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ADVANCED REVIEW

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Forensic advisors: The missing link

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Abstract

In this paper we advocate for the re-establishment of the generalist role in forensic science systems in the form of a forensic advisor. The generalist can be defined as an individual possessing a broad scientific knowledge base coupled with comprehensive knowledge of forensic science, criminalistics, traces, crime scene and criminal investigations. The forensic advisor's role is that of a collaborative, non-competitive effort intended to provide scientific consultation with the myriad actors in the investigative process to advance justice and aid in crime prevention efforts. The generalist forensic scientist, in the role of forensic advisor, helps bridge gaps and break down silos by facilitating communication between actors and overseeing the potential contribution of traces in investigatory efforts. The purposes of this paper are to address the current status of forensic advisors within existing organisational frameworks; to propose roles and responsibilities of the forensic advisor; to delineate the key attributes of the forensic advisor; and to present challenges to implementing this advisor role within a jurisdiction. In developing the roles and responsibilities of the forensic advisor, we examine front-end, midpoint and back-end stages of an investigation. Despite organizational challenges explored in this article, the introduction of forensic advisors can serve to diversify the contribution of forensic science and improve the efficiency of the delivery of forensic science services.

This article is categorized under:

Crime Scene Investigation > Crime Scene Examination

Crime Scene Investigation > From Traces to Intelligence and Evidence

Jurisprudence and Regulatory Oversight > Interdisciplinary Collaboration

KEYWORDS

case coordination, crime scene, generalist, investigation, trace

1 | INTRODUCTION

Forensic science must progress at a pace where its application supports the overarching goals of preventing crime and delivering justice. Despite the shift toward cybercrimes in which digital technologies and associated digital traces are the primary focus of a criminal act, physical traces are no less important to the forensic science system than they were in the nineteenth century when "criminalistics" was being defined and applied to criminal matters.[1] Traces not only serve to draw connections that can be presented in a criminal trial, but when detected and recognized for their significance, can elicit patterns and help guide investigations, including providing leads at the onset of an investigation.

In response to this constant evolution of competing interests within the criminal justice system, law enforcement agencies need to invest in models, technologies, and personnel which can yield optimum results in a short period of time.

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Effectiveness and efficiency are therefore of great importance to mitigating and solving crime. The technologies used to analyze traces and facilitate interpretation have become increasingly complex while at the same time becoming less cumbersome in terms of portability and operability, lending to the ease at which investigators can "bring the laboratory to the scene." These technological developments increase the selectivity of clues and traces found and collected at crime scenes, and carry with them the potential to influence an investigation almost without delay (Gremaud et al., 2015).

While technology can assist in the rapid screening of traces at the scene, the recognition, signification, analysis, and interpretation of traces require human intervention in order to ascertain their relevance and to ensure that the investigator or jurist can capitalize on the utility of the trace within the framework of the investigation or within the courtroom.[2] Balancing technology and human intervention was even a concern almost 70 years ago, with Paul Kirk (1954) asserting "...the overemphasis on investigative aids tends to obscure the more fundamental requirements placed on the investigator—thoroughness, common sense, care and thought in approaching the problem, and a definite and deliberate plan of action designed to achieve the desired result. In short, the tendency to substitute gadgets for skilled personnel is the most serious mistake that can possibly be made" (p. 56). This article advances the stance that investigative decisions, regarding traces at crime scenes, should be made by appropriately educated and trained scientific actors. To address the need for a skilled "criminalist" overseeing investigations and collaborating with the myriad actors within an investigation, we advocate for the implementation of a forensic advisor role filled by a scientist with specific education, training, and experience to apply a generalist approach to cases. Moreover, we encourage early intervention by the forensic advisor, preferably at the initial stages of an investigation. While different titles have been utilized to define such a role depending on jurisdictional preferences (e.g., case coordinator and case manager), we have opted to designate "forensic advisor" as the title of choice in this manuscript. While the authors chose this terminology, the role should not be perceived as merely passive or reactive, with the advisor having an active and responsible position in the decision-making process. Also, with differing jurisdictions, this role might be a temporary solution eventually leading to the full integration of forensic generalists.

