A Discussion of Current and Future Issues Relating to the Use of Forensic DNA Evidence

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Introduction

After presenting a review of the legal literature recently (Walsh, in press), I was asked why circumspect critiques of forensic biology were not as common in the forensic literature as they were in the literature of other disciplines.[1] Several practical reasons sprang to mind related to the young age of our discipline and the burdens of casework delivery. Notwithstanding these possible reasons, the current status of the field could be seen as an ideal juncture to review our forensic contribution, learn the lessons of the past, and turn a strategic eye to future developments and pre-empt their likely impact (Walsh, Ribaux, Buckleton, & Roux, 2004).

Undoubtedly, the role of the forensic biologist in the criminal justice system has changed, as, of course, it will continue to in the future. This change is predominantly due to the impact of several developments that have expanded the use of the technology, amended the casework and evidence submission profiles, and increased the demands on practitioners and laboratories. These include the following:

- A considerable increase in the volume of testing required and a change in the submission profile of the cases and the associated evidence
- A considerable increase in the use of DNA databases
- A groundswell to move DNA typing (along with other forms of forensic evidence) forward in the chain of events so that it functions more effectively as part of the investigative domain
- Strong feelings (in contrast to the previous point) that forensic applications should be completely isolated from neighbouring domains of the criminal justice system
- A diversifying technological platform that is extending into areas beyond identification

Although these developments have emerged as logical extensions of the use of forensic DNA profiling, their implementation has not always been closely scrutinised. In some way, each development is linked to the manner in which forensic DNA evidence is utilised and presented in court. As a result, some have emerged as concerns in court cases in Australia and overseas. The following discussion offers a concise inventory of issues currently facing forensic biology. It is written to encourage the forensic community to realise the significance of some of these factors and take ownership for their manr nent and control. This encouragement is premised on

the fact that we are best positioned to accept these challenges and respond to them in such a way that will advance our field and thereby benefit the justice system.

Changing Volume and Submission Profile of Casework

While the contribution of forensic DNA evidence has increased in the past 5 to 10 years, the increased volume of casework and the alteration in the nature of core evidence types are associated with a series of accompanying pressures. In summary, staff must cope with greater personal expectations in terms of their casework output, in the context of more complex technical and interpretative challenges that are commonly associated with discrete evidence types (e.g., low copy number templates). Frequently, laboratories have been unable to cope with the rising volume of casework. Many jurisdictional centres in Australia and overseas have accrued casework backlogs that have in turn brought delays in the presentation of DNA evidence in court. In some circumstances, trials have had to proceed without any DNA evidence at all.

From a scientist's perspective, this operational environment can cause considerable stress and pressure. This, in turn, can heighten the potential for error; compromise the ability to adequately prepare personally for court testimony; leave insufficient time for research, training, and professional development; or diminish the emphasis on best-practice models that may be seen as incurring unmanageable commitments of staff time. Another potential consequence of an excess workload is that it could encourage a generation of scientists or a professional culture that is conditioned to focus specifically on output at the expense of genuine expertise. An environment that is streamlined to respond only to core-business demands and necessitates energy and aptitude more than deliberate, expert reasoning is perhaps ill-suited to the intrinsic scrutiny that is a precept of the justice system.

Of course, this reality is undesirable, but it is also a reality that has evolved through the continued success of this forensic discipline and the personal contributions of those administering or practising within it. As a result, one must be careful not to complain incessantly about it but rather to encourage the necessary changes to the process. These needs can differ for different jurisdictions but may be resource-based or problems of culture or competence.

The Increasing Use of DNA Databases

The increase in case volume has been catalysed largely by the introduction of DNA databases. In addition, there has also been an alteration to the types of crimes and evidence submitted for biological analysis. In particular, some of the trends include the following:

- Increased submission of evidence from "high-volume" crimes such as burglary, vehicle theft, robbery, and drug offences (Harbison, Hamilton, & Walsh, 2001)
- Increased submissions of discrete evidence types such as swabs from touched surfaces (referred to hereinafter as "trace DNA") (Raymond, Walsh, van Oorschot, Gunn, & Roux, 2004), swabs from drinking containers (Abaz et al., 2002), or food remnants and cigarette butts (Walsh & Moss, 2001)
- Increased submission of evidence types such as those listed above, which may have a lower probative value than traditional forms of biological evidence such as blood and semen
- Increased submission of cases and evidence in circumstances in which there is a lack of any other supporting evidence (i.e., when DNA evidence stands alone as a supportive aspect of a particular proposition)

In response to both the growing volume and the changing nature of submissions, laboratories have faced an increasing need to streamline their practices in an attempt to gain efficiency where possible. A practical consequence of this is a reduced likelihood that a reporting scientist will have actually had a role in the technical analysis of the samples themselves. This is not unusual in many forms of laboratory analysis, and the practice is commonplace in forensic laboratories from around the world; however, gains in the efficiency of the laboratory process are not the only concern when it comes to forensic work.

The courts require expert evidence to satisfy an array of criteria based upon the Evidence Acts and their case law derivatives. In two recent Australian cases, evidence generated from a streamlined analytical or reporting process was deemed unsuitable for use in criminal proceedings. In *R v. Sing* (2002), the New South Wales Court of Criminal Appeal considered this trend of analysis and reporting from the perspective of the "hearsay" rule. In *Sing*, the question as to whether under such circumstances the evidence of a witness involves hearsay or is based on hearsay was not ultimately resolved. Of more importance was the failure of the Crown to fulfill its obligation to "present all available witnesses of events alleged to constitute the offence and of essential parts of the prosecution case, unless there is some justification for not doing so" (Hodgson JA at paragraph 35, to which Levine and Howie JJ agreed). This was held to be of particular relevance in this case due to the compelling nature of the DNA as identification evidence. In explaining the court's reasons, Hodgson JA stated (to which Levine and Howie JJ agreed),

> If this court were free to speculate about the matter, one might speculate that there is only a very small probability that there was error in the carrying out of the tests, or that a significant possibility of error could be demonstrated to a jury either by cross-examination or evidence. However, for reasons I have given, I think this was a serious gap in the prosecution case, and I do not think this court should speculate about the matter. I do not think this court can be certain that the appellant has not lost a realistic chance of either having the DNA material excluded, or at least significantly weakened. (at paragraph 38)

Similar issues were highlighted in *R v. Ryan* (2002) in which the Supreme Court of Victoria Court of Appeal found that the Crown had failed to establish the facts or continuity of evidence upon which the forensic DNA expert opinion was based. In so ruling and ordering that a verdict of acquittal be entered, Ormiston, Vincent, and Eames JJA state, "In the present matter, the prosecution simply failed to adduce any admissible evidence whatever in relation to what was in effect the single issue before the jury" (at paragraph 12).[2] Unfortunately, the appeal in *Ryan* came 2 years after the defendant had first been incarcerated and as such could legally be viewed as an inappropriate conviction involving the presentation of DNA evidence. Although the evidenc ··self was not at issue, the manner in which it is obtained

and reported is at the heart of both *Ryan* and *Sing*. These rulings should alert the forensic and prosecutorial sectors. From a forensic perspective, there is the challenge to ensure that we understand the needs of the courts as well as our scientific domain. Streamlined laboratory practices may be resource- and time-efficient; however, if they lead to evidence of unsuitable quality, then they are of little ultimate value to the justice system.

The changing nature of the submitted DNA evidence from traditional sources, such as blood and semen, to more discrete evidence types, such as trace DNA and discarded items (e.g., drinking containers, cigarette butts, etc.), has an associated effect on the probative value of such evidence. This can indirectly place the scientist in a more difficult position. This is particularly true in the interpretative areas in which the questions focus on the link between any recovered DNA evidence and the actions or activities alleged to have taken place in a criminal event. These are, of course, the areas that are the primary concern of the courts, as they often contribute to resolving pivotal issues such as culpability or intent. In evaluating these sorts of evidential ambiguities, a forensic witness would routinely turn to a body of experimental data (e.g., the population data and statistical research that underpins likelihood ratio calculations) and interpret the current findings in the context of this empirical information. There are two challenges of working with discrete evidence sources: (1) ambiguities relating the source of the deposit, the duration it has been in the location it was recovered from, and the mechanism by which it was deposited remain unanswerable and (2) where experimental data exists, it is as yet inconclusive and may never adequately address the myriad of potential propositions that could be advanced to explain the origins of a sample of trace DNA evidence. When these limitations (and this is all that they can be seen to be) of the DNA evidence are brought before a court, they are often met with concern and/or alarm by members of the judiciary or the jury. This may be related to the perceived "aura of certainty" that has been said to precede DNA evidence when it is placed in the legal or public domain (Corns, 1992).

A recent example of an adverse reaction to this issue occurred in the Supreme Court of the Northern Territory (Criminal) where trace DNA evidence was excluded in *R v. Joyce* (2002) on the basis that the probability of innocent secondary transfer could not be adequately assessed. In *Joyce*, the complainant (a 14 year-old boy) had slept at the home of the accused, in clothes that were later included as evidence. DNA profiles located on the clothes matched the DNA of the accused; however, this was deemed to be inconsequential as the clothing was known to have contacted "furniture, floors or carpets at the accused place of residence" (at paragraph 3). This potentially innocent explanation for the presence of the DNA results was obviously contrary to the prosecution hypothesis. The fact that the Crown had not adequately countered this alternate hypothesis, "nor laid any scientific basis for preferring one hypothesis over another" (at paragraph 5) led Angel J to conclude (at paragraph 8), ". . . there is no reliable foundation upon which a jury could properly assess the explanation for the presence of the accused's DNA on the complainant's clothing . . . The evidence is thus of no probative value and therefore inadmissible as proof of guilt."

The ruling in *Joyce* highlights difficulties alluded to earlier and may also indicate that forensic DNA research is guilty of focusing too heavily on technological aspects of the process, to the neglect of helpful criminalistic features associated with transfer, persistence, and abundance.

The increasing use of DNA intelligence databases also has the effect of incorporating DNA evidence in cases in which there is a lack of other supporting evidence. This is particularly true for "historic" cases, which are submitted for DNA analysis as "cold cases" in the hope of re-invigorating unsolved investigations ("Using DNA," 2002). In many circumstances (e.g., numerous post-conviction DNA cases examined in the United States), the probative value of the DNA link may be unequivocal. In some circumstances, however, the probative link will be of a more tenuous nature. This may be a source of pressure for a forensic scientist. It is important, given the often high-profile nature of this kind of testing, to reinforce once more that DNA remains an item of physical evidence only and is not in itself proof of guilt or innocence. In this regard, it is scientists who must ensure that the wrong impression of the potential strength of the evidence is not propagated by those wishing to inflate or denigrate its potential. A failure to engender this understanding will only increase pressure on witnesses and foster unreasonable expectations on the part of police, prosecutors, and the public.

Another future aspect of DNA evidence, which is related both to the use of DNA databases and a common misunderstanding on behalf of members of the public, is the likely event of adventitious matches.[3] As the size of DNA databases increase, the likelihood of an adventitious match between unrelated individuals also increases (Walsh & Buckleton, 2004). In fact, adventitious matches (at 6 STR loci) have already been identified in countries with very large databases, such as the UK (Samuel, 2001) and in countries where the existence of duplicate profiles are examined and investigated, such as New Zealand (Walsh et al., 2002). Forensic scientists need to firstly understand in detail the meaning of the match statistics that they calculate and report so as not to mislead the courts or public unduly with regard to the strength of the evidence. Secondly, the propensity for adventitious DNA matches to occur with DNA databases at some time in the future must be understood, and appropriate strategies should be devised to inform people during what will without doubt be a time of some confusion and misplaced concern about the integrity of the DNA database system.

A final point that forensic scientists must consider in relation to the use of forensic DNA databases is the increased need for awareness of relevant sociolegal issues. In a practical context, DNA-based legislation represents an additional level of governance for forensic professionals, and one of the first pieces of law that places direct requirements on the manner in which they undertake their professional work. In addition, it prescribes sanctions for individuals or institutions who contravene the administrative processes detailed in these laws. Fervent debate has continued on many of the issues associated with the use of forensic DNA profiling in the criminal justice system, and this debate has now expanded to encompass applications of the scientific process that are primarily the responsibility of the forensic community. Unfortunately, the forensic community has remained largely mute in this discussion. As such, it has been dominated by a generalist tone that is abstract from the practical context. Notwithstanding this, forensic professionals (and particularly the administrators of forensic institutions) would do well to acquaint themselves with these issues and enter the existing debate. Failure to do so could mean that the direction for the application of our scientific tools will become the responsibility of individuals who are well-removed from the forensic community itself.

Increasing the Use of Forensic DNA Evidence as an Intelligence Tool

Forensic DNA databases have catalyzed a re-think of the role of forensic evidence in the investigative process. Traditionally, forensic DNA evidence has been thought of as information for the use of the court. This has meant that it is usually applied retrospectively, after the police investigation has concluded and a suspect(s) has been identified by other means. The DNA evidence is then used to corroborate (or not) the version of events proposed on the basis of the police investigation. Because of the potential for DNA databases to link cases to individuals, or other cases, on the basis of a common DNA profile, they have been used increasingly as an investigative tool by police as a means to direct the investigation, rather than simply reaffirm its findings.

This is an exciting advance for forensic science and one that allows new potential for using DNA evidence and forensic DNA databases proactively rather than reactively (Walsh, Moss, Kleim, & Vintiner, 2002). More advanced models of what has been termed "forensic intelligence" have successfully integrated DNA evidence fully as part of the investigative and crime analysis response of police, facilitating their ability to detect crime trends and respond in a manner that has an increased likelihood of apprehension (Ribaux & Margot, 1999, 2003; Ribaux et al., 2003). An interesting by-product of this approach, however, is that it relies upon a more intimate relationship between forensic and law enforcement domains. This, in turn, not only alters the stage at which DNA evidence is introduced into an investigation but also the use to which it is put by the police. Critical aspects of useable intelligence, such as timeliness, are not readily achievable by a system that is focused on delivering an extremely high level of precision and discrimination. In addition, should this aspect of the evidence be altered in the interests of integrating DNA results into an intelligence-based framework, any resultant effect on the use to which the DNA evidence can be applied must be clearly communicated to police (i.e., it must be clear if results are provided for intelligence uses only as opposed to evidence uses).

The use of DNA evidence in this way represents a potential for a greater contribution to the resolution of crimes and possibly to crime reduction and prevention strategies. As with other topics discussed earlier, however, it is contingent upon a thorough level of understanding by all participants of the justice system and a thoughtful model of application. At present, the area of forensic intelligence is emerging and remains only partially understood by many in the forensic and law enforcement fields. It is vital that forensic scientists also understand and accept the implications of adopting such a model of operation. That is, they should be comfortable with an operational context that is more purposefully linked to the law enforcement domain, and they should undertake this role as an additional application of DNA evidence and not as a substitute for the highly discriminating level of evidence that is demanded by the criminal courts. This dichotomous application of forensic DNA evidence (should it come to pass) must be purposefully implemented with the full commitment of law enforcement and forensic agencies.

The Call for Fully Isolated and Independent Forensic Laboratory Services

In contrast to the previous point, there has been a continued call for greater segregation of forensic services from police and prosecutorial agencies (Roberts, 1996; Thompson, 1997). This view is premised on the implication, partially supported by some unfortunate examples of misconduct (Starrs, 1988; Giannelli, 1993), that the pressures on a scientist working in a police- or prosecutor-controlled laboratory will compromise their objectivity, either consciously or unconsciously (Saks, Rissinger, Rosenthal, & Thompson, 2003). Thompson (1997) specifically warned of the danger of forensic scientists "adopting the goals of their clients (the law enforcement team) as their own" (p. 1115). Research has supported the assertion that the most significant pressures brought to bear on a forensic expert come from being a witness in the adversarial process (Lucas, 1989; Saks, 1989).

Two points arise from the topic of these discussions:

1. It is misleading to propagate a perception that forensic DNA evidence is inherently unreliable or that forensic experts are inherently incompetent or untrustworthy. This is not the intentions of the previously mentioned articles; however, there is an occasional tendency to perceive them as such. I believe that regardless of the isolated individuals or circumstances that may have contributed to miscarriages of justice—and whether those individuals were practitioners in the legal or scientific domains—we must accept that the issue is a system-wide issue and that the responsibilities for appropriate use of evidence are often inextricably shared. As such, failures of integrity, impartiality, or accuracy must be addressed by the individual domains if necessary, but as part of a system that has some level of overall culpability.

2. It is somewhat redundant to continually cite the context within which our expertise is applied as a source of insurmountable ethical dilemmas. As forensic scientists, we should determine and then advocate the most appropriate means to utilise our scientific expertise. This may well encompass a greater incorporation of intelligence-based approaches, and as such, a greater engagement with the investigative phase of the criminal justice process. If it does, however, this need not occur at the expense of our objectivity or impartiality. Forensic scientists must accept their need to operate (to varying degrees) as a component of the investigatory team and draw the appropriate professional conclusions in order to undertake such a role without compromising the high standards of professional integrity demanded by our justice system and our communities. As with many of the aforementioned points, this is a commitment to an appropriate attitude. One that realises the importance of the role of a forensic scientist, values it, and seeks to contribute purposefully to the resolution to complex problems of criminal justice.

Diversification of the Technological Platform

Technology has played a key part in the expanded use of forensic DNA profiling; however, it has primarily been directed at the issue of identification of source. Most technological effort has focused on enhancing the sensitivity of PCR-based systems, increasing thei scriminating power (through the addition of more

loci), and moving toward higher throughput (aided by robotics and multi-channel electrophoretic devices). Another significant aspect of DNA technology is that it has primarily targeted variation on the noncoding regions of the genome as they provide more informative solutions to the question of identity. Noncoding loci have an added nontechnical advantage in that they do not prescribe physical or personal features of the donor (with the exception of a marker that is routinely typed to infer gender). This feature has been a reassurance to those who are concerned about widespread use of DNA evidence through databases or mass-screens, as it invalidates the notion that forensic DNA testing is linked in any way to the search for the criminal gene or part of some modern form of eugenics (Webb & Tranter, 2001).

This, however, may be about to change. The technological platform upon which DNA profiling is based is not only set to continue its drive toward greater expansion, automation, and miniaturisation, but it is also set to diversify into areas beyond the identification of source (Walsh, Roux, Ross, Ribaux, & Buckleton, 2002). Research is progressing in the identification of markers that can infer phenotypic characteristics of the sample donor (e.g., hair colour and ethnicity) (Grimes, Noakes, Dixon, & Urquhart, 2001; Frudakis et al., 2003). The range of available markers could expand in many directions and provide different forms of useful intelligence for police investigators. Once again, these kinds of developments are best suited to an investigative rather than evidential use. That is because they will always be limited in their conclusiveness and as such should be utilised to simply aid investigative decisionmaking rather than in the legal determination of culpability. They will function more as a categorization rather than an individualization (Inman & Rudin, 2001), assisting police in the reduction of the overall pool of investigative options (suspects), to a smaller, more manageable pool.

As scientific participants in this burgeoning development, the forensic community has a responsibility to manage this technological metamorphosis. Although there will be many members of the community that will see these developments as nothing other than a beneficial advance in the area of law enforcement and crime investigation, there will also be a significant section of the community that will be alarmed by the thought of genetic determination of ethnicity or appearance forming the basis of decisions made by law enforcement personnel. Quite clearly, the key is education and openness. The forensic community must take care to correct unrealistic expectations about the potential for this technology. We must clearly communicate its differences from the established form of DNA evidence, both in the role it will play and the level of certainty it will provide. We must also ensure that the model under which such technology is utilised has been well-considered and supports the most appropriate and beneficial application.

Conclusion

The application of forensic DNA profiling has evolved from a novel specialization to a wide-reaching public tool. Accordingly, discussion and speculation regarding the manner in which DNA evidence is applied has intensified. This expanded role has increased the burden of responsibility borne by forensic scientists. In addition, it has widened the range of issues that have relevance to the use of forensic DNA testing. Many of these issues are neither solely technical in nature nor restricted to the scientific domain; as such, they are beyond the traditional comfort zone of scientists. Nonetheless, they must be understood and confronted. Recently,

scientists to be "multi-skilled," as their role as "educators and communicators was as important as their role as molecular biologists." This is true. In fact, it could be extended further to a requirement for forensic experts to be multi-disciplinarily skilled as many of the previously mentioned complexities have their foundation in law, criminology, and sociology. If scientists are not prepared to acknowledge and accept this professional reality and the associated pressures and demands, then their contribution as expert forensic biologists may be compromised. If we rise to these challenges with the requisite level of professional integrity, commitment, and expertise, however, our contribution to maintaining a functional system of criminal justice will be a significant one.

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Endnotes

[1] Encompassed in the mentioned review is evidence of a lack of cross-publication by the forensic community on issues that abut the legal domain.

[2] Of additional significance in *Ryan* was the fact that the DNA evidence was essentially "stand alone" as the prosecution followed a DNA database match.

[3] Adventitious matches refer to genuine links provided through the DNA database in circumstances in which an individual could not have been involved in a given case but who shares a common DNA profile with the crime scene sample purely through coincidence.

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