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PAPER

GENERAL

Michael Welner,[1] *M.D.; Emily E. Davey,*[1] *M.A.; and Adam Bernstein,*[1] *B.A.*

Peer-Reviewed Forensic Consultation in Practice: Multidisciplinary Oversight in Common Expertise

ABSTRACT: The fallibility of forensic science consultation is an ongoing and major justice concern. Prospective peer-reviewed forensic consultation has over 10 years of application in American criminal and civil courts, adapting from the traditional oversight of teaching hospitals, rules of evidence and discovery, conventions of testimony of expert witnesses, and attorneys' overall trial strategy. In systematizing heightened oversight, this process ensures greater accountability in forensic science consultation. The integration of peer reviewers' complementary expertise and experience enhances the sophistication and overall quality of assessment. Forensic examination frequently involves the interface of different specialties. Multidisciplinary peer review augments expert proficiency with that of professional peers having different vantage points from relevant scientific disciplines. This approach ensures greater sophistication of a case inquiry, built-in accountability, and streamlined processes when multiple experts are necessitated. Here, the authors present examples of several cases and the primary and secondary benefits of this collaborative, rigorous, cross-disciplinary exercise.

KEYWORDS: forensic science, expert witness, peer-reviewed forensic consultation, peer review, forensic evaluation, oversight, multidisciplinary consultation

Expert witnesses are placed on a pedestal by the attorneys who present them and may also be highly valued by juries for varying attributes of both juror and expert (1–4). Jurors may have little choice but to simply trust that the science presented before them is correct. However, experts within the forensic sciences are not immune to error (5–9), the consequences of which can be enormous. Notwithstanding simple oversight or human error, experts must deal with bias and pressure from the retaining party (10). Peer review, a valued practice in clinical settings (11), is emerging as a safeguard against human error on the witness stand (12,13).

The term peer review in forensic sciences may suggest a retrospective critique of work already completed, such as for learning or audit purposes. However, when engaged continuously throughout an evaluation, peer review serves to prospectively marshal oversight and protect the examination from bias, ensure its diligence, and enhance its adherence to established scientific understandings of a given area. Experts with complementary or supplemental expertise provide not only oversight, but the quality of in-service training that enhances the expertise of the examiner and confidence in the foundation of the examination. No two pathologists, for example, have identical expertise; each can learn from the experiences and erudition of the other.

Prospective peer review disciplines the forensic consultation before mistakes happen (14). The oversight of peer reviewers who can interact with a primary examiner as knowledgeable, objective, and experienced academic and professional colleagues identifies blind spots of inadequate facts, inadequate knowledge, bias, and other contaminants before they advance far enough to seriously limit the validity of an exam. A peer-reviewed examination is always an organic, self-perpetuating process, and its actual form is determined by the observed needs and demands of the case itself.

Subspecialties do not mingle academically. Conferences for psychiatry understandably have no room for pathology, radiology, or toxicology, for example. Applied to the forensic inquiry, however, a specialist's lack of fluency in a separate discipline may fatally handicap the fact finding and analysis. Often, in cases such as death investigations or claims of sexual abuse, the overlapping expertise can be identified early. On other occasions, the relevance of another subspecialty emerges into view only after review of most, or even all, of the data. A question of central importance to the jury's understanding may position itself just beyond the expert's comfort zone.

The justice system tends to accommodate this challenge in three ways. First, attorneys may hire a separate expert in the specialty of newly appreciated importance. Second, the original expert may scramble through unfamiliar journals to quickly familiarize themselves with the literature, incorporating only a superficial understanding of the unknown field. And third, the expert may barrel ahead, take to the witness stand and tactically avoid questions on the minds of all of the jurors.

All of these approaches have flaws. Retaining an additional expert requires the costs of a completely separate record review and may slow the case down. Once that expert's work is

[1]The Forensic Panel, New York, NY 10001, USA.

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completed, pressures may arise from the conflicting perspectives of different specialties. A child psychiatrist may interpret data differently from a pediatrician. Attorneys, worried about how opposing counsel exploits such variation to damage the credibility of both, confront pressures to bring the opinions into conformity. Skilled attorneys working with collaboratively minded experts may successfully conduct such an orchestra. The artifice of opinions shaped directly by the litigant's trial strategy risks rendering the opinions to be reflective only of how an evaluation would be performed for that individual case. However, an expert's opinions should reflect conclusions one would have regardless of the retaining party, with facts being the same. Conformity arranged by the advocate risks producing something that is not scientific but "based on science," not unlike an adapted screenplay.