The generalist in forensic investigations is defined as an individual possessing a broad scientific knowledge base coupled with comprehensive knowledge of forensic science, criminalistics, traces, crime scene, and criminal investigations. The generalist goes beyond the cursory technical and scientific knowledge of what traces are and how they can be analyzed using various methods (such as microscopy, chemistry, and spectroscopy), extending their expertise to knowledge about traces with respect to their environment and nature of activity (detection, transfer, persistence, and relevance). Furthermore, the generalist actively utilizes analytical reasoning skills in combination with observation and hypothesis generation to guide their inquiries.

The idea of the generalist-investigator can be traced back to the nineteenth century, with Hans Gross describing the characteristics and qualities required of the investigating officer in his 1893 work *Handbuch für Untersuchungsrichter als System der Kriminalistik*. In the early 1900s, Edmond Locard focused on the portion of Gross's work concerned with the techniques of exploiting traces found at the scene of a crime, applying the French term *criminalistique*. Locard developed this discipline within a laboratory specially designed to help authorities apply scientific knowledge to investigations by exploiting clues based on traces resulting from the exchange of material caused by criminal activity (Ribaux & Margot, 2011). Prior to the establishment of this laboratory, Alphonse Bertillon developed his anthropometric system for identifying repeat offenders, extolling the idea of a so-called scientific police. Concurrently, Rodolphe Archibald Reiss integrated these different points of view to create a discipline in an institute for scientific police at the University of Lausanne in 1909. Reiss also extended criminalistics by exploring its links with criminology, reasoning that criminal action and the exchange of material take place in a physical and social environment (Reiss, 1911).

As forensic science and criminalistics evolved in the 20th century, the idea of the generalist and scientist-at-the-scene remained an essential component of good investigatory practice, and a fundamental characteristic of a criminalist (Collins, 1961; Kind, 1987; Kirk, 1954; Nickolls, 1956; O'Hara & Osterburg, 1949). In their 1949 text *An Introduction to Criminalistics: The Application of the Physical Sciences to the Detection of Crime*, O'Hara and Osterburg remark,

> Quite frequently the important critical work in a case involving physical evidence is performed at the scene of the crime and not the laboratory. The services of the scientific investigator are needed primarily at the scene, where his experienced and critical mind can judge the worth of the evidentiary traces [...] The analysis at the laboratory is often a routine affair which may be entrusted to an ordinary technician [...] The knowledge [...] which leads to the discovery, correct evaluation of the clue materials, and proper care of the traces found in connection with the crime must be derived from thorough training and experience (p. xiii).

And, in 1961, Collins took the idea of the "police scientist" (a designation used by Vollmer, 1930 and Kirk and similar to Bertillon's scientific police) and defined the field criminalist: "The field criminalist must have the scientific background [...] He

should have experience in investigation, and the necessary knowledge and educational skills to work in a general police laboratory; for without this knowledge and experience, he would not be effective at the crime scene" (p. 469). Collins (1961) goes on to add, "[t]o serve to his fullest capacity, he must have enough knowledge of all areas to call upon the services of experts when the evidence indicates" (p. 470). It is therefore important to establish that criminalistics and a true criminalist (as opposed to a laboratory position with the job title of "Criminalist") were not intended to be confined to a laboratory or restricted to technical duties. "Criminalistics is fundamentally an intellectual endeavour which is concerned with scientific problem solving. It is not merely a loose amalgam of sundry techniques and technologies [...]." (De Forest & Peter, 1999, p. 197).

With the evolution and popularization of forensic science in the last 50 years, service providers have shifted from the generalist forensic scientist model to a more specialist-centric system (De Forest & Peter, 1999; DeHaan, 2008). In this model, which is more common presently, laboratories have scientists or technicians specialized in a type of expertise or technique (e.g., DNA analyst and drug analyst) that are confined to the laboratory while the crime scene work is often conducted by sworn officers with education and training focused on policing rather than science. This approach to utilizing insufficiently educated and trained individuals at the crime scene is not novel. In 1954, Kirk lamented, "[police investigators ...] usually have a very limited appreciation of the nature and value of physical objects as evidence. Uncollected evidence cannot be made to assist in solving crimes. In a very large majority of cases most of the valuable physical evidence is never collected, and the little that is recovered may often be inadequate to establish proof. When this occurs, it is often listed as a laboratory failure when in fact the laboratory never had a chance" (p. 58). This sentiment is echoed almost 60 years later by legal scholar Jennifer Laurin (2013).

Crime scene "investigation" has been reduced to more of an exercise in techniques of recovery, rather than reasoning and reconstruction necessary for detection of traces (Delémont et al., 2014). In the existing framework, crime scene investigation is more akin to processing by technicians—iterations of documentation, collection, packaging, preservation, and storage. Issues concerning properly conducted crime scene investigations were largely overlooked in the oft-cited National Academy of Sciences Report in 2009 that took a critical eye to forensic sciences (National Academy of Sciences, 2009). In 2013, Laurin brought attention to the need for more early science and the problematic, paradoxical "upstream discretion of forensic science users" (e.g., police and prosecutors) in making decisions that should be made by scientists. Laurin (2013) remarks that by permitting "an array of decisions made outside a laboratory by police and prosecutors deciding what evidence to collect, what evidence to submit for testing, and how (if at all) to act upon analysis that a laboratory can or does perform [...] police and prosecutors are themselves playing critical and frequently dispositive roles in 'adjudicating' the significance of scientific evidence in a particular case" (p. 1071). This critical decision-making and interpretation by nonscientists with a vested interest in the case outcome is concerning, yet is apparently overlooked or ignored by policy-makers and jurists. In fact, Laurin (2013) directly states that such actions are "a reality that the NAS report does not engage" (p. 1072). Despite the oversight, calls for the need for scientists at the scene (driven largely by forensic scientists) have persisted into the 21st century (De Forest, 2004; Margot, 2011), and the generalist approach has also been presented with respect to modern forensic disciplines, ranging from general criminal investigation (Delémont et al., 2014), to cybercrime investigations (Miranda, 2021). Recently, Weyermann and Roux (2021) reiterated that addressing challenges at the initial stages of the forensic science process (e.g., crime scene investigation) is essential for proper function of the overall system.

The tendency toward a siloed system and the decentralization of forensic science (Casey et al., 2019), with law enforcement, crime scene, the laboratory and the end user being separate from each other has resulted in a resurgence of the need for a generalist forensic scientist role in matters of investigatory decision-making.[3] Moreover, a focus on laboratory efficiency (not efficacy) and awareness of cognitive bias within the forensic science system has led laboratory administrators to consider limiting both the interaction between the end user and the expert performing the examination; and the flow of investigatory information. The process could be facilitated by a forensic advisor, who could ensure that the expert has access to necessary information at the correct point in time. As such, this article supports the push for the generalist forensic scientist, and advocates for the implementation of a forensic advisor role within jurisdictions to bridge the communication gaps between the silos; translate scientific information to the different actors within the system (law enforcement, science, and legal); and advocate for the most efficient use of forensic techniques for a given purpose. Most notably, the authors wish to assert the usefulness and necessity of the generalist role in improving the forensic science system.

2 | THE FORENSIC ADVISOR—CURRENT STATUS

It should be stated at the outset that the key to the forensic advisor's role is that of a collaborative, noncompetitive effort intended to facilitate communication and provide scientific consultation with the myriad actors in the investigative

process to advance justice and aid in crime prevention efforts. The actors that the forensic advisor may interact with include jurists, law enforcement officials, crime scene units, laboratory scientists, and pathologists.[4]

This collaborative effort is highly dependent on the integration of forensic science in the criminal justice system, including the procedural structure and organization. It is recognized that informed and aware decision-making by equal and acknowledged partners benefits justice and crime prevention (Fraser, 2007). In the same sense, Kind (1987) identifies that specialized chemists or biologists cannot contribute effectively to the crime investigation, if "they know nothing about the problem they are supposed to solve" (Ribaux et al., 2015, p. 63). Integrating the generalist forensic advisor allows for informed decision-making at the investigatory level while keeping laboratory analysts separate from investigatory details that may be viewed as having the potential to impart bias during analysis and reporting.

Tilley and Ford (1996) reported on practices pertaining to the utilization of forensic science services in England and Wales as part of a Police Research Group study, in which requests for scene of crime officers (SOCOs) and forensic scientists at the scene were at the discretion of the police responding to the scene. The study found that there were "serious weaknesses in systems that depend heavily on the first officer attending" the scene due to gaps in understating about potential contributions of physical traces, thereby impacting the first responder's decision-making (p. 14). Moreover, Tilley and Ford (1996) found that most time was spent looking for fingerprints, with little focus on "other forensic evidence" (p. 17).[5] As a result of their study, Tilley and Ford reported the following best practices for scene investigators: an appropriate and adequate level of understanding of forensic science, the law and the investigative process for the role to be performed successfully; the provision of sufficient information about a case to examine the scene intelligently and make appropriate decisions about items [traces] selected for submission to the laboratory; and access to someone who does understand the investigatory potential (or lack of potential) of items [traces] if educated decisions about submission are to be made. Moreover, first responders need to have sufficient understanding of the nature of traces for a given case in order to determine whether or not a forensic scientist should be present at the scene in the first place. It is the generalist forensic advisor that would be best equipped to consider criminal behavior, the scene and its components, as well as the nature of the traces in order to make decisions about the systematic search and recovery of relevant traces.

The integration of the forensic advisor role can either be performed by adding a new position within the institution or by changing the tasks and functions of a pre-existing role (Bitzer, 2019b). In 2019, Bitzer reported on case coordination in Europe, describing the function and contributions of coordinators in five European countries to investigatory efforts. Titles, responsibilities, organizational structure, and integration modes varied. In some countries, the coordinator needs to be formally requested (in most cases) by the investigator in charge of the case, whereas in other countries, the laboratory assigns a forensic case coordinator to the case at the request of different parties of the process (i.e., jurist, police, and laboratory expert).[6] A brief overview of Bitzer's findings are presented in Box 1.

BOX 1 Selection of forensic advisor efforts in Europe

Belgium—Forensic Advisor. Responsibilities include: triaging of traces; suggesting trace analyses and their analytical sequence; summarizing, explaining, and interpreting analytical results.

The Netherlands—Intake Coordinator. Responsibilities include: overseeing the logistics of information exchange; triaging of traces; suggesting trace analyses and their analytical sequence; explaining analytical results (information exchange).

Sweden—Forensic Advisor. Responsibilities include: overseeing the logistics of traces and information exchange; triaging of traces; suggesting trace analyses and their analytical sequence; summarizing and interpreting analytical results.

Finland—Coordinator. Responsibilities include: overseeing the logistics of information exchange; suggesting trace analyses and their analytical sequence; summarizing and providing assistance with the understanding of reported analytical results; subcontracting examinations in situations where the required expertise is not available in-house.

Germany—Case Coordinator. Responsibilities include: overseeing the logistics of traces and information exchange; suggesting trace analyses and their analytical sequence, summarizing analytical results.

Some jurisdictions, such as Switzerland, align with the approach posited by Kirk (1954): "[the police scientist...] is in an excellent position to serve as a liaison" between the laboratory and the field investigator, assuring that "evidence is not overlooked or disregarded, that the preliminary examinations... are carried out in close coordination with the police..." (p. 60). Indeed, specially selected SOCOs can contribute toward elucidating the potential value of traces. Opting for an adjunct to SOCOs, France introduced the Cocrim (coordinateur en criminalistique; Crispino et al. (2009), Schuliar (2009)) who helps to detect traces at the scene; educates investigators and highlights the ability of such information to provide investigatory leads; and considers the presence of patterns on the front end of the investigation.[7] Moreover, crime scene investigators are regionally supervised by the Cocrim. Similar to the Cocrim in France, forensic advisors in Belgium explain opportunities for collection of traces to magistrates, under whose responsibility they intervene in the case. In most cases, this triage considers items previously collected by crime scene investigators, but in rare cases the advisors are called in to provide guidance concerