can be generated, to conditions where knowledge is quite limited and forensic practitioners are not con-

versant or confident with scientific research methods that would enable them to evaluate their procedures and conclusions.

4.1. Validation studies, proficiency tests and error

When responding to questions about validation (or performance) studies, answers will be dependent on the domain and the procedure. In line with professional responsibilities to be conversant with contemporary research and developments, forensic practitioners should adapt practices and reporting to make them consistent with relevant studies. Some areas of forensic science and some procedures are well-supported scientifically (e.g. DNA profiling and drug analysis), others less so (e.g. bite mark comparison and forensic gait analysis). Over time, most areas of forensic science and medicine should undergo evaluation, standardisation, and reform. The upshot is that forensic practitioners need to be conversant with and, where appropriate, respond to, the scientific literature relevant to their procedures, practices and abilities. Research and its implications, positive or negative, should be taken seriously and referenced in reports and testimony. Practices, analyses and conclusions, along with the form of expression, should be guided by scientific studies. The absence of appropriate research should manifest in formal disclosure, genuine epistemic modesty and occasionally by vacating the 'field'.

4.1.1. No studies available

Validation (and performance) studies provide the appropriate framework to assess abilities and levels of performance – i.e. generate relevant 'knowledge' about procedures and performances[88]. Where there are no independent studies supporting the validity and reliability of a procedure, this should be disclosed in clear terms in reports and made conspicuous in oral testimony. It must be appreciated that bare disclosure – that a procedure has not been evaluated – does not provide the means of assessing the procedure or the performance of a practitioner. That is, the opinion is effectively subjective (i.e. speculative) and the information required to make sense of it is not available[89].

In the absence of validation, 'expert' reports should explain what was done in a transparent manner. Forensic practitioners should be slow to suggest that validation studies are unnecessary or impossible, or that the lack of validation studies can be overcome through a practitioner's experience or training. This is not to suggest that untested forensic practitioners are without abilities, but rather that in the absence of testing, we do not know how well forensic practitioners perform. It may be that, like latent fingerprint examiners comparing prints, practitioners generally perform very well. In the absence of testing, however, it is antithetical to the state's burden of proof in criminal proceedings to assume that they do. Unacknowledged uncertainty is likely to lead to over-valuation of opinion evidence, thereby compromising the fairness of proceedings and threatening the burden and standard of proof.

Finally, it should be recognised that for some practices (and expressions) it is unlikely that supportive research will ever be forthcoming. No scientific studies will, for example, provide support for the ability to identify a person or object to the exclusion of all others[90]. This means that some forensic practitioners are not reporting opinions in ways that reflect actual (i.e. known) abilities or are operating in ways that are inconsistent with the methods available to (and recommended by) mainstream scientists – notably, statisticians, engineers, psychologists and biomedical researchers[91]. Such

practices should be rectified and, in the interim, discordance with authoritative recommendations should be acknowledged.

4.1.2. *Where studies exist*

Some areas of forensic science can respond positively to the kinds of questions posed in HTCE. Many areas of analytical chemistry, biology (particularly around DNA profiling) and some aspects of latent fingerprint comparison, for example, have a substantial research base or studies that enable quite positive, even detailed, responses to many of the questions posed in HTCE[92]. Other procedures and practices, however, have not been subjected to formal evaluation. Moreover, many so-called 'studies' are not actually the kinds of experimental evaluation associated with validation. In some disciplines, there has been a reliance on laboratory-based proficiency tests and case-based simulations as proxies for validation studies. Despite the name, commercial proficiency tests are not necessarily genuine tests of proficiency. Many 'proficiency tests' (e.g. those offered by Collaborative Testing Services, Inc.) do not assess the validity and reliability of procedures or the proficiency of the practitioners who use them[93]. Moreover, they provide little insight into whether forensic practitioners exhibit superior performance to laypersons (i.e. possess more than 'common knowledge') and whether their opinions are based on 'specialised knowledge' related to 'training, study or experience'[94]. Without independent proof that the procedure can be applied consistently and reliably across cases and practitioners, along with insight into the impact of specific variables on the potential for error, it is difficult to use proficiency tests and case-based reconstructions as validation.

Obviously, it is not possible to test every scenario that might be encountered in casework or to accurately anticipate analytical requirements in the future. Nevertheless, testing underlying principles and specific procedures on materials that are representative of those encountered in routine casework is fundamental to attempts to understand the value of procedures and derivative opinions. Empirical assessment of practitioners' abilities to identify features and characteristics within 'traces', to determine similarity or dissimilarity, and to make an assessment of the support provided to competing propositions, provide means of approaching the assessment of the probative value of opinions.

Given that cases will continually generate new permutations and possibilities not anticipated or studied, full validation of all procedures and processes is not a viable goal. What does this mean for practitioners' obligations? In terms consistent with the goals of transparency, disclosure, epistemic modesty and impartiality, forensic practitioners should make clear the kinds of studies that have been undertaken, their applicability and limitations. They should disclose when appropriate studies have not been performed. There are some areas where studies are unlikely, and there is little hope, certainly in the short to medium term, of conducting studies that are case specific. Conversely, some areas will be sufficiently significant or destabilising to warrant immediate attention. A conspicuous example is research into the transfer (i.e. secondary, tertiary and so on) of DNA[95]. Until such supplementary studies are undertaken, when asked about specific scenarios where the research is incomplete or ambiguous, forensic practitioners should indicate that they are speculating (even if on apparently reasonable grounds) and that their opinion and its strength should – consistent with the need for transparency, epistemic modesty and impartiality – embody uncertainties that are both known and unknown.

4.1.3. Small numbers of studies and weak studies

As forensic scientists and scientists begin to increase the volume of validation research, there will be a need for forensic practitioners, lawyers and courts (and jurors) to make sense of the emerging results. Many forensic sciences, particularly the comparison (and pattern recognition) disciplines, have procedures composed of many discrete steps; often embedded in larger processes. Consequently, any study will be limited in its scope and generalisability, especially where an assumption is made regarding the larger process. No single study will validate the entirety of a discipline's claims and, given the large number of variables typically associated with a forensic procedure, the external validity of any study may be open to legitimate dispute[96].

Several recent and small-scale studies, relating to image comparison (so-called facial mapping and forensic gait comparison), concluded that because practitioners (i.e. anatomists, physical anthropologists and podiatrists) performed above chance or better than the general public, on that basis their opinions ought to be received in criminal proceedings[97]. This, however, does not necessarily follow. Some of these studies were weak, featuring fewer than a dozen subjects (and not always compared with the performance of laypersons). Others, relied on distinctive features for the purpose of the test. Courts will be required to make policy decisions about the levels of accuracy, error and risk they are willing to tolerate, given the various personnel, costs and dangers associated with admitting the opinions of those legally recognised as experts[98]. Courts should be careful to avoid relying too heavily on weak, poorly designed and one-off (or case) studies, particularly if the forensic practitioner proffering the opinion will be presented as experienced or authoritative.

For any single published study, the non-trivial question is whether it is adequate in terms of design, control, fidelity, quality, analysis, size, and so forth. When it comes to some of the first generation of studies, that test general capabilities – i.e. expertise in a particular domain – the basic ability of practitioners should be assessed and compared to novices before investigating narrower questions. It is essential that practitioners be aware of the potential for error, and avoid the temptation to 'borrow' validity from research where procedures were applied in different conditions. As practitioners move from their area of demonstrated ability – based on formal evaluation of the procedure and proficiency testing – they should be fully transparent and circumspect.

In general, when assessing the value of the contribution made by any study, the fundamental issue of experimental power should be at the forefront. The explanatory 'power' of an experiment is derived from both the number of participants in the experiment, and the number of decisions those participants are asked to make (i.e. the number of trials). Where large numbers of participants can be recruited, relatively small numbers of trials are required from each participant to obtain a robust estimate of 'true' performance. However, where small numbers of participants are available, as in many areas of forensic science, many trials are required. Studies with only 10 or 20 participants completing only a handful of trials will shed limited light on the ability being assessed and need to be treated with particular caution.

The need for caution is accentuated if experiments are poorly designed, where, for example, valid alternative explanations are not ruled out, experimental procedures do not preserve the independence of respondents, or issues relating to human agency in experimental trials are not carefully managed. To some extent, these problems can be avoided through collaboration. Studies conducted by multidisciplinary groups, published in peer reviewed journals (particularly in mainstream science journals), and suc-

cessfully presented at national and international conferences, will typically be relatively robust. Public institutions involved in the production of forensic science and medicine evidence should 'publish' their validation studies following independent peer review[99]. Such studies will tend to be more resilient than studies designed and conducted by isolated groups; groups with vested interests in outcomes of a particular kind (rather than knowledge in general); groups with limited expertise in conducting human research; and, groups who do not disseminate their research among broader scholarly communities[100].

Norms and professional obligations require scientists to engage with pre-existing research and to characterise it accurately. Similarly, forensic practitioners have legal and professional obligations to reference relevant scientific literatures and to describe them in a balanced manner. Practitioners should not cherry-pick favourable research or exaggerate the value of small or poorly designed studies if these do not provide the kinds of evidence required to support the particular procedure, interpretation or expression.

4.1.4. Detailed questions about validation studies and how to validate

What should a forensic practitioner say if asked detailed questions about what validation is, how to conduct a validation study, or what available research reveals, *and they are not really sure*? Practitioners should always answer honestly and try to be as clear as possible. They should acknowledge uncertainties and, if appropriate, respond to questions with 'I do not know' or 'That is not part of my expertise'. There is no shame (or embarrassment) in explaining that you are a practitioner who uses the procedure(s) taught to you and that you do not fully understand all of the underlying processes and assumptions – although it is important to recognise that comprehension and sophistication are generally desirable and often required by professional codes and employers[101]. Forensic practitioners should stay within the appropriate realm of expertise (where there is demonstrable knowledge), and let others answer questions if they are pressed and beyond their abilities. If the defence or judge requires additional information then the prosecutor should call supplementary witnesses with domain relevant (i.e. methodological) expertise[102]. These will usually be senior scientists and/or managers from the institution.

4.1.5. Collaboration on validation and other studies

Forensic practitioners may not have relevant experience, methodological skills, infrastructure, or the time and resources to conduct scientific experiments comparing expert and novice accuracy, measuring validity and reliability, or isolating the factors that influence expert decision-making[103]. Other groups, such as research scientists, may be well positioned to assist. Cognitive scientists, for example, specialise in phenomena such as human learning, memory, performance, perception, attention, decision-making, and reasoning. University-based research scientists in Australia routinely collaborate with industry partners across a variety of fields and recently these partnerships have extended to include studies of fingerprints and face matching[104]. Such collaborations may involve analysing practices and protocols in routine casework; designing and participating in experiments; disseminating findings in presentations and training, reports, and peer-reviewed journals; and improving institutional policies and practices. This kind of research can make important contributions to the evidence-base of the

discipline, enhance efficiency and performance, and be invoked in response to emerging legal interest in 'knowledge'.

4.1.6. Overview

Validation and proficiency studies provide information required by decision makers when determining if an opinion can rationally assist the resolution of disputed facts and what weight it might be given[105]. Forensic practitioners should remain firmly within the realms of demonstrable expertise and be reluctant to move into the shadowy penumbra of convention, belief, and speculation, at least without a heavy dose of epistemic modesty. Practitioners should make it clear to the court if their opinions are not well-supported by experimental studies.

As new studies contribute to the evidence-base of their domain, forensic practitioners may have to modify traditional practices (e.g. to take account of human factors) and forms of expression (e.g. move to probabilistic approaches; including statements that incorporate alternative hypotheses). In some cases validation studies might suggest that the probative value of opinion evidence is higher than historically claimed (or allowed to be expressed) in criminal proceedings. In other cases research may require traditional practices and expressions to be moderated and even abandoned[106].