The expert who stops cold at the border of one's expertise is commendable for adhering to boundaries of their professional contribution and scientific integrity. But when a pivotal question remains unanswered, and that expert could clearly have contributed more than a layman, the result is that the jury is less informed than it needs to be.

The expert who explores literature outside one's own expertise to embrace the pursuit of knowledge is admirable for expanding their viewpoint. However, peripheral scientific exploration, no matter how well-intentioned, cannot replicate the contribution of a fully knowledgeable expert in the relevant field. Aside from possessing, necessarily, a comprehensive foundation of relevant knowledge, experts may rely upon different sources of information than their peers from other fields of specialty. An expert exploring uncharted territory on their own may not know what he does not yet know. So, too, is the jury in a similar position.

Forensic evaluation is an organic process, and each undertaking entirely unique. Some cases interfacing multiple forensic sciences require separate examinations by separate examiners. Other cases involve other disciplines only to a limited degree. In these instances, peer review is all the more important to address evidence that clearly tests the boundaries of customary expertise. Peer review enforces the responsible acknowledgment of the limits of a primary examiner's expertise while affording opportunity for the symphony of multiple disciplines to provide oversight.

Multidisciplinary peer review extends the quality of sophistication available to forensic analysis and relieves the examiner of the pressures of defining borders of one's expertise and necessary self-training in a vacuum. At first blush, one might not consider the oversight of others in separate disciplines to be peer review, because these colleagues do not share identical expertise and are therefore not "peers." This is a fair semantic argument. However, peer review in many academic subspecialty journals is conducted by multiple disciplines. Forensic psychiatry journals, for example, employ peer reviewers from sociology, criminology, nursing, and forensic psychology, as well as forensic psychiatry.

What establishes one as a peer is expertise in the core area of scrutiny, academic, or in this case, medicolegal. Different disciplines have expertise in the same topic. But because their specialties encompass distinctive training and literature, their individual expertise is actually incomplete by not allowing for cross-disciplinary scholarship. The inherent multidisciplinary nature of certain medicolegal questions invites the convergence of expertise unique to separate disciplines that overlap in their common knowledge of a particular topic matter, be it death in anxiolytic withdrawal, lithium toxicity, critical care morbidity, or mechanism of injury.

In practical application, peer-reviewed examination necessitates a number of critical intervals for conference. Primary examiners present the case data, the sources from which it originates, the tests employed and their results, as well as their analyses and conclusions to peer reviewers for critical feedback. These peer review forums provide structured oversight and accountability from the start – including accountability to peer reviewers that would be missing from blind peer review.

The specific role of each peer reviewer is defined by the unique challenges of every case. Peer reviewers educate the other case participants about the salient literature in a given area and teach the significance of the specialty data to evidence gathered by the primary examiner. Peer reviewers incorporate their unique expertise into actual evidence-gathering by augmenting questions for witnesses. Expertise from multiple forensic disciplines not only enhances these processes, but further aids the identification of pertinent sources of information otherwise unbeknownst to the primary examiner.

Case Examples

The Case of Mr. M

Mr. M was a 33-year-old male with a history of panic disorder, managed by his psychiatrist through a monitored regimen of quetiapine (Seroquel), paroxetine (Paxil), and alprazolam (Xanax). He was convicted of driving while intoxicated and sentenced to 30 days in jail. Jail policy prohibited benzodiazepines such as alprazolam due to their potential for abuse. To manage the risks of alprazolam withdrawal symptoms, including seizures, Mr. M scheduled to serve 7 days per week for 15 weeks to refrain from discontinuing alprazolam for one continuous month. He was medicated with a long-acting 10 mg dose of diazepam (Valium) prior to entering jail, on the expectation that the long-acting agent would diminish his risk for withdrawal seizure. He received his last dose of alprazolam the day before entering jail.