More than ever before, the procedures used by forensic practitioners are visible to attentive research scientists. Forensic practitioners should endeavour to engage with the concerns and recommendations of attentive audiences, and to document, in good faith, limitations, concerns and controversies. This will demonstrate an impartial orientation and provide important resources for the prosecution and defence as they endeavour to grapple with the complexities of the forensic science evidence in the context of more expansive evidentiary arrays.

4.2. Error rates, limitations and uncertainties

All expert opinions, whether contained in a report or expressed orally in a proceeding, should include a clear indication of limitations, uncertainties and/or a statement addressing the potential for error. An expert opinion that does not index the 'knowledge' on which it is grounded and disclose known limitations is incomplete. It does not comply with admissibility rules, creates a serious risk of being misunderstood, and contravenes the expert's overriding duty to impartially assist the court[107].

Once again, the appropriate response is to provide useful information about the limits of the procedure or process behind the opinion. In many cases such information will be extracted from an experiment, or series of studies, where the procedure and practitioner have been tested against ground truth – i.e. a known result. As a matter of experimental design, ecological validity may have been sacrificed in order to isolate task components and associated abilities. For example, experts might be asked to make time-limited decisions, to forego collaborative opinion forming, have limited access to databases, tools or procedures, or may be required to provide binary (e.g. yes/no) responses rather than use their specialised conclusion scales. While such restrictions may impinge on ecological validity, these experiments nevertheless provide useful frameworks through which to assess abilities and opinions[108]. Estimates of error may need to be qualified or explained in the context of a specific case, but the need to extrapolate from the general (to the individual, or specific) is unavoidable[109].

Experimental results on the limitations of forensic procedures need to be made available to the court. Without some indication of error (and other limitations), it may be difficult, perhaps very difficult, to assess the value of a practitioner's opinion[110]. Is, for example, the performance of the forensic practitioner better than a layperson (making the evidence relevant) and if so how much better[111]? And, how do we know? Is the task easy or difficult? Do practitioners make mistakes? How often? In what circumstances does the procedure work well or work poorly? Is this assay typical of the kind of procedures performed by this practitioner? Here, the invocation of previous legal recognition, like recourse to long experience and personal confidence, may be distracting. In the absence of information about limitations derived from empirical studies, opinions may be no more than bare assertion – i.e. *ipse dixit*.

The generation of information about error (and other limitations with a procedure) is, undoubtedly, a complicated problem, which may require trade-offs and compromises. Error rates that map precisely onto the complex and varied circumstances of a *sui generis* case are generally unattainable. Instead, error rates will generally be oriented toward the procedure, perhaps the laboratory, rather than the individual practitioner or the circumstances of a specific prosecution. Courts should expect to be using these kinds of base rates and then to extrapolate from the general to the specific with information about the value of procedures (and proficiency)[112].

One attempt to wrestle with some of these challenging issues is the 'Guide to Forensic Testimony: Fingerprints', advanced by Edmond, Thompson and Tangen[113]. These authors proposed a way of refining the reporting of latent fingerprint evidence in response to emerging criticisms, a few important preliminary studies, and the immediate needs of criminal justice systems that continue to investigate and prosecute relying on latent fingerprint evidence[114]. They proposed appending the following to a 'match' report.

A guide to forensic testimony: fingerprints

- A decision about whether two fingerprints match or not is based on the judgment of a human examiner, not a computer.
- There are several documented cases where an examiner has incorrectly said that two prints 'match' when they actually came from two different people.
- Laboratory-based experiments suggest that errors of this sort happen infrequently (around 1% of the time). In practice, however, it is unknown how often examiners say that two fingerprints match when they actually come from two different people.
- Without specific evidence, it cannot be known whether an error has occurred in a particular case[115].

The authors acknowledge that the 'Guide' is a compromise and has limitations. However, it seems an improvement on the traditional way of reporting latent fingerprint evidence in reports and expert certificates. Historically, latent fingerprint examiners have equated a 'match' with positive identification of a person. Ordinarily there is little explanation of how this conclusion is reached, whether there was disagreement between examiners, whether it was subject to a meaningful review and what that involved, and there is almost never any reference to the risk of error in reports or oral testimony. These conventional reporting practices systematically exaggerate the probative value of the opinion, privileging the prosecution case and subverting fundamental criminal justice values[116].

By not incorporating limitations, uncertainties and some kind of indication of error, the state – through its prosecutors and fingerprint examiners – could be accused of misrepresenting the value of its expert opinion evidence and partisanship[117]. The defence should not be obliged to somehow identify and explain limitations or persuade the court that there is a real-world error rate. There always is a risk of error and it is incumbent on forensic practitioners to provide an indication of its magnitude. If the risk of error is small, as they generally appear to be with much latent fingerprint and DNA profiling evidence, little will be lost in reporting it[118]. The forensic practitioner has a conspicuous duty to provide an indicative error rate in order to prevent over-reliance on the opinion.

It is improper to suggest that forensic practitioners do not make mistakes[119]. The scientific and medical literature on human factors indicates that all humans, including the most highly-trained scientists and doctors, make mistakes[120]. The fact that practitioners are not aware, or do not believe, that they have made a mistake does not mean performance is error free. In criminal justice systems, ground truth is generally inaccessible. Indicative error rates enable the court to assess expert opinion evidence[121]. Even a base-rate error that is not perfectly suited to the particular case will almost always be preferable to omission or denial and the resulting risk of misunderstanding and over valuation.

4.3. Peer review and verification

Forensic practitioners should try to avoid suggesting that peer review or other verification procedures in themselves can somehow overcome or repair the absence of validation. Peer review and verification may help to reduce errors and are more likely to do so when they are conducted in specific conditions – such as where procedures are known to be valid and review is blind – see Section 4.5[122]. However, where peer review and verification are applied to procedures of unknown validity, or where the reviewer is exposed to the earlier result (or the desired result) or other suggestive information, peer review and verification may provide little improvement or improvement of unknown value. As things stand, we have relatively limited information about the value of review processes in relation to most of the forensic sciences[123].

Currently, some of the practices presented as ‘peer review’ more closely resemble a kind of editorial review than a genuinely independent assessment of a particular process or conclusion. For transparency, practitioners should explain what they mean by ‘peer review’ in the specific instance. In some cases terms such as ‘looked over’ or ‘proof read’ may be more accurate descriptions of institutional practices.

4.4. Expression of opinions

The terminology used by forensic practitioners in expressing their opinions should be based on experimental research. Use of particular terminologies or scales should be empirically justified (i.e. linked to validation and, if appropriate, frequency data), clearly explained and comprehensible.

The expression of opinions should be derived from what we know about the validity of procedures and the proficiency of forensic practitioners. In developing expressions, whether quantitative (such as likelihood ratios or frequencies) or qualitative (e.g. the use of tables, a range or form of words), forensic practitioners should engage with statisticians, science communicators and cognitive scientists.

Expression and comprehension are complex domains and those lacking specialist knowledge in the area should seek guidance[124]. This advice extends to courts. In some cases judges may place constraints on what they allow forensic practitioners to say in court (e.g. limiting opinions to 'similarities')[125]. Apparently intended to embody and convey evidentiary limitations, judge-imposed expressions are often as arbitrary as the expressions conventionally employed by forensic practitioners. Experimental studies and the insights of cognitive scientists, rather than terms imposed by judges or conjured by forensic scientists, especially those steeped in antiquated individualisation (i.e. positive identification) traditions, should inform the way opinions are expressed in reports and testimony.

Forensic practitioners should generally avoid neologisms – such as 'to a reasonable degree of ballistic certainty' (used in the US) – and be careful about the use of loaded terms such as 'match', 'consistent (with)', 'similar' or 'multiple similarities', and especially 'cannot exclude', 'no differences', and 'no significant differences'[126].

Finally, forensic practitioners should not think that because they are allowed to express expert opinions in reports and testimony they are entitled to proffer personal opinions unsupported by 'knowledge'[127]. Forensic practitioners cannot avoid professional and legal obligations on the basis that they are merely proffering a personal opinion or impression. To be admissible, opinions must be wholly or substantially based on 'specialised knowledge'. Where it is not based on identifiable 'knowledge', the opinion of a forensic practitioner is not admissible.

4.5. Human factors and genuine impartiality

Forensic practitioners should be attentive to human factors research and alive to risks of implicit bias[128]. Institutions responsible for producing forensic science and medicine evidence should have policies and practices designed to regulate the kinds of information that practitioners are provided with, and where possible their processes (especially verification and review) should be designed to avoid biasing evidentiary products. When it comes to reports and testimony, forensic practitioners should describe the processes that are in place to avoid (or reduce) undesirable exposures, such as suggestion and confirmation biases. They should be able to identify and explain mitigation strategies, such as selective unmasking or requiring a different practitioner to screen exhibits in order to determine what should be tested. Where there are no or few processes in place practitioners should disclose this absence.

Significantly, forensic practitioners cannot credibly contend that information about the case or suggestive practices have not influenced interpretations and decisions, unless at least one of the following conditions is satisfied:

(1) the practitioner is shielded (i.e. blinded) from gratuitous information or gradually exposed through a staged process that documents exposure and emerging interpretations (e.g. sequential unmasking); and/or
(2) studies confirm that exposures or processes are unlikely to influence a specific type of practice (e.g. the comparison of a 'high quality' latent fingerprint with a reference print or the interpretation of a 'simple' electropherogram)[129].

If these conditions are not satisfied there will be an unavoidable risk that the practitioner's interpretation will be contaminated. Forensic practitioners cannot plausibly contend that knowing about risks enables them (somehow) to overcome their effects or

take cognitive influences into account. Specific blinding or sequential unmasking processes must be designed and implemented to address such risks[130].

In most cases blinding (or some kind of documented sequential unmasking) will enable forensic practitioners and prosecutors to resist the claim that context effects and other human factors (e.g. bias as a member of a team or institution) may have exerted unintended influence on the opinion[131]. Blinding procedures will tend to focus practitioners on their task, and the area in which they have demonstrated expertise, and will enhance the value of their results. Results obtained in conditions where the practitioner knew what was expected or had access to domain-irrelevant case information – e.g. about the suspect or the results of other procedures – are less valuable. That is, the probative value is reduced and the danger of unfair prejudice is increased.

In consequence, institutions should develop systems to prevent exposing forensic practitioners to information or processes that might compromise analysis and review. Where practitioners have been provided with information about the case, expectations or other influences, this should be documented in the forensic practitioner's report. Further, the institution's response to threats from human factors should also be included in a report or be described on a website referenced in reports. It should be noted, however, that documentation and disclosure, though important, are unable to overcome the problems introduced by inappropriate and gratuitous exposures.

Some forensic domains do not appear to have made serious efforts to understand the impact that information and suggestive processes may exert on practitioners[132]. In fields where attempts to shield practitioners are limited or non-existent, the fact that practitioners were exposed to suggestive information is not usually documented and the risk of evidence being 'double-counted' or biased often passes unrecognised[133]. We accept that blinding may make it difficult, perhaps impossible, to persist with traditional practices, in some disciplines. But this calls for re-consideration of the way these domains are organised and practised. What information do the practitioners need to perform their analyses? What are they exposed to? Why? And, can practices be re-organised to avoid some or most of the dangers[134]?

Codes of conduct and legal practice directions uniformly call for experts to be impartial or objective in the production and presentation of their evidence. Genuine impartiality requires the development of practices and processes that embody desired values and protect practitioners (and evidence) from notorious dangers. The failure to incorporate human factors research into the practice of forensic science and medicine exposes practitioners to criticism that they are biased, or inattentive to the dangers of bias, and in breach of fundamental duties to the courts. Genuine impartiality requires the adoption and use of processes that facilitate impartial outcomes. This means good faith attempts to address notorious risks, as well as disclose limitations, constraints, and disagreements.

4.6. Expert reports

There is a conspicuous continuity between the substantial subjects raised in HTCE and an earlier contribution by the Evidence-Based Forensics Initiative on the content required in expert reports[135]. Expert reports should include information that enables a reader to ascertain what was done and to evaluate the opinion (or conclusion)[136]. This is both a condition of legal admissibility (following the decisions in *HG*, *Dasreef,*

Honeysett and *Tuite*) and required if opinions are to be rationally evaluated (recall *Davie*)[137]. In recent decades these expectations have also been codified in practice notes and/or procedural rules in most jurisdictions. Although not necessarily expressed in technical terms, codes and procedural rules require reports to include information pertaining to validation, reliability, proficiency, uncertainty and limitations, human factors, necessary qualifications, ongoing controversy and so on – see Section 3.2. The provision of this information, will make the practitioner compliant with formal expectations. More importantly, it will make the opinion evidence transparent and comprehensible. For model experts, aspiring to act impartially as servants of the court, the failure to provide such information is inexcusable.

Expert reports should incorporate appropriate information – reflecting the obligation to act as an impartial expert, sworn to tell the 'whole truth' and with an overriding duty to assist the court. This requires that sufficient information be included to explain: what information was provided to the practitioner (or what the practitioner learnt from examining the scene); what was requested of the practitioner; the work carried out by the practitioner, along with an explanation of the procedure and the resulting opinion; evidence that supports the procedure (i.e. 'knowledge'); the proficiency of the practitioner; means of assessing the procedure and conclusion (e.g. error rates); along with insight into relevant standards, controversies, limitations, and assumptions[138].

An expert report should be sufficient to enable another expert or scientist to make a clear assessment of the analysis and conclusion. It should also provide materials that enable a non-expert to undertake further research or seek independent advice. Admittedly, the provision of such information may pose practical problems. It may require institutions to make additional materials available electronically on a website or, less desirably, upon request. It might, alternatively, necessitate production of a short or summary report, in conjunction with a longer report that is largely composed of standardised text describing procedures and practices. Not every detail needs to be included in a report. The goal is to disclose useful information in a fair-minded (i.e. impartial) and transparent manner, not to overwhelm prosecutors, defence lawyers and the occasional scientist reviewing the material, with information of marginal utility.

Assessing the conduct and performance of forensic practitioners should be directed to the quality of reports, the propriety of opinions, and the consistency of testimony with available scientific research and authoritative recommendations. These are clearly more appropriate indicia of expert performance than convictions or successful resistance to (often perfunctory) cross-examination[139].

4.7. What to say in response to questions based on authoritative reports (e.g. Goudge, NAS, NIST, and the Fingerprint Inquiry)

Recent inquiries and reports have addressed a wide range of issues that might be raised in cross-examination. Some of these interventions, such as the NAS report for example, are oriented to specific jurisdictions (i.e. the US) but are, nevertheless, quite general in scope and application. Others, such as the NIST report on human factors in latent fingerprint examination, are more tightly focused in their subject matter, although also imbued with broader significance. Below, we have endeavoured to canvass a range of potential reactions to these reports and some of the issues they raise.

1. *The criticisms only apply to the US or the UK or Canada*. Such responses may be more or less accurate, but the main issue is whether the forensic practitioner's

evidence is underpinned by relevant research (particularly validation or performance studies). Jurisdictional differences, even substantial differences around accreditation, certification (and training) and standardisation, for example, may not overcome: a lack of research; uncertainty about the rate of error; uncertainty about actual proficiency; and inattention to human factors.

2. *We do things (fundamentally) differently.* In some cases this is not accurate, or the differences are not significant or not known to be significant (see point 1, above). Differences in practice between jurisdictions may be less important than the availability of experimental research supporting what is done domestically.
3. *We already have standards and accreditation in place.* The issue here is whether these are based on experimental research or merely formalisations of conventional practices and beliefs. Moreover, are practices explained and standards identified and complied with[140]?
4. *Our forensic practitioners are much better trained.* This may be true and training would generally seem to be desirable, especially if it involves formal scientific and technical instruction in universities[141]. The issue is how such training relates to validity, reliability and proficiency. Some emerging research suggests, perhaps counter-intuitively, that the relationship between training/experience and performance is not linear[142]. Moreover, abilities do not necessarily improve over time. This means that we cannot assume that the most experienced forensic practitioners will necessarily be the most proficient. (Such insights may have serious implications for the selection of forensic practitioners, training and review mechanisms – see Section 4.1.5).
5. *The recommendations are normative or aspirational.* There may be some truth to this, but many of the large number of recommendations, especially those in the NAS report, seem to be unequivocal. Most appear to be practical and prescriptive rather than abstract or aspirational[143].
6. *These are scientific reports, written for scientists (i.e. findings and recommendations are not legal and not directed to legal practice)*. Many of the reports and reviews were written by scientists (and others) for forensic practitioners. They have implications for how forensic practitioners should understand their professional responsibilities and obligations and how they conduct themselves in relation to legal proceedings. All of the recent reports call for further research and changes to current practices.
7. *Relevant research is being undertaken.* This is undoubtedly true and highly desirable. As research is published the results should, where appropriate, inform practice and reporting – see Section 4.1. The question is what can we say if the relevant research has not been undertaken or does support contemporary practices and expressions? Practitioners should be transparent and modest. They should disclose limitations and frailties and these should inform interpretations and conclusions. Once research is published it may be appropriate to modify practices, reporting and the kinds of expressions used.
8. *Invoking the report for positive commentary.* The reports are sometimes positive in their description of current procedures and capabilities, although these favourable statements are often quite restricted in scope. If forensic practitioners invoke favourable commentary then they should also address criticism, concerns and recommendations.
9. *We already have a National Institute of Forensic Science (NIFS)*. The NAS recommended that the US government establish a large and independent institute to

oversee the reformation of the forensic sciences. Australia already has a national institute, although it bears little resemblance to the institution envisaged by the NAS. While the Australian NIFS has exerted a generally positive impact on the Australasian forensic landscape, it has serious limitations[144]. It is a tiny organisation (with just a handful of employees and no active research scientists). It is modestly funded, located in police headquarters, and overseen by senior police[145]. Current reforms in the United States under the auspices of the National Institute of Standards and Technology (NIST) – a less costly alternative, preferred by Congress – are, in comparison, engaged with multidisciplinary researchers and vastly better resourced than the Australian incarnation of a 'National Institute'[146].

10. *The reviewers were not the appropriate 'community' to review the forensic sciences.* It would be misleading to suggest that the committees and individuals responsible for the inquiries and reports were misguided or dominated by critics. Rather, the various committees and individuals responsible for the reports generally took submissions, heard testimony, reviewed literatures (e.g. the NAS report) or included forensic practitioners among their number (e.g. the NIST report). Most of the members were highly trained and eminent scientists, statisticians, physicians, engineers and/or senior jurists (e.g. Edwards, Campbell and Goudge) who came to their inquiry with positive expectations regarding the quality of forensic science evidence[147]. The various review processes, particularly those incorporating exogenous multidisciplinary perspectives, would seem to represent a desirable way of assessing the forensic sciences[148]. Moreover, similarity in the findings and recommendations across many different reviews (and jurisdictions) lends considerable weight.
11. *The authors are not experts in my field.* This sort of response is perversely parochial. The issue is not whether an author, critic or commentator is a tool mark examiner or biologist or document examiner. The issue is whether their concerns and criticisms are apposite. Why have critics with technical and scientific qualifications from beyond forensic science communities repeatedly expressed concerns about the practices in many areas of forensic science and medicine[149]?
12. *Forensic practitioners are technicians rather than scientists and so the scientific commentary is inapplicable.* This contention has little to recommend it. Practitioners are not insulated from the concerns and criticisms of attentive scientists and other commentators by nomenclature[150]. The need for foundational research persists however forensic practitioners are characterised.
13. *The Galileo posture – 'I disagree with the NAS'.* Forensic practitioners, particularly those without research qualifications, should be cautious – indeed reluctant – to unilaterally disagree with the findings and recommendations in the reports. Unless backed up by appropriate independent research, such responses do not represent good faith or informed engagement with exogenous commentary and criticism. Any forensic practitioner offering this kind of response should be closely questioned about their familiarity with the report and the process underlying its creation, and the basis on which they have formulated their opinion.

This canvassing of potential responses is not intended to stifle debate or even resistance. But engagement should be undertaken in good faith and draw upon scientific evidence rather than past practices, longstanding assumptions and previous legal accommodation. The authors of the various reports were well aware of what was done

or allowed historically and were critical notwithstanding. Forensic practitioners, and their institutions, should consider why mainstream scientists have expressed concerns and recommended substantial reform to current practices and reporting, particularly around the positive identification of persons and objects and even the way apparent similarities are infused with significance[151]. The reports demand, and provide an opportunity for, re-consideration of traditional practices and their justifications.

Where forensic practitioners are reluctant to adopt the recommendations in the reports they are, nevertheless, obliged to engage with them. They should explain why the considered assessments of eminent multidisciplinary reviewers are mistaken (or inapposite) and make very clear what they have done (i.e. through disclosure and transparency) so that others can make their own evaluation. Practitioners should avoid trivialising or ignoring scientific criticism and recommendations. We appreciate that some of the criticisms undermine the foundations of conventional practices and legally recognised procedures[152]. Some recommendations may be onerous (occasionally, even impractical). Nevertheless, the general thrust of the reports is to call for (more) scientific research and to base the practices of forensic practitioners on a firm scientific foundation.

To ignore or summarily reject substantive criticisms from the NAS and other reports is a risky strategy, especially as institutions and disciplines begin to transform their practices in accordance with contemporary scientific expectations. Forensic practitioners who reject mainstream scientific commitments – around validation and reliability, the provision of error rates and indicia of uncertainty, and the threat posed by human factors and suggestive procedures – will become increasingly vulnerable when a competent cross-examiner seeks to challenge their evidence. Simultaneously, they make themselves vulnerable in every subsequent proceeding where their earlier, deficient reports and testimony might be raised in cross-examination. Forensic practitioners should respond to criticisms with epistemic modesty, taking seriously the advice and concerns of mainstream scientists, engineers, statisticians, biomedical researchers and cognitive scientists.

5. Pros and cons of transparency, disclosure, epistemic modesty and impartiality

Relatively few disadvantages flow from following the proposed rubric, complying with formal obligations and adopting a more scientific orientation. Most of the risks are linked to persisting with past practices and traditional commitments that have now been subjected to authoritative criticism.

Let us begin with benefits. Complying with legal and professional obligations will help to facilitate the goal of doing justice in the pursuit of truth[153]. It makes it more likely that the criminal justice system, particularly prosecutors and the courts, will operate according to espoused values and goals. Compliance will help lawyers, judges and juries to understand and properly assess forensic science and medicine evidence.

Complying with rules and obligations is inherently preferable to non-compliance. It reduces the need for secrecy, dissembling and cognitive dissonance. Disclosure, transparency, epistemic modesty and impartiality will help to insulate forensic practitioners when things unexpectedly take a turn for the worse[154]. If the possibility of error was proactively conceded in reports and testimony it is more difficult to criticise the practitioner if errors are subsequently exposed. Non-compliance, in contrast, will make the practitioner vulnerable in potentially hostile legal contexts, such as courts of appeal or public inquiries[155].

Epistemically modest opinions may make the role of forensic practitioners easier. Defence lawyers may be content with appropriate concessions made in reports and examination-in-chief regarding the lack of study, uncertainty or the risk of error. The result may be fewer admissibility challenges, fewer court appearances, and less expansive cross-examination when forensic practitioners are called to testify. In general, compliance will tend to temper the severity of challenges from defence lawyers and should also reduce *ad hominem* attacks to the extent that practices and conclusions are evidence-based.

It seems unlikely, based on past practice, that greater disclosure and increasingly research-based opinions will lead to the exclusion of forensic science evidence. However, legal responses may become increasingly sensitive to the outcome of validation studies[156]. Courts may exclude, or impose new qualifications upon, some types of forensic science and medicine evidence that was historically admissible (and relatively unconstrained), but it is likely that the vast majority of forensic science and medicine evidence will continue to be admissible, even if the strength of some of the conclusions might be moderated on the basis of experimental research.

If admissibility standards are raised or lawyers and judges take more of an interest in the reliability (and validity) of forensic science and medicine evidence as part of their exclusionary practice (e.g. UEL, ss 135, 137 and *Tuite*), then forensic practitioners using validated procedures, and reporting in ways that are consistent with practice directions, are least likely to be affected.

While greater disclosure, transparency, epistemic modesty and impartiality might signal limitations to the technically literate these might not be appreciated by less methodologically sophisticated audiences. Mere disclosure of oversights and limitations does not necessarily enable the tribunal of fact to evaluate the evidence – whether the opinion, the practitioner's proficiency or even credibility[157]. Knowing what has not been done is not a substitute for the results of what should have been done. Knowing that appropriate testing has not been conducted, knowing that error rates should be available but are not, knowing that there was a risk of contextual bias that was not addressed, does not enable a decision-maker to somehow factor these into their decisions[158]. Knowing about unknowns does not necessarily facilitate rational decision-making. It may produce too much caution or, more problematically given the burden and standard of proof, may lead to the over valuation of evidence.

As for the cons associated with compliance, a number might be mooted: loss of prestige; diminished scope of legally-recognised expertise; having to provide narrower or weaker opinions; more limited participation in legal proceedings; loss of 'membership' in the prosecutorial 'team'; a less direct relationship with the resolution of crime (through successful prosecutions); and, the need for more continuing education. But it is questionable whether any of these are real losses. To the extent that they were not predicated on scientific research and demonstrated abilities or consistent with appropriate role expectations, these traditional practices, relationships and commitments were misguided[159].

Forensic practitioners might worry that greater compliance with legal rules and professional obligations will lead to the exclusion or tempering of evidence and so perhaps result in fewer convictions. Such concerns reflect a misunderstanding of their role, and of the operation of the presumption of innocence. As impartial servants of the court, disinterested in the outcome of proceedings, forensic practitioners should not be especially concerned if a particular individual is not prosecuted or convicted. However, it is useful to note that greater disclosure and transparency, and even acknowledging the real

possibility of human error, is only likely to have a marginal impact. In most cases, the probative value of forensic science evidence will not be dramatically reduced. Furthermore, most pleas and prosecutions rely on a range of different types of direct and/or circumstantial evidence, such that moderating the strength of one piece of the evidence will not necessarily introduce reasonable doubt. Greater compliance will, however, decrease the gap between current practice and legal principles and aspirations; making criminal proceedings fairer because outcomes are based on forensic science evidence that is consistent with what is known.

We can envisage state-employed forensic practitioners expressing concerns about the behaviour of defence lawyers and expert witnesses called by the defence. While expert witnesses called by the defence have the same basic legal obligations (drawn from relevant practice directions), there may be slightly fewer expectations in relation to disclosure and they might not be bound as tightly by the high standards applicable to the state's model forensic scientists. Misconduct or highly strategic actions by the defence do not provide a warrant for the prosecution to circumvent legal and professional obligations. Under no circumstances should forensic practitioners take it upon themselves to somehow compensate for defence behaviour or problems with the case. It makes no difference what defence lawyers might say or do, improved disclosure, more transparency and a modest epistemology, remain the guiding principles for the forensic practitioner. Obligations to speak truthfully and to impartially serve the court override any obligation to a party or 'team' – whether the police or prosecution, victim/complainant or even personal beliefs about the guilt of the accused.

Obviously, where a defence witness has made false, misleading or controvertible claims, forensic practitioners should, indeed have an obligation to, point them out to the prosecutor and respond during their testimony (or in any subsequent report). Forensic practitioners do not need to stand idly by if defence experts are mistaken, misguided or duplicitous.

6. Discussion

This essay, along with HTCE, was written because forensic practitioners have not always understood or fulfilled their obligations. Cultures of secrecy (and distrust of outsiders), non-disclosure, conviction-oriented investigation and reporting, and inattention to mainstream scientific research and recommendations remain entrenched in some areas of forensic science and some public institutions. In this essay we have endeavoured to explain what forensic practitioners should be doing to fulfil their professional and legal obligations along with some of the reasons for our recommendations. We accept that other participants in the criminal justice system, conspicuously prosecutors and defence lawyers, have not always performed well, and that some of their derogations and advice may have contributed to misunderstandings as to the role identity and expectations on forensic practitioners. We also accept that some of the expectations and their modern expressions are relatively new; often developed in response to new legal rules (e.g. UEL) and practice directions emerging out of experience with wrongful convictions, public inquiries and their recommendations[160].

History and misunderstandings may help us to understand how we got to where we are, but they do not excuse the failure to comply with the range of formal expectations imposed on forensic practitioners. Regardless of how other professional groups might respond to the changing socio-legal environment, forensic practitioners are obliged to reform their practices in line with legal rules, professional codes and the best scientific

research and advice available. In order to assist this end, we have provided an indication of the kinds of issues and subjects forensic practitioners should be endeavouring to address through the provision of overarching principles intended to capture and clarify contemporary expectations – namely, disclosure, transparency, epistemic modesty and impartiality.

In concluding, it is important to address a few misapprehensions and attitudes that are inconsistent with these expectations. Forensic practitioners are not asked or expected to prove guilt. Rather, in the vast majority of cases they can only provide more modest insights – such as whether two things (e.g. latent prints, fibres or handwriting samples) appear similar and whether the observed similarities support one or more propositions pertaining to the source[161]. Questions of what such assessments (usually opinions) mean to the case as a whole are generally not for forensic practitioners. To the extent that forensic practitioners endeavour to address or resolve the question of guilt, in most cases they will have trespassed from the limited role assigned to the expert witness on to the role of the fact-finder. Under our constitutions (both state and federal), it is for the tribunal of fact (whether jury or judge sitting in summary judgment) to evaluate the evidence in relation to the standard of proof.

The impartial forensic practitioner does not omit relevant information, does not omit controversy and criticism, does not solicit 'review' from those most favourably disposed to a position, and does not omit differences of opinion amongst colleagues. Impartial forensic practitioners do not express opinions that extend further than underlying research (i.e. knowledge) can support. Impartiality requires the disclosure of information that is relevant to understanding and evaluating the practitioner's opinion. By definition, impartiality requires being indifferent as to the parties or outcomes in the provision of opinion evidence and the information required to make sense of it. It also means fully qualifying the opinion and even conveying qualifications that the forensic practitioner might personally disagree with.

Forensic practitioners are obliged to present their evidence in the most accurate and comprehensible ways available[162]. Their primary obligation is to the court – to tell the truth and to act impartially. This obligation trumps and traduces any perceived obligation to the prosecution (or defence), the police, their employer, the victim or complainant, and even to protect the community. Forensic practitioners should avoid too much (or unnecessary) contact with prosecutors, victims, complainants and their families, because it may compromise their actual or apparent impartiality. Forensic practitioners should make themselves available to the lawyers for other parties and should speak frankly if asked questions in a pre-trial conference.

In order to assist forensic practitioners to orient themselves, it is useful to pose a few questions. These questions are intended to encourage forensic practitioners (and others) to think about their practices and attitudes. Do you comply in good faith with legal practice directions and your professional responsibilities? Are you disclosing assumptions, limitations, problems, difficulties, uncertainties, the lack of validation, criticisms and recommendations, in a genuine or constructive manner, that explains or engages with their significance and implications? If not, why not? What do you think your role is? What is your model of impartiality? Are you intentionally or unwittingly suppressing information that is relevant to understanding your expertise and performance (or defence decisions about what to do in relation to your evidence)? Are you, perhaps unintentionally, usurping the role of the tribunal of fact by withholding information that would enable it to make more informed decisions? How do impartiality and your overriding duty to the court (rather than your employer, the prosecutor and

conviction) manifest in your report and testimony? Would your practices and opinions satisfy an independent panel of scientists? If not, why not? One useful, if slightly confrontational, way to think about this is to ask: would I have written the same (or a substantially similar) report if I were engaged by the defence?

Ours is an accusatorial system. It is the responsibility of the state to prove guilt beyond a reasonable doubt. The accused has few evidentiary obligations (beyond some defences and giving notices). The emphasis on prosecutorial disclosure and transparency sits comfortably within this framework. Notwithstanding our adversarial procedure, responsibility for identifying and conveying known limitations with the state's forensic science and medicine evidence should not fall exclusively upon the accused. Prosecutors and experts have formidable obligations that require them to disclose problems and to actually present them to the tribunal of fact. The accused should not bear the risk that evidence is error free or that trial 'safeguards' work. The state has the burden and an obligation to evaluate procedures, attend to notorious risks (e.g. contextual bias) and qualify evidence appropriately; based on what is known. The state and its employees are obliged to make trials (and appeals) substantially fair.

The decreasing resourcing of trials in conjunction with the increased use of scientific and technical evidence puts an additional burden on prosecutors and model forensic scientists. In most contested cases it is unlikely that the defence will have access to an expert to advise the lawyers preparing the case or to provide rebuttal evidence[163]. The majority of reports relied upon in charge and plea negotiations, and even contested proceedings, will not be reviewed by an independent scientist. An expert's failure to comply with formal obligations, particularly the failure to disclose limitations and make what was done transparent, will likely mean that others in the legal system will be oblivious to limitations with the evidence, at least in the short term. Our system works poorly when the defence is deprived of information that might help it to ascertain the value of incriminating opinions.

Notes

1. Edmond G, Martire K, Kemp R, Hamer D, Hibbert B, Ligertwood A, … White D. How to cross-examine forensic scientists: a guide for lawyers. Aust Bar Rev. 2014;39(2):174–196.
2. Like HTCE, the discussion of methods (e.g. validation and error rates) in this article is primarily, though not exclusively, directed toward the comparison and pattern recognition domains.
3. See Edmond G. The admissibility of forensic science and medicine evidence under the Uniform Evidence Law. Crim Law J. 2014;38(3):136–158; Edmond G. Legal versus non-legal approaches to forensic science evidence. Int J Evid Proof. 2016;20(1):3–28. Conventionally, legal interest tends to be focused on factors such as formal qualifications, experience, the existence of 'fields' and previous admissibility decisions.
4. See Kahneman D, Klein G. Conditions for intuitive expertise: a failure to disagree. Am Psychol. 2009;64(6):515–526. doi: 10.1037/a0016755; Hogarth R. Educating intuition. Chicago, IL: University of Chicago Press; 2001. Cunliffe E. Judging, fast and slow: using decision-making theory to explore judicial fact determination. Int J Evid Proof. 2014;18 (2):139–180. doi: 10.1350/ijep.2014.18.2.447.
5. Uniform Evidence Law (UEL), s 79(1). See also Section 3.1 below. We accept that credibility might also be an issue; such as where a practitioner has previously misrepresented evidence or there is some reason for doubting their opinion or abilities. Generally, credibility is a second-order consideration. When evaluating expert opinion evidence, it is usually more important to know whether a technique or process works and how well than to focus on the credibility or demeanour of an individual.

6. More generally, see Edmond G. What lawyers should know about the forensic 'sciences'. Adelaide Law Rev. 2015;37(1):33–99.
7. Although we believe that Australian admissibility standards are currently too liberal, improving the performance of forensic practitioners and lawyers may circumvent the need to formally revise them.
8. Other interventions have focused primarily on admissibility. See Edmond G. Specialised knowledge, the exclusionary discretions and reliability: reassessing incriminating expert opinion evidence. Uni New South Wales Law J. 2008;31(1):1–55; Edmond G, San Roque M. Before the High Court - *Honeysett v The Queen*: Forensic science, 'specialised knowledge' and the Uniform Evidence Law. Sydney Law Rev. 2014;36(2):323–344; Edmond G. A closer look at *Honeysett*: enhancing our forensic science and medicine jurisprudence. Flinders Law J. 2016;17(1):in press.
9. Edmond G. Forensic science evidence and the conditions for rational (jury) evaluation. Melbourne University Law Rev. 2015;39(1):77–127.
10. This article is directed primarily toward forensic practitioners employed or engaged by the state. These individuals produce the vast majority of forensic science evidence relied upon in decisions to charge, plea and charge negotiations, and criminal prosecutions.
11. We are referring to the commitment to testing and standardising procedures in regular use. More generally, see Merton RK (edited by Storer NW). The sociology of science: theoretical and empirical investigations. Chicago, IL: University of Chicago Press; 1973; and critical commentary: Mulkay MJ. Norms and ideology in science. Soc Sci Inf. 1976;15(4–5):637–656; Mulkay MJ. Interpretation and the use of rules: the case of norms of science. In: Gieryn T, editor. Science and social structure: a festschrift for Robert K. Merton. New York: New York Academy of Sciences; 1980.
12. See Mnookin JL, Cole SA, Dror IE, Fisher BAJ, Houck MM, Inman K, … Stoney DA. The need for a research culture in the forensic sciences. UCLA Law Rev. 2011;58(3):725–780.
13. National Academy of Sciences. Strengthening the forensic sciences in the United States: a path forward. Washington, DC: National Academies Press; 2009 ['NAS Report']. Retrieved from https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf; National Institute of Standards and Technology. Latent print examination and human factors: improving the practice through a systems approach. Washington, DC: US Department of Commerce; 2012 ['NIST Report']. Retrieved from http://www.nist.gov/oles/upload/latent.pdf.
14. Understanding the process and its limitations is generally more important than preventing 'criminals' from finding out about it. Failure to disclose procedures and especially limitations, threatens the primary goals of the accusatorial trial – to provide a substantially fair and open process that produces an accurate verdict. There may be some circumstances where technical capabilities need to be kept secret but these will be exceptional.
15. This applies regardless of whether these are explicitly required by jurisdictional rules. See Goudge ST. Final report of the inquiry into Paediatric Forensic Pathology Services in Ontario. Toronto, Canada: Queen's Printer; 2008 [Goudge Report].
16. We note that impartiality has limits (especially as an analytical category to evaluate evidence), but as a normative commitment it is desirable, especially among state-employed forensic scientists. See the discussion by the Supreme Court of Canada in *White Burgess Langille v Abbott and Haliburton Co*. [2015] SCC 23.
17. Limitations and oversights are not necessarily identified or repaired by trial safeguards. See Edmond G, San Roque M. The cool crucible: forensic science and the frailty of the criminal trial. Curr Issues Criminal Just. 2012;24(1):51–68.
18. Modest. In *Merriam Webster Online Dictionary*. Retrieved from http://www.merriam-webster.com/dictionary/modest.
19. In *Honeysett v The Queen* [2014] 253 CLR 122, the High Court of Australia endorsed definitions of 'knowledge' from *Daubert v Merrell Dow Pharmaceuticals Inc* [1993] 509 US 579, 590 and *R v Tang* [2006] 65 NSWLR 681, 713–714. Specifically, the Court endorsed the *Macquarie Dictionary* definition of 'knowledge', namely 'acquaintance with *facts, truths, or principles*, as from study or investigation' (emphasis in original). More generally, see Brewer S. Scientific expert testimony and intellectual due process. Yale Law J. 1998;107(6):1535–1681, who suggests that the 'mark of the epistemic is the concern with warranted belief'; and Beecher-Monas E. Evaluating scientific evidence: an interdisciplinary framework for intellectual due process. New York: Cambridge University Press; 2007.

20. Here, the point is not to call something scientific or non-scientific, or technical or experience-based or merely an opinion. Rather, the point is what does available research support in terms of capabilities?
21. NAS Report, 106 n79, quoting Mnookin J. The validity of latent fingerprint identification: confessions of a fingerprinting moderate. Law, Prob Risk; 2008;7(2):127–141. doi: 10.1093/lpr/mgm022. See also Turkheim D. Flawed convictions: 'Shaken baby syndrome' and the inertia of injustice. New York: Oxford University Press; 2014.
22. Thompson MB, Tangen JM, McCarthy DJ. Human matching performance of genuine crime scene latent fingerprints. Law Human Behav. 2014;38(1):84–93. doi: 10.1037/lhb0000051.
23. Ulery BT, Hicklin RA, Buscaglia J, Roberts MA, Fienberg SE. Accuracy and reliability of forensic latent fingerprint decisions. Proc Nat Acad Sci USA. 2011;108(19):7733–7738. doi: 10.1073/pnas.1018707108; Tangen JM, Thompson MB, McCarthy DJ. Identifying fingerprint expertise. Psycholog Sci. 2011;22(8):995–997. doi: 10.1177/0,956,797,611,414,729; Thompson MB, Tangen JM. The nature of expertise in fingerprint matching: experts can do a lot with a little. PloS one. 2014;9(12):e114759. doi: 10.1371/journal.pone.0114759.
24. Ulery BT, Hicklin RA, Buscaglia J, Roberts MA. Repeatability and reproducibility of decisions by latent fingerprint examiners. PloS one. 2012;7(3):e32800. doi: 10.1371/journal.pone.0032800; Langenburg G, Champod C, Genessay T. Informing the judgments of fingerprint analysts using quality metric and statistical assessment tools. Forensic Sci Int. 2012;219(1–3):183–198. doi: 10.1016/j.forsciint.2011.12.017. But see Thompson MB, Tangen JM, McCarthy DJ. Expertise in fingerprint identification. J Forensic Sci. 2013;58(6):1519–1530. doi: 10.1111/1556–4029.12203 for a discussion about generalising the results from laboratory-based experiments to the everyday operations of a fingerprint bureau.
25. Ulery BT, Hicklin RA, Buscaglia J, Roberts MA, Fienberg SE. Accuracy and reliability of forensic latent fingerprint decisions. Proc Nat Acad Sci USA. 2011;108(19):7733–7738. doi:10.1073/pnas.1018707108; Ulery BT, Hicklin RA, Roberts MA, Buscaglia J. Measuring what latent fingerprint examiners consider sufficient information for individualization determinations. PloS one. 2014;9(11):e110179. doi: 10.1371/journal.pone.0110179; Ulery BT, Hicklin RA, Roberts MA, Buscaglia J. Changes in latent fingerprint examiners' markup between analysis and comparison. Forensic Sci Int. 2015;247(1):54–61. doi: 10.1016/j.forsciint.2014.11.021.
26. Kassin SM, Dror IE, Kukucka J. The forensic confirmation bias: problems, perspectives, and proposed solutions. J Appl Res Memory Cognit. 2013;2(1):42–52. doi: 10.1016/j.jarmac.2013.01.001.
27. Thompson MB, Tangen JM, McCarthy DJ. Human matching performance of genuine crime scene latent fingerprints. Law Human Behav. 2014;38(1);84–93. doi: 10.1037/lhb0000051. Generally, benchmarking tests of fingerprint examination, as in other forensic science domains, provide evidence that can be used to estimate the bounds of a particular procedure. See also research on unfamiliar face matching by White D, Phillips PJ, Hahn CA, Hill M, O'Toole AJ. Perceptual expertise in forensic facial image comparison. Proc Roy Soc B: Bio Sci. 2015;82(1814):1–8. doi: 10.1098/rspb.2015.1292.
28. On the identification paradigm, see Saks MJ, Koehler JJ. The Individualization Fallacy in forensic science. Vanderbilt Law Rev. 2008;61(1):199–219; Cole SA. Forensics without uniqueness, conclusions without individualization: The new epistemology of forensic identification. Law Prob Risk. 2009;8(3):233–255. doi: 10.1093/lpr/mgp016; Koehler JJ, Saks MJ. Individualization claims in forensic science: still unwarranted. Brooklyn Law Rev. 2010;75(4):1187–1208.
29. It is important to emphasise that more scientific attention has been directed toward fingerprint evidence than most comparison procedures (e.g., shoe, foot and tyre prints, ballistics and tool marks, handwriting, image, voice and gait comparison). It is far from clear that these other procedures are as robust.
30. There may be a limited place for more speculative approaches in investigations, but these should not form part of charging decisions, plea negotiations and prosecutions. There is a need for caution because the use of unreliable and speculative procedures in investigations may waste resources and mislead investigators; especially if undisclosed.

31. Association of Forensic Science Providers. Standards for the formulation of evaluative forensic science expert opinion. Sci Justice. 2009;49(3):161–164. doi: 10.1016/j.scijus.2009.07.004; Evett I. Evaluation and professionalism. Sci Justice. 2009;49(3):159–160. doi: 10.1016/j.scijus.2009.07.001.
32. Impartiality requires that forensic practitioners discharge their responsibilities to assist the court to reach an accurate conclusion, including by explaining uncertainties and limitations – rather than conceiving of their role as one of assisting police or the prosecution to secure a conviction. See Cunliffe E. Independence, reliability and expert testimony in criminal trials. Australian J Forensic Sci. 2013;45(3):284–295. doi: 10.1080/00450618.2013.784358.
33. In other contexts, forensic practitioners should perform their work, especially analyses, accurately and impartially.
34. In some cases it may be appropriate to restrict the use of procedures until experimental studies confirm their validity and reliability.
35. Most of the same obligations apply to other experts, including defence experts, although as we explain, there are special obligations on experts employed and called by the state. State-employed forensic practitioners should be model expert witnesses.
36. See *Daubert v Merrell Dow Pharmaceuticals Inc*. [1993] 509 US 579; *Kumho Tyre Co v Carmichael* [1999] 526 US 137 (1999), and the revised US Federal Rules of Evidence (1975) r 702. See also *R v Trochym* [2007] 1 SCR 239; *R v Abbey* [2009] ONCA 624.
37. Law Commission of England and Wales. Expert Evidence in Criminal Proceedings in England and Wales, 34. London: HMSO; 2011; Criminal Procedure Rules (2014) r 33 (England and Wales). See also Ward T. Expert evidence and the law commission: Implementation without legislation? Crim Law Rev. 2013;2013(7): 561–576.
38. Leveson B. Review of the effectiveness of criminal justice. 60–62. London: Judiciary of England and Wales; 2015.
39. See Edmond G, Cole SA, Cunliffe E, Roberts A. Admissibility compared. U Denver Crim Law Rev. 2013;3(1): 31–109.
40. See for example *R v Lundy* [2014] NZHC 2527; *New Zealand Pork Industry Board v Director-General of the Ministry of Agriculture and Forestry* [2013] NZCA 65; *R v Carter* [2005] NZCA 422. The New Zealand *Evidence Act* 2006 s 26 includes references to both 'knowledge' and 'expert'.
41. South Australia, Western Australia and Queensland are governed by a mixture of parochial evidence acts and the common law.
42. In UEL jurisdictions, s 76.
43. UEL s 79(1).
44. *Dasreef Pty Ltd v Hawchar* [2011] HCA 21, [32]; *Honeysett v The Queen* [2014] HCA 29, [23].
45. *HG v The Queen* [1999] 197 CLR 414, [39]. The knowledge should be independent of the practitioner and any claimed ability. Ideally, there should be some experimental study that can be referred to (and produced if necessary).
46. In *Daubert* the Court offered a list of criteria that might be used flexibly to assist trial judges with reliability (and validity). The *Daubert* criteria include: testing; peer review and publication; error rates; whether standards exist and have been applied; and, whether the procedure is generally accepted.
47. *Honeysett v The Queen* [2014] HCA 29.
48. *Honeysett v The Queen,* [42].
49. *Honeysett v The Queen,* [43]. According to the Court, 'Professor Henneberg's opinion was not based on his undoubted knowledge of anatomy.' Rather, the 'conclusion was based on Professor Henneberg's subjective impression of what he saw when he looked at the images.'
50. *Honeysett v The Queen* [2014] HCA 29, [23].
51. Ibid, quoting from *Daubert v Merrell Dow Pharmaceuticals Inc*. [1993] 509 US 579.
52. The High Court recognised that 'specialised knowledge' could be obtained 'without any formal qualifications … by experience' but only with regard to 'matters that are not of a scientific or technical kind': Ibid.
53. In *Tuite v The Queen* [2015] VSCA 148, [70], the Victorian Court of Appeal concluded that earlier decisions such as *R v Tang* [2006] 65 NSWLR 681 and *Honeysett* meant that it was not possible to read 'reliability' into 'specialised knowledge' from s 79. This approach

is inconsistent with the interpretations of 'knowledge' and procedural requirements imposed by superior courts in other jurisdictions such as the United States, Canada, England and Wales. Notwithstanding *Tang, Honeysett* and *Tuite*, the High Court has yet to decide the issue. See Edmond G. The admissibility of forensic science and medicine evidence under the Uniform Evidence Law. Crim Law J. 2014;38(3):136–158.

54. UEL s 137 states: 'In a criminal proceeding, the court must refuse to admit evidence adduced by the prosecutor if its probative value is outweighed by the danger of unfair prejudice to the defendant.' This is similar, though not identical, to the common law *Christie* discretion.
55. *Tuite v The Queen* [2015] VSCA 148, [11], [102], [103]ff. Dangers of mis-use and deference were also raised in *HG v The Queen* [1999] 197 CLR 414, [44] and *Honeysett v The Queen* [2014] HCA 29, [45].
56. *Tuite v The Queen* [2015] VSCA 148 perpetuates the schism between the courts in NSW and Victoria. See Edmond G, Hamer D, Ligertwood A, San Roque M. Christie. Section 137 and forensic science evidence (after *Dupas v The Queen* and *R v XY*). Monash U Law Rev. 2014;40(2):389–412. Interestingly, the Family Court of Australia seems to prefer the Victorian approach, see *McGregor & McGregor* [2012] FamCAFC 69.
57. The NAS Report, 53, concluded that trial safeguards have been 'utterly ineffective' in ensuring the reliability of forensic science evidence. HTCE and this article recognise that skilled cross-examination and judicial instructions have the potential to play important roles in a more rational approach to forensic science. See also Sanders J. Utterly ineffective? Do courts have a role to play in improving the quality of forensic expert testimony? Fordham Urban Law J. 2010;38(2):547–570.
58. See for example *Makita Pty Ltd v Sprowles* [2001] NSWCA 305, [85]; *Hillstead v R* [2005] WASCA 116; *Dasreef Pty Ltd v Hawchar* [2011] 243 CLR 588.
59. Allen RJ, Miller JS. The common law theory of experts: deference or education. Northwestern U Law Rev. 1993;87(4):1131–1147; Brewer S. Scientific expert testimony and intellectual due process. Yale Law J. 1998;107(6):1535–1681.
60. *Davie v Lord Provost, Magistrates and Counsellors of the City of Edinburgh* (1953) SC 34. See also the Goudge Report, at 414–20.
61. *Davie,* 40. See also Ward T. 'A new and more rigorous approach' to expert evidence in England and Wales? Int J Evid Proof. 2015;in press. doi: 10.1177/1365712715591471.
62. *General Electric Co. v Joiner* 522 US 136, 146 (1997).
63. These might be influenced by case exigencies, client instructions, the strategy adopted, technical abilities, resources and the competence of the cross-examiner and tend to vary dramatically between cases. On principle, we should be looking for solutions (or standards) that are less case-dependant and less susceptible to inconsistency.
64. Other examples include the Federal Court of Australia, *Practice Note CM 7: Expert Witnesses in Proceedings in the Federal Court of Australia* and the *Uniform Civil Procedure Rules 2005* (NSW) Schedule 7: Expert Witness Code of Conduct. Schedule 7 applies in criminal proceedings by virtue of Part 75 Rule 3(j) of the *Supreme Court Rules* 1970 (NSW). See also *The Criminal Procedure Rules* (2014) Part 33 (England and Wales).
65. Forensic Evidence Working Group (2014). *Practice notes: Expert evidence in criminal trials.* Retrieved from https://www.countycourt.vic.gov.au/sites/default/files/forms/Practice%20Note%20-%20Expert%20Evidence%20in%20Criminal%20Trials_FINAL%20%28June%202,014%29_0.pdf
66. See The Australian and New Zealand Forensic Science Society Inc. Code of professional practice for members of the ANZFSS: Version 1. 2014. Retrieved from http://anzfss.org/wp-content/uploads/2012/05/ANZFSS-Code-of-Professional-Practice-Final.pdf
67. Code of professional practice for members of the ANZFSS.
68. Here, 'client' should be interpreted broadly, in terms of the various constituencies served by forensic scientists – which include the community and defendants. Regardless of the business models that forensic or police organisations might use, the police and prosecutors are not the forensic practitioner's clients. It is preferable to conceptualise the court as the 'client'; even if only a small proportion of results ever make it into criminal proceedings and the court does not pay for the service. There are a range of undesirable orientations and influences introduced by conceptualising investigators and prosecutors as clients, especially if using a service model.

69. We have not included complainants or victims because these are not special 'clients' but are, along with defendants, part of the community. Interactions and dispositions may create particular difficulties for some types of practice, such as nurses and physicians working in the domain of sexual assault.
70. While experts are generally immune from civil liability in Australia, this is not the case in other common law jurisdictions, see *Jones v Kaney* [2011] UKSC 13.
71. Consider the description of expert witness performance in *Gilham v The Queen* [2012] NSWCCA 131 and the blood and textile evidence in Morling T. Report of the Commissioner: Royal commission of inquiry into the Chamberlain convictions. Canberra, Australia: Government Printer; 1984. More generally, consider the discussion Wynne B. Establishing the rules of law. In Smith R, Wynne B, editors. Expert evidence: Interpreting Science in the law. London, UK: Routledge; 1989, p. 23–55.
72. Consider the certificates and opinions expressed by 'prosecution' experts in NSW in *R v Tang* (2006) 65 NSWLR 681; *Honeysett v The Queen* [2013] NSWCCA 135 and *Morgan v The Queen* [2011] 215 A Crim R 33.
73. The contention that proprietary interests should override the interests or ability of criminal justice actors to obtain access to information has recently been criticised by the Chief Justice of England and Wales. See Lord Thomas, Chief Justice of England and Wales. Expert evidence and the future of forensic science in criminal trials. Speech presented at the Criminal Bar Association Kalisher Lecture; 2014, 14 October.
74. Independence may be difficult to accomplish when there are few, or no other, employees.
75. These may be pronounced where the witness's livelihood depends on the provision of opinions.
76. More generally, see Edmond G. (ad)Ministering justice: expert evidence and the professional responsibilities of prosecutors. U New South Wales Law J. 2013;36(3):921–953.
77. Most forensic practitioners are not able to observe the entire trial.
78. See also Legal Profession Uniform Conduct (Barristers) Rules (2015): 'Rule 4. These Rules are made in the belief that: (a) barristers owe their paramount duty to the administration of justice' and the New South Wales Professional Conduct and Practice Rules 2013 (Solicitors' Rules): '3.1 A solicitor's duty to the court and the administration of justice is paramount and prevails to the extent of inconsistency with any other duty.'
79. *Boucher v The Queen* [1954] 110 CCC 263, 270. See also *Berger v United States* [1935] 295 US 78, 88 and *Whitehorn v The Queen* [1983] 152 CLR 657, 663–664.
80. Office of the Director of Public Prosecutions – New South Wales. (2007). *Prosecution Guidelines of the Office of the Director of Public Prosecutions for New South Wales*. Retrieved from http://www.odpp.nsw.gov.au/docs/default-source/default-document-library/prosecution-guidelines.pdf?sfvrsn=2
81. Legal Profession Uniform Conduct (Barristers) Rules 2015.
82. Obiter in *Velevski v The Queen* [2002] 187 ALR 233, around not needing to disclose and explain limitations with expert evidence, by Gummow and Callinan JJ, appears inconsistent with contemporary Barristers' rules and practice directions, as well as admissibility jurisprudence focused on 'knowledge'.
83. Prosecutors should not treat methodological concerns as trivial and claim that experience or past practice somehow compensate for these deficiencies. In plea bargains, prosecutors and others should not overstate the strength of the evidence against the accused. Similarly, investigators should not do this during formal interviews with suspects, as this may affect the admissibility (or reliability) of any admissions, see UEL s 90.
84. Relatively few of the reports produced by forensic practitioners engaged in non-DNA comparison or pattern recognition are compliant with the terms of practice notes, professional ethical codes or what an impartial expert would disclose.
85. Moreover, it is more likely that limitations (including serious methodological and technical issues) will be seen as trivial or motivated if raised by the defence rather than introduced and explained by the prosecutor.
86. This is analogous to the need for the prosecution to call all material witnesses so they can be cross-examined by the defence. Problems and limitations with forensic science evidence should be raised by the state, so the defence knows about them and can explore them if this is considered appropriate.

87. More is required of prosecutors than other lawyers. They are expected to act in strict conformity with professional duties and legal rules.
88. *Daubert v Merrell Dow Pharmaceuticals Inc* [1993] 509 US 579 and *Tuite v The Queen* [2015] VSCA 148 suggest that the trustworthiness or 'reliability' of forensic science evidence should be demonstrated by evidence of validity.
89. Even consistency with other evidence and apparent plausibility may not be particularly useful here. See Edmond G, Tangen J, Searston R, Dror IE. Contextual bias and cross-contamination in the forensic sciences: The corrosive implications for investigations, plea bargains, trials and appeals. Law Prob Risk. 2014;14(1):1–25. doi: 10.1093/lpr/mgu018.
90. See Cole SA. Suspect identities: a history of fingerprinting and criminal identification. Cambridge, UK: Harvard University Press, 2001; Saks MJ, Koehler JJ. The individualization fallacy in forensic science evidence. Vanderbilt Law Rev. 2008;61(1):199–219; Cole SA. Forensics without uniqueness, conclusions without individualization: The new epistemology of forensic identification. Law Prob Risk. 2009;*8*(3):233–255. doi: 10.1093/lpr/mgp016
91. For example, NAS report.
92. Consider engagement by latent fingerprint examiners Glenn Langenburg and Eric Ray on the Double Loop Podcast: Cross-Examination Part 1 and Cross Examination Part 2: https://soundcloud.com/double-loop-podcast/episode-89-cross-examination-article-part-1 and: https://soundcloud.com/double-loop-podcast/episode-90-cross-examination-article-part-2.
93. In fact, Collaborative Testing Services acknowledges that their tests are not indicative of practitioner performance by including the following disclaimer in every report: 'This report contains the data received from the participants in this test. Since these participants are located in many countries around the world, and it is their option how the samples are to be used (e.g. training exercise, known or blind proficiency testing, research and development of new procedures, etc.), the results compiled in the Summary Report are not intended to be an overview of the quality of work performed in the profession and cannot be interpreted as such. The Summary Comments are included for the benefit of participants to assist with maintaining or enhancing the quality of their results. These comments are not intended to reflect the general state of the art within the profession.' (http://www.ctsforensics.com/assets/news/3424_Web.pdf. See also Tangen JM, Cole SA, Vokey JR. On the preliminary psychophysics of fingerprint identification. Q J Exp Psychol. 2009;62(5):1023–1040. doi: 10.1080/17,470,210,802,372,987; Thompson MB, Tangen JM, McCarthy DJ. Expertise in fingerprint identification. J Forensic Sci, 2013;58(6):1519–1530. doi: 10.1111/1556–4029.12203.
94. See, for example, UEL ss 55, 56, 79(1), 135, 137.
95. See, for example, *Fitzgerald v The Queen* [2014] HCA 28.
96. There is a paucity of tests that benchmark examiner performance against the population at large reported in the scientific literature, but those that do exist show significant variability in the accuracy of judgments from one trained examiner to the next. See Ulery BT, Hicklin RA, Buscaglia J, Roberts MA, Fienberg SE. Accuracy and reliability of forensic latent fingerprint decisions. Proc Nat Acad Sci USA. 2011;108(19):7733–7738. doi: 10.1073/pnas.1018707108; White D, Phillips PJ, Hahn CA, Hill M, O'Toole AJ. Perceptual expertise in forensic facial image comparison. Proc Roy Soc B: Bio Sci. 2015;282(1814): 1–8. doi: 10.1098/rspb.2015.1292.
97. Consider, for example, Wilkinson C, Evans R. Are facial image analysis experts any better than the general public at identifying individuals from CCTV images? Sci Just. 2009;49(3):191–196. doi: 10.1016/j.scijus.2008.10.011; Birch I, Raymond L, Christou A, Fernando MA, Harrison N, Paul F. The identification of individuals by observational gait analysis using closed circuit television footage. Sci Just. 2013;53(3):339–342. doi: 10.1016/j.scijus.2013.04.005; Birch I, Vernon W, Burrow G, Walker J. The effect of frame rate on the ability of experienced gait analysts to identify characteristics of gait from closed circuit television footage. Sci Just. 2014;54(2):159–163. doi: 10.1016/j.scijus.2013.10.002.
98. See *Honeysett v The Queen* [2014] HCA 29. Policy decisions should be informed by a range of insights, including studies on the performance of laypersons with statistics and probabilities. Cf *Aytugrul v The Queen* [2012] 247 CLR 170.
99. Where publication in scientific periodicals is not possible, studies should be reported, and made available, on institutional websites.

100. For a discussion of the risks and benefits of using 'insiders' vs 'outsiders' to review expert practices, see Greenhalgh T. How to read a paper: the basics of evidence-based medicine, 5th ed. Chichester, UK: Wiley-Blackwell; 2014, and sources cited therein.
101. Practitioners and technicians should be able to identify and refer to relevant validation studies and be aware of issues with human factors. See, for example, NIST Report, Recommendation 6.3: 'A testifying expert should be familiar with the literature related to error rates. A testifying expert should be prepared to describe the steps taken in the examination process to reduce the risk of observational and judgmental error. The expert should not state that errors are inherently impossible or that a method inherently has a zero error rate.'
102. See some of the examples in Cole SA. A cautionary tale about cautionary tales about intervention. Organisation. 2009;16(1):121–141. doi: 10.1177/1,350,508,408,098,925.
103. Tangen JM. Identification personified. Aust J Forensic Sci. 2013;45(3):315–322. doi: 10.1080/00450618.2013.782339.
104. On fingerprints, see Donaldson SI, Berger DE, Pezdek K (eds). Applied psychology: new frontiers and rewarding careers. Philadelphia, PA: Psychology Press; 2006; Tangen JM, Thompson MB, McCarthy DJ. Identifying fingerprint expertise. Psychol Sci. 2011;22(8):995–997. doi: 10.1177/0,956,797,611,414,729; Busey TA, Parada FJ. The nature of expertise in fingerprint examiners. Psychon Bull Rev. 2010;17(2):155–160. doi: 10.3758/PBR.17.2.155; Dror IE, Charlton D, Péron AE. Contextual information renders experts vulnerable to making erroneous identifications. Forensic Sci Int. 2006;156(1):74–78. doi: 10.1016/j.forsciint.2005.10.017; Erlikhman G, Ghose T, Garrigan P, Mnookin JL, Dror IE, Charleton D, Kellman P. Fingerprint matching expertise and its determinants. J Vision. 2013;13(9):51–51. doi: 10.1167/13.9.51. On faces, see for example Kemp RI, Towell N, Pike G. When seeing should not be believing: photographs, credit cards and fraud. Appl Cognitive Psych. 1997;11(3):211–222; White D, Kemp RI, Jenkins R, Matheson M, Burton AM. Passport officers' errors in face matching. PloS one. 2014;9(8):e103510. doi: 10.1371/journal.pone.0103510; Burton AM, Kramer RS, Ritchie KL, Jenkins R. Identity from variation: Representations of faces derived from multiple instances. Cognitive Sci. In press.
105. The word 'rationally' is taken from the meaning of relevance in the Uniform Evidence Law, ss 55, 56.
106. Some procedures and forms of reporting have been abandoned altogether. Consider the recent treatment of bullet lead comparison, bite marks, and microscopic hair comparisons, for example: National Research Council. Forensic analysis weighing bullet lead evidence. Washington, DC: National Academies Press; 2004; and Federal Bureau of Investigation, Department of Justice. FBI/DOJ microscopic hair comparison analysis review. n.d. Retrieved from https://www.fbi.gov/about-us/lab/scientific-analysis/fbi-doj-microscopic-hair-comparison-analysis-review.
107. The fact that any error rate will be somewhat artificial, and might not capture the precise conditions of the analysis is not an excuse. Awareness of this issue did not prevent the NAS and other groups insisting that these should be determined and disclosed: NAS Report, 184, 122.
108. Moreover, in many comparison practices, expertise inheres in the analyst rather than these other things, even if they may enhance performance.
109. Faigman DL, Monahan J, Slobogin C. Group to individual (G2i) inference in scientific expert testimony. U Chicago Law Rev. 2014;81(2):417–480.
110. The lack of research might prevent appropriate qualifications being made.
111. More generally, how much better than a layperson should an 'expert' typically perform before the various risks and dangers associated with expert opinions are imposed on the trial? This is a policy issue that warrants consideration by appellate courts.
112. Faigman DL, Monahan J, Slobogin C. Group to individual (G2i) inference in scientific expert testimony. U Chicago Law Rev. 2014;81(2):417–480.
113. Edmond G, Thompson MB, Tangen JM. A guide to interpreting forensic testimony: scientific approaches to fingerprint evidence. Law Prob Risk. 2014;13(1):1–25. doi: 10.1093/lpr/mgt011.
114. The 'Guide' is obviously dated in the sense that it will require modification and revision.

115. Edmond G, Thompson MB, Tangen JM. A guide to interpreting forensic testimony: scientific approaches to fingerprint evidence. Law Prob Risk. 2014;13(1):1–25. doi: 10.1093/lpr/mgt011. In many cases a 2 × 2 table will provide a useful indication of the proportion of correct results and incorrect results and the incidence of different types of errors in specific processes, thereby providing a useful means of approaching the assessment of a particular result.
116. See NAS Report, 142; The Fingerprint Inquiry, Recommendations 1 and 3; NIST Report, Recommendation 3.7; Campbell A. The Fingerprint Inquiry Report. Edinburgh, Scotland: APS Group; 2011 ['Fingerprint Inquiry Report'].
117. This applies to latent fingerprints, DNA evidence, ballistics and so on.
118. The Netherlands Forensic Institute is one of the few to openly acknowledge errors in biological trace analysis, with publication of department-wide error rates: Sjerps M, Quak A, Kloosterman A. Error rates in forensic DNA analysis: definition, numbers, impact and communication. Forensic Sci Int Genetics. 2014;12(1):77–85. doi: 10.1016/j.fsigen.2014.04.014. The explicit recognition of both method-based and human-derived errors and their impact on the accuracy of opinions provided across ~450,000 analyses provides empirical data for courts to judge the reliability of DNA results from their laboratory. Although the authors acknowledge that the translation from an academic discussion around general error rates to application for specific cases is problematic, guidance is provided to courts and investigators around errors, and how to request case-specific error analysis.
119. Practitioners might give reasons why they are confident, but in most cases they cannot be certain that a mistake has not been made.
120. For example, Kohn LT, Corrigan JM, Donaldson MS (eds). To err is human: building a safer health system. Washington, DC: National Academies Press; 2000. Retrieved from http://www.nap.edu/read/9728/chapter/1#v.
121. Sometimes error might enable the jury to accommodate inconsistent evidence such as alibis. Consider Vincent FHR. Report: inquiry into the circumstances that led to the conviction of Mr Farah Abdulkadir Jama. Victoria, Australia: Victorian Government Printer; 2010.
122. This is not how most 'peer review' operates within forensic science institutions.
123. There is a large literature about peer review and its limitations in relation to biomedical publication. See, for example, the discussion of peer review and publication in civil litigation in Edmond G. Judging the scientific and medical literature: some legal implications of changes to biomedical research and publication. Oxford J Legal Studies. 2008;28(3):523–561. doi: 10.1093/ojls/gqn021.
124. Comprehension of reports and testimony is a separate, though obviously related, issue that requires the input of judges and cognitive scientists. Forensic scientists should not second-guess what courts might like, unless these have been negotiated based on evidence.
125. See, for example, *R v Tang* [2006] 65 NSWLR 681 and *R v T* [2010] EWCA Crim 2439.
126. See, for example, Kaufman F. Report of the Kaufman Commission on proceedings involving Guy Paul Morin. Toronto, Canada: Queens Printer; 1998. See also NIST Report, 128 and NRC Report, 185; Goudge Report, 433–35. See also McQuiston-Surrett D, Saks MJ. The testimony of forensic identification science: what expert witnesses say and what factfinders hear. Law Human Behav. 2009;33(5):436–453. doi: 10.1007/s10979–008-9169–1; Martire KA, Kemp RI, Newell BR. The psychology of interpreting expert evaluative opinions. Aust J Forensic Sci. 2013;45(3):305–314. doi: 10.1080/00450618.2013.784361.
127. On 'opinionisation', see Cole SA. The 'opinionization' of fingerprint evidence. BioSocieties. 2008;3(1):105–113. doi: 10.1017/S1745855208006030.
128. Concerns about human factors featured prominently in the NAS report, the NIST Report, the Fingerprint Inquiry Report and their recommendations.
129. But even these can be difficult as practitioners do not always agree on sufficiency or quality or the number of contributors.
130. See Edmond G, Tangen JM, Searston RA, Dror IE. Contextual bias and cross-contamination in the forensic sciences: the corrosive implications for investigations, plea bargains, trials and appeals. Law Prob Risk. 2014;14(1):1–25. doi: 10.1093/lpr/mgu018.
131. Krane DE, Ford S, Gilder JR, Inman K, Jamieson A, Koppl R, … Thompson WC. Sequential unmasking: a means of minimising observer effects in forensic DNA interpretation. J Forensic Sci. 2008;53(4):1006–1007. doi: 10.1111/j.1556–4029.2008.00787.x. It is

important to emphasise that we are not suggesting that everyone needs to be blinded. Rather, it is just the practitioner undertaking the analysis and perhaps any reviewers. Forensic science institutions can manage contextual bias, especially suggestion, through managers (or practitioners) determining what needs to be examined and what needs to be known by others in order to undertake rigorous analysis. Those regulating access to information are known colloquially as 'puppet masters'.

132. In the Goudge Report the commissioner did not recommend, for example, that forensic pathologists should be blinded, but the report does not appear to fully grasp the seriousness of the problems. Compare, for example, Dror IE, Charlton D, Péron AE. Contextual information renders experts vulnerable to making erroneous identifications. Forensic Sci. Int. 2006;156(1):74–78. doi: 10.1016/j.forsciint.2005.10.017.
133. See Edmond G, Tangen JM, Searston RA, Dror IE. Contextual bias and cross-contamination in the forensic sciences: the corrosive implications for investigations, plea bargains, trials and appeals. Law Prob Risk. 2014;14(1):1–25. doi: 10.1093/lpr/mgu018; Cunliffe E. Murder, medicine & motherhood. Oxford, UK: Hart Publishing; 2011. Double-counting may occur when the same information informs the 'expert' interpretation and is also presented to the tribunal of fact as independent evidence for them to consider. The evidence might be counted twice, and often the tribunal will be oblivious to the fact that the information might have influenced (perhaps inappropriately or inadvertently) the 'expert' opinion. Examples include a fire investigator knowing about a recent rise in insurance cover when trying to determine the cause of a fire, or a forensic pathologist knowing about enmity between a married couple or the demographics of parents when examining the body of a wife or child, to determine cause of death.
134. The published literature offers many suggestions for institutional processes to reduce the risks of bias. See for example Dror IE, Thompson WC, Meissner CA, Kornfield I, Krane D, Saks MJ, Risinger M. Context management toolbox: a linear sequential unmasking (LSU) approach for minimising contextual bias in forensic decision-making [Letter to the editor]. J Forensic Sci. 2015;60(4).
135. See Found B, Edmond G. Reporting on the comparison and interpretation of pattern evidence. Aust J Forensic Sci. 2012;44(2):193–196. 10.1080/00450618.2011.644260. The NAS, NIST and Goudge reports all list the kinds of information that should be included in an expert report. See the discussion in Edmond G. What lawyers should know about the forensic 'sciences'. Adelaide Law Rev. 2015;37(1):33–99.
136. See Sections 3.2 and 3.3 and the codes and practice directions discussed there.
137. *Davie v Lord Provost, Magistrates and Counsellors of the City of Edinburgh* [1953] SC 34.
138. Reports should also document what the forensic practitioner was told or exposed to and what was requested. This should include information passed during informal exchanges and inadvertently.
139. Institutions should focus on whether expert reports are consistent with expectations and formal legal requirements. Similarly, testimony should occasionally be independently reviewed to determine if what was said in court is consistent with the report and what is known.
140. We note that many standards (e.g. ISO 17,025) operate at a very general level, though they do impose the need for some, historically weak, accreditation. Surprisingly few expert reports are compliant with relevant Australian standards and even Codes of Conduct and Practice Notes.
141. Significantly, those with formal university training, especially advanced degrees in the sciences, are best placed to undertake formal evaluation through validation.
142. See for example White D, Kemp RI, Jenkins R, Matheson M, Burton AM. Passport officers' errors in face matching. PloS one. 2014;9(8):e103510. doi: 10.1371/journal.pone.0103510.
143. Consider the following extract, taken from the NAS Report, 184: 'All results for every forensic science method should indicate the uncertainty in the measurements that are made, and studies must be conducted that enable the estimation of those values. … the accuracy of forensic methods resulting in classification or individualization conclusions needs to be evaluated in well-designed and rigorously conducted studies. The level of accuracy of an analysis is likely to be a key determinant of its ultimate probative value.'
144. Recent reforms add 'sponsors' and 'stakeholders' to management committees, but there appears to be no substantial injection of funds and few references to research in the new organisational arrangements and revised business plans.

145. Australian and New Zealand police agencies have, to their credit, been the only organisations willing to fund the Australian NIFS. Significantly, embedding NIFS within policing organisations has come at the cost of: modest funding; limited independence from police; difficulty advocating reform; and insufficient attention to the need for research and sponsoring research.
146. The US government has established an elaborate structure, under the auspices of NIST, to undertake improvements following the NAS report.
147. See for example Edwards HT. Solving the problems that plague the forensic science community. Jurimetrics. 2009;50(1):5–19.
148. Consider Edmond G. Advice for the courts: a multidisciplinary advisory panel? Int J Evid Proof. 2012;16(3):263–297. Compare the not particularly critical report prepared by the NIJ, just a decade before the NAS Report: National Institute of Justice. Forensic sciences: review of status and needs. Gaithersburg, MA: US Department of Justice; 1999. Retrieved from https://www.ncjrs.gov/pdffiles1/173412.pdf
149. See the informative discussion in Lynch M, Cole SA. Science and technology studies on trial: dilemmas of expertise. Soc Stud Sci. 2005;35(2):269–311. doi: 10.1177/0,306,312,705,048,715; Cole SA. A cautionary tale about cautionary tales about intervention. Organisation 2009;16(1):121–141. doi: 10.1177/1,350,508,408,098,925. We should not forget that fairly weak performances around the early processing, analysis and reporting of DNA profiling evidence led to two National Research Council reports. See Kaye D. DNA and the law of evidence. Cambridge, MA: Harvard University Press; 2011.
150. See *United States v Haavard* [2000] 117 F. Supp 2d 848. Contrast *Kumho Tyre Co v Carmichael* [1999] 526 US 137.
151. Consider the treatment of the use of similarities in the case of Splatt, substantially criticised in Shannon CR. Royal commission of inquiry in respect to the case of Edward Charles Splatt. Adelaide, Australia: Government Printer; 1984.
152. The Canadian Supreme Court recognised that previous admission, and longstanding practices, should not insulate procedures from review in *R v Trochym* [2007] 1 SCR 290, [31]. See also Leveson B. Review of the Effectiveness of Criminal Justice. London: Judiciary of England and Wales; 2015.
153. Ho HL. A philosophy of evidence law: Justice in the search for truth. Oxford, UK: Oxford University Press; 2008.
154. Where forensic practitioners become aware of a mistake, or generate a misleading or mistaken impression in their report or testimony, even if it was not their fault, they have a responsibility to correct it. In relation to testimony they can do the following: (a) ask the judge if they might supplement a response, at the time, in order to clarify the answer (or avoid giving a partial or misleading impression); (b) indicate to the judge, after testifying (though before standing down), that there is an issue that should be raised in the absence of the jury. When the jury has left, the practitioner can raise their concern with the judge and lawyers present; and (c) after leaving the witness box, draw the attention of the solicitor or prosecutor to the issue. (Forensic practitioners might be advised to generate and retain a documentary record of any exchange – e.g. capture the substance of any communication in an email to the solicitor and prosecutor).
155. Consider the treatment of Joy Kuhl in Morling T. Report of the Commissioner: Royal commission of inquiry into the Chamberlain convictions. Canberra, Australia: Government Printer; 1984; Dr Wallace on gunshot residue in Martin B. Inquiry into the Conviction of David Harold Eastman for the Murder of Colin Stanley Winchester, 2014, and *Eastman v DPP (ACT) [No 2]* [2014] ACTSCFC 2; Associate Professor Cross in *Wood v R* [2012] NSWCCA 21; Dr. Lawrence in *Gilham v R* [2012] NSWCCA 131; and Dr Manock in *Keogh v R (No 2)* [2014] SASCFC 136. Imagine being summoned by a court of appeal or a royal commission, reviewing a (perhaps mistaken) conviction, to be cross-examined on a report you wrote a decade ago. The ability to point to genuine attempts to properly characterise the evidence and its limitations based on what was known would be of tremendous value in such a setting.
156. See for example *Tuite v The Queen* [2015] VSCA 148.
157. Contrast the English approach in *R v Atkins* [2009] EWCA Crim 1876, discussed in Edmond G, Kemp RI, Porter G, Hamer D, Burton M, Biber K, San Roque M. *Atkins v The Emperor*: The "cautious" use of unreliable "expert" opinion. Int J Evid Proof. 2010;14(2):146–166.

158. Edmond G. Forensic science evidence and the conditions for rational (jury) evaluation. Melbourne U Law Rev. 2015;e(1):77–127.
159. It is likely that losses will primarily manifest in what can be said, and a clearer appreciation of the need for more research in many areas of forensic science and medicine routinely admitted and relied upon in criminal proceedings.
160. Concerns and recommendations from public inquiries are not necessarily incorporated into contemporary legal practice and consciousness. Consider Morling T. Report of the Commissioner: Royal commission of inquiry into the Chamberlain convictions. Canberra, Australia: Government Printer; 1984; Shannon CR. Royal commission of inquiry in respect to the case of Edward Charles Splatt. Adelaide, Australia: Government Printer; 1984.
161. Other examples might relate to the cause of an injury or death.
162. Edmond G, Roberts A. Procedural fairness, the criminal trial and forensic science and medicine. Sydney Law Rev. 2011;33(3):359–394.
163. The defence does not usually have access to expert advice. And, preliminary analyses suggest that calling a rebuttal expert is not a particularly effective means of countering misrepresented and exaggerated forensic science evidence at trial.
164. The Australian and New Zealand Forensic Science Society Inc. Code of professional practice for members of the ANZFSS: Version 1; 2014. Retrieved from http://anzfss.org/wp-content/uploads/2012/05/ANZFSS-Code-of-Professional-Practice-Final.pdf. See Appendix 1.

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Appendix 1. Code of professional practice for members of the ANZFSS

Preamble

The forensic sciences and related disciplines utilise knowledge and experience to enhance the welfare and safety of all members of the community without discrimination or prejudice, treating all with respect, honesty, equality and integrity. Forensic practitioners display technical, scientific and professional understanding in the application of their profession and continually develop their knowledge and skills throughout their working careers. A professional code of practice is required to formalise how forensic practitioners meet these obligations. A professional must also meet any legal or workplace standards and codes of conduct.

Principles

The key principles which assist forensic practitioners meet their professional roles and responsibilities are embodied in four obligations, these being:

- to society
- to the Justice system
- to clients and/or employers, and,
- general professional obligations.

1. Obligations to Society …

1.2 Act with honesty, integrity, fairness and without discrimination

Forensic practitioners must act with honesty, integrity, fairness and without unlawful discrimination.

2. Obligations to Clients and Employers

2.1 Act truthfully, objectively, and not mislead people, nor engage in misrepresentation, including through omission

Forensic practitioners must act truthfully and objectively, and not knowingly provide misleading information, statements, reports, opinions or evidence, nor knowingly misrepresent a situation.

Forensic practitioners must never misrepresent credentials, education, training, experience or membership status.

2.2 Disclosure includes

Forensic practitioners must disclose actual or possible conflicts of interest to a client or employer upon discovery of that actual, potential or perceived, conflict of interest. Conflicts of interest will include any financial or other interest that is likely to affect, or appear to affect, the forensic practitioner's judgement. …
Disclosure includes:

- forensic practitioners have an overriding duty to the court and justice system for disclosure. Client confidentiality is important but should not to be an excuse for non-disclosure. Where a forensic practitioner believes they are being inhibited from appropriate disclosure they should: seek explicit authorisation by the client to disclose specified information

2.3 Examinations and analyses

A forensic practitioner must:

- examine and analyse the evidence in a case provided to them in a manner proportionate to the nature of the case
- conduct and document all examinations and analysis using established protocols and fit-for-purpose or validated methods
- render opinions having a basis that is demonstratively valid
- not withhold any findings, where inculpatory or exculpatory, that would cause the facts of a case to be misrepresented or distorted, and,
- disclose or make available test methods if requested.

3. General Professional Obligations

3.1 Apply knowledge, skill and judgement

Forensic practitioners must bring knowledge, skill, judgement and care that are of a standard which might reasonably be expected by the public by relevant professional peers, or as determined by formal standards.

3.2 Not engage in professional misconduct, fraudulent, or dishonest behaviour

Forensic practitioners must not:

- engage in misconduct in a professional respect, or,
- engage in fraudulent or dishonest behaviour in their forensic practice.

3.3 Communicate with fairness, honesty, and adequate knowledge

Forensic practitioners must, both orally and in writing, express opinions, make statements, or give evidence with fairness, honesty, and only on the basis of adequate knowledge. …

3.4 Work within areas of competence and not misrepresent competence

Forensic practitioners must:

- undertake forensic services only within their area of competence
- not misrepresent their competence, and,
- not knowingly permit forensic practitioners whose work they are responsible for to breach the above obligations. …

Examples of not misrepresenting competence in an area of practice include:

- fully informing the client as to any limitations or legitimate concerns that a forensic practitioner might have with regard to their competence relevant to the client's specific instructions, and/or,
- if competence is not fully established, organising for a person competent in the area to provide supervision of or advice to the forensic practitioner in relation to the task. …

3.5 Continue to develop knowledge, skills and expertise

Forensic practitioners must:

- continue to develop relevant knowledge, skills, and expertise throughout their careers
- actively assist and encourage those with whom they are associated to do likewise, and,
- seek to meet Continuing Professional Development (CPD) requirements appropriate to their discipline and role[164]. Appendix 1.