Jail psychiatrists prescribed paroxetine and chlorpromazine (Thorazine) to treat Mr. M's panic symptoms and to sedate anxiety. Two days later, he reported feeling unwell and was taken to the hospital unit at 5:20 am. He returned to his cell by 6:38 am with some degree of improvement. At 8:20 am, he went into the shower, and at 8:35 am, he was found unresponsive with blood in his mouth. He was pronounced dead at 9:10 am, just prior to his scheduled discharge. The autopsy found a previously undetected sarcoidosis of the heart, and sarcoidosis was listed as the cause of death.

The case was referred for a peer-reviewed forensic consultation to probe the range of potential causes of death, including the effects of alprazolam withdrawal. A forensic pathologist was assigned as the death investigation's primary examiner. Questions regarding the metabolism of diazepam and the nature of its protective effect necessitated the involvement of a forensic toxicologist, who was assigned to peer-review the forensic pathologist and contribute a more sophisticated analysis of the above. Alprazolam withdrawal has specific clinical manifestations, and other medicines were administered by the jail to limit panic symptoms, warranting additional peer review from an expert in psychopharmacology.

Jail medication administration records noted paroxetine was to have been given early in the morning of Mr. M's death, after he had been taken to the infirmary at 5:20 am. Testimony from jail officials and records offered contradictory information about what medication was administered and when. The toxicology

report from the autopsy showed a level of paroxetine higher than the upper limit of its therapeutic range and chlorpromazine at a level below the optimal therapeutic range. Neither diazepam nor alprazolam were detected in his system. The autopsy did not examine the oral cavity for signs of trauma, despite blood having been found in Mr. M's mouth.

When presenting the case to colleagues, the forensic pathologist primary examiner referenced experiences of those who have had terminal seizures in the shower. The forensic psychiatrist peer reviewer cited chlorpromazine's well-recognized risk for lowering seizure threshold, and paroxetine's clinical quality of noticeably calming some patients after they take the medicine. The forensic toxicologist calculated the amount of paroxetine and chlorpromazine that could have been administered from perimortem blood levels. The psychopharmacologist noted the potential for rebound anxiety and the need to distinguish rebound anxiety from physiological withdrawal from alprazolam. Both peer reviewers identified witnesses who might further fill the gaps and discrepancies of information, the timeline, and Mr. M's presentation along the course of his demise.

With a more comprehensive inventory of identifiable informants, and a more thorough line of questioning from peer review input, the primary examiner yielded a considerable amount of new historical data. Ultimately, cause of death was determined to be a terminal seizure due to alprazolam withdrawal, precipitating a cardiac arrhythmia in a heart scarred by sarcoidosis. Chlorpromazine was irrelevant to the cause of death for being dosed too low and too remote in time to have facilitated a seizure or to have itself caused an arrhythmia.

Ultimately, multidisciplinary peer review extended the scientific investigation to more fully query witnesses and to account for a fuller range of potential causes of death. The final determination resolved many of the ambiguities. Multidisciplinary peer review reduced the potential for speculation where gaps once existed.

The Case of Ms. D

Ms. D, a 51-year-old female, resided in a group rehabilitation facility with diagnoses of mental retardation and bipolar disorder. Her psychotropic treatment plan included valproic acid (Depakote), risperidone (Risperdal), olanzapine (Zyprexa), trazodone (Desyrel), and lithium carbonate. In addition, she was prescribed levothyroxine (Levoxyl) for hypothyroidism.

A pharmacy incorrectly filled her lithium carbonate prescription, doubling her customary prescription dose, and the living facility staff dispensed her medication as ordered on the pill bottle. Seventeen days later, she began experiencing insomnia. A week after the onset of insomnia, she showed symptoms of agitation, such as screaming and loss of balance. Two days later, she began refusing to eat or drink, and her insomnia persisted. In another 2 days, her condition had deteriorated to the point where the living facility rushed her to the emergency room. Dehydration was immediately noted, and initial blood work revealed levels of lithium of 6.8 mg/mL, sodium of 166 mEq/L, potassium of 7.1 mEq/L, blood urea nitrogen of 98 mg/dL, and creatinine of 2.6 mg/dL. Doctors diagnosed Ms. D with severe dehydration, hypernatremia, and lithium toxicity. She died 2 days after entering the hospital from acute renal failure and hypotension.

The question presenting for forensic assessment related to breaches of standards once the patient had presented at the emergency room. Naturally, the erring pharmacy was targeted for litigation, but civil claims for malpractice were filed against many targets. What standards were breached, and to what degree did they relate to Ms. D's demise?

An expert in inpatient psychiatric care acted as primary examiner in this matter. Lithium toxicity, whether its presentation reflected the course one would expect from the doubled dosage, and expectations for monitoring lithium levels given a change in her presentation, all drew early scrutiny.

Because a number of medical problems presented in the emergency room, and in the critical care setting preceding Ms. D's death, peer reviewers from emergency medicine and critical care medicine were assigned to provide oversight to the primary examiner psychiatrist. Evidence from medical records and laboratory testing were all the more emphasized because Ms. D was not verbal and could not have communicated changes in her presentation to a degree that would enable the customary pinpointing of when she began to feel differently. Due to her mental retardation and consequent possession of limited communication skills, traditional symptoms of lithium toxicity such as nausea or disorientation would have been impossible to diagnose.

Peer reviewers contributed to the determination that dehydration substantially aggravated the effects and presentation of lithium toxicity and risk to Ms. D's life. In this case, both peer reviewers examined chart documentation near the time of Ms. D's death to better draw out the medical decision-making during her critical stages. Chart documentation revealed that dialysis and aggressive treatment were withheld after her family opted for a "do not resuscitate" order and to withhold aggressive measures. The emergency physician and critical care specialist, with a sophistication beyond that of the experienced psychiatrist, were able to point out that the documentation reflected efforts by the medical staff to employ dialysis and other aggressive measures to save the life of Ms. D, prevented by the family. The peer reviewers, referencing available literature from their respective professional communities, expressed their opinion that Ms. D's condition was not so irretrievable that aggressive intervention would not have been able to reverse the effects of lithium toxicity on the patient's kidneys.

Ultimately, the primary examiner felt that the psychiatrist's management of the case breached standards by failing to monitor Ms. D's lithium level in the face of clinical changes, even though the patient was unable to communicate. However, peer reviewers with specific expertise in treating acute lithium toxicity beyond the boundaries of psychiatric inpatient management felt that this critically ill patient could have been saved by following the emergency department's recommended treatment plan. It was family – the same family that later brought litigation – that made a decision that ensured Ms. D's death. Whatever the breach of standard, its impact was reversible but for the decision to withhold treatment.

The Case of Mr. C

Mr. C was a 79-year-old male suffering from end-stage cancer, complicated by a medical history that included hypertension, diabetes, and chronic renal insufficiency. He was admitted to the hospital to receive a standard chemotherapy regimen, but passed away 16 days later. During that hospital stay, Mr. C's will was changed. His debilitated condition introduced questions of his testamentary capacity.

Mr. C had completed a 10 day course of radiation when admitted to the hospital, and by the end of the treatment course, his medication profile included 21 different medications with

morphine and Percocet among them. During the course of hospitalization, a number of different specialists examined Mr. C, and his records show that many of the physicians and hospital staff noted how the patient's mental status continued to decline.

As a result, a medical toxicologist was assigned as primary examiner. Peer reviewers included a forensic psychiatrist to focus on the mechanics of establishing testamentary capacity and what had been established before the will was changed, and a critical care medicine specialist to speak to the progression of Mr. C's medical conditions during the course of his hospitalization.

Documentation of Mr. C's mental status was noted by the primary examiner to be contradictory. Eleven days into his stay, Mr. C was "obtunded···arousable to verbal command." Yet the following day Mr. C executed a last will and testament in the presence of an attorney, his sister, a nurse, and a social worker. Peer review from a forensic psychiatrist informed the primary examiner that waxing and waning of delirium could present in just this way. Delirium could also manifest in a superficially clear sensorium that under deeper scrutiny would reveal signs of confusion. Mr. C showed signs of depression, which needed to be accounted for in the overall assessment of whether the beneficiary of the changes to the will exploited Mr. C through undue influence.

However, forensic psychiatry could not inform the severity of medical conditions the days following Mr. C's radiation regiment. Delirium is the by-product of an acute medical condition or drug effect, but a psychiatrist does not have the requisite expertise in establishing the cause of the delirium. With no medical or toxicological source, the recorded history could be no more than a reflection of who is doing the documentation.

The medical toxicologist, by reviewing of the multiple prescribed medicines, when they were being administered, drug interactions, the half-lives of their metabolism, and the time of documentation, concluded that Mr. C's medications would not be expected to compromise his mental status.

The critical care specialist focused on the successive laboratory tests and considerable documentation by many medical specialists and identified several medical conditions, primarily renal failure, that were acute and severe as early as 9 days into radiation treatment, 3 days before Mr. C changed his will. Any one of these conditions would have been advanced to the degree that they could be responsible for a delirium.

Each of these respective specialties could have been tasked with the primary examiner role, and each of the specialties could have worked independently. But Mr. C's case illustrates how the borders of expertise would have handicapped each of the examinations, for different reasons. The psychiatrist would have been unable to resolve whether delirium, depression, or neither was operative, for lack of familiarity with the fine points of the acute conditions at the time of the changing the will. Likewise, even with knowledge of the administered medications, these included opiates (morphine and Percocet) that can contribute to confusion if sufficiently dosed or poorly metabolized and accumulating in the system.

A forensic psychiatrist under such circumstances, peer-reviewed only by others within his or her specialty, would be speculating a conclusion on these points. When assessment is forced to leap in analysis, the adversarial process may guide the examiner to bias in favor of the retaining party. This is why diminishing gray areas is so pivotal to promoting a valid forensic analysis from any specialty.

From the medical toxicology standpoint, that primary examiner would never have been able to discern more if peer-reviewed only by toxicology colleagues. Psychiatrists deal every day with delirium and can recognize it even when it avoids detection by the naked eye. Likewise, without input from critical care medicine, medical toxicology would be left with nothing remarkable about the decline to interpret the chart as anything more than sloppily documented. Additionally, critical care medicine can appraise the progression and severity of medical illness. Applying this analysis to interpretation of a question as specific as the disposition of one patient's assets is not part of the expertise of a medicine specialist.

It is entirely possible that were the three examiners to have evaluated the case in parallel, all would have reached different opinions. An attorney may have then moved to reconcile the opinions in a way that created an artificial compatibility. Peer review as an interactive and critical exercise aims at reaching a scientifically valid answer, not at reconciling multiple answers so that they play right in court.

The Case of Mr. H

Mr. H, a law enforcement official, received a call from his neighbor telling him that someone was trying to break into his car. He exited his home carrying a semiautomatic rifle and observed two men attempting to break into his vehicle. As Mr. H approached, one of the thieves jumped into a getaway vehicle. To determine whether there was a second individual in the car, Mr. H stepped into the vehicle's path, shining his flashlight toward the front windshield. The vehicle accelerated forward and Mr. H opened fire, but the vehicle continued. The driver of that vehicle could have fled the scene, but he turned and he accelerated back toward where Mr. H was standing. Mr. H fired toward the driver's side windshield. The getaway vehicle careened off the street and crashed into a neighboring house. The driver of the car was wounded in the face and filed suit against Mr. H, contending he had been shot after his vehicle had crashed and was helpless, posing no threat to Mr. H.

Records indicate that Mr. H fired more than 20 bullets from the semiautomatic rifle. Mr. H asserted that the shots were fired in self-defense as the vehicle attempted to run him over twice. The driver of the vehicle, however, asserted that he was cruelly shot in the head from behind after the car had already crashed into the neighboring house.

The case was referred for reconstruction of the confrontation based upon the wounds sustained by the driver of the vehicle and the extensive physical evidence encountered. A forensic pathologist was assigned as the primary examiner, given his experience in wound analysis. Initially, he was assigned peer reviewers from forensic pathology with similar experience in integrating evidence from ballistics, crime scene analysis, medical records, motor vehicle wreckage, and police investigative interviews.

The primary examiner, benefiting from peer reviewer oversight, carried out an exceptionally diligent examination, disciplined for its objectivity and for not extending beyond the expertise customary to even an experienced forensic pathologist. An important impasse emerged, however.

After the driver litigant had been shot, he was hospitalized and treated surgically. Records from the hospital were seemingly detailed; however, they needed not concern themselves with whether the bullet entered his face from behind in the neck region and traveling back to front, or whether the bullet entered the face through the front windshield and while the driver was directing his car at Mr. H. So whatever the diagrams and

detailed surgical summary, this question remained unresolved and critical. At this point, the case and the plaintiff's injuries and studies were presented to a forensic radiologist in peer review. The case file included X-rays and CT scans, performed prior to reconstructive surgery, from the affected area.

The radiologist contributed questions from his own unique expertise to those being posed to witnesses. However, he was able to transcend the forensic pathology opinion to offer an informed opinion, on the basis of X-ray data and his qualification of interpretation, about where the bullet entered the plaintiff, and its trajectory. Radiographic evidence available included pre- and postoperative CT scans of the facial wound. Photographs of the preoperative wounds proved to be less helpful than imagined due to the amount of blood pooled around the injury, leaving the injury site and wound tract obstructed. CT scans demonstrated a bullet entering the face close to the nose area and fragmenting as it came into contact with the underlying bone, in a left to right directionality, finally exiting through the right cheek area.

This is an example where even excellent work cannot venture beyond a clear boundary of expertise. The ability of peer review from a different specialty of emerging relevance essentially completed the exercise of forensic science evaluation. Such contribution to a case facing an impasse can be done cost-effectively and can save an otherwise correct and thorough examination from being compromised because it cannot address emerging question that clearly would matter to a jury.

General Discussion

Multidisciplinary peer review is an established practice in some clinical settings, with potential to enhance not only the quality of clinician supervision (15) but also the quality of patient care and treatment outcome (16,17). In a forensic setting, peer review from colleagues with complementary expertise offers a similarly wide array of benefits. Here, it protects an examination against bias, promotes necessary diligence, and ensures adherence to updated standards of the field. It follows from the above that whatever a primary examiner's inability to account for all of the most recent progress in his field, that examiner would be especially unable to account for progress in other disciplines that may be pivotal to that case. Moreover, being blinded to updated standards in a discipline relevant to the case contributes, both consciously and unconsciously, to bias.

More often, the multidisciplinary approach to forensic investigations is performed by individuals denominated a forensic "team." For example, a forensic anthropology examination of the Daegu Subway Disaster highlighted the team's multidisciplinary approach, with the authors concluding that "[t]hanks to the multidisciplinary team effort, we were able to declare the number of victims with reasonable certainty" (18). The National Transportation Safety Board (NSTB) is another example of multidisciplinary investigative process (19).

The key distinction of the cases in this article is that a primary forensic examiner with the requisite expertise to examine the core medicolegal question is designated, and those from other disciplines are not examining as a team, but providing oversight on a topic of shared expertise while enhancing the sophistication of an already qualified expert through their complementary expertise. In that regard, multidisciplinary peer review is no different from peer review by those in the same discipline; all specialists have expertise that has strengths and weaknesses of understanding and experience relative to a peer. For example, the psychologist who treats trauma in refugees is exposed to a range of responses distinct to this population. A given forensic psychiatrist may have experience in assessing trauma claims in civil litigation, but does not have the treatment experience with patients from that country. The civil case at hand may involve someone who originates from that country and same culture, but is not a refugee and was not exposed to the same stressors – yet has PTSD. Either examiner has acceptable qualifications for conducting an examination without need for a team. Oversight by one specialist of the other therefore imbues the quality of the analysis with complementary expertise and the oversight one cannot muster in solitude.

Multidisciplinary peer review therefore acknowledges the presence and importance of aspects of the case at hand which encroach upon and may cross into a different expertise altogether. Integrating these specialists from other disciplines promotes learning in the primary examiner and the honesty of acknowledging what one cannot say.

The approach presented from the examples of this article does not promote witnesses testifying beyond their expertise. Their boundaries remain defined by the limits of their specialty qualification. However, their fluency in the topic area, be it death investigation in the incarcerated mental health consumer, the course of lithium toxicity, decision-making capacity during critical illness, and injury reconstruction is more fully informed through the shared experience and complementary expertise of peers. When questioning at trial extends into the science of another discipline, just as it does within clinical practice, the primary examiner demurs. Either litigating attorney may then choose to call the relevant peer-reviewing specialist to add supportive testimony (if deemed necessary) or to confront (if deemed sensible).

An interactive peer review results in different specialties organically fitting together seamlessly, including fitting together in a way that appropriately negates the merit of a case. This outcome reflects on the validity of the process, not just its efficiency. The alternative, without this peer review, is multiple experts with different vantage points producing qualified but incongruous opinions because they have not integrated the perspectives of disciplines and areas of expertise that are distinct from their own.

Creating a platform of learning from experienced, if unrelated, colleagues enhances the knowledge of the primary examiner through case review itself. The primary examiner discovers research he never knew existed, noted in journals he would never otherwise have read. And the contribution of the other disciplines is extensive, layered, and imbues the primary examiner with training to apply to casework.

Such cumulative knowledge inevitably evokes an appreciation for the wisdom of "three heads are better than one." Experience teaches the authors that courts find this oversight and collectivism bolsters the validity of forensic examination, an exercise that is inherently vulnerable to blind spots.

In many respects, the application of PRFC is no different from traditional models of the attorney-consulting specialist or court-consulting specialist relationship. The attorney reserves the right to approve the primary examiner and peer reviewers before any work is undertaken. The work product is a matter of the attorney-expert work product. The process itself is subject to deposition and cross-examination in the same vein as DNA testing might hold chain of custody accountable and raise a basis for doubt based in fact or perception.

Primary examiners have clearly reviewed each of the materials and are charged with the ultimate opinion. Primary examiners are in line to testify, but peer reviewers may be called by either side to give accountability to the process or expose flaws in its quality control. However, the impetus remains on the primary examiner to produce a scientifically objective and informed opinion derived from thorough checks and balances.

Because the model of the cases above involved oral presentation of the data by the primary examiner to peer reviewers, the process requires a careful internal quality control and good faith understanding by peer reviewers that they are hearing a full presentation of all potentially relevant data. Peer reviewers may then solicit more information through additional questioning. Some data are necessarily shared, such as photographs of autopsies and death scenes. But text material, for example, is expected to be properly distilled. Doing so saves the costs of separate examiners consuming what may be a tremendous investigative file. Like laboratories performing sophisticated assays, PRFC requires excellent in house materials management and organization in order to ensure the cost-effective implementation of a vibrant and critical oversight system. As humans are involved and machines are not, all involved must be as serious and committed as surgeons around an operative field.

Experience has demonstrated that this protocol, which vets human error before release of findings, promotes settlement and therefore saves time and court costs, whether the PRFC is an arrangement agreed upon by both parties or solicited by one side of an adversarial proceeding.

As a matter of trial strategy, if internal scientific regulation of the exam weakens an opinion, an attorney may find such an approach unwelcome. Strategically, it comes down to whether an attorney is willing to risk findings that are less favorable by a process in which science disciplines the inquiry rather than an attorney's control over the flow of information or the nuance of how it is spun.

Peer reviewers may have different conclusions about a case, sometimes so pronounced that peer reviewers withdraw support for the primary examiner's work. This is the prerogative of the peer reviewer and where PRFC departs conspicuously from the planned conformity of the attorney managed model. For this reason, some attorneys deem such a PRFC exercise an unnecessary risk. However, the role of peer review is to ensure objectivity, adequate diligence, and conclusions that show fidelity to the facts and to the science. Oversight promotes the integrity of the forensic expert, but is not meant to compete for decision-making responsibility.

Science is a cumulative endeavor, and as such, it is essentially collaborative. The information gleaned by our predecessors and peers necessarily informs our contemporary scientific and medical opinion and remains relevant across specialties. Forensic science should reflect the same standards (20).

Forensic consultation has a particular vulnerability to narrow thinking. Experts may be asked to consult matters from a highly specific vantage point or theoretical challenge. It is far too easy to lose the forest for the trees while responding to what may be an attorney's respectful inquiry. Multidisciplinary peer-reviewed forensic consultation ensures an examination process with dramatically upgraded quality control. As we struggle within the forensic sciences to promote realistic, cost-effective approaches that truly refine the application of forensic sciences to the law (21,22), multidisciplinary peer review proves to be a welcome approach for the present and future.

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Additional information and reprint requests:
Michael Welner, M.D.
The Forensic Panel
224 West 30th Street
Suite 806
New York
NY 10001
USA
E-mail: drwelner@forensicpanel.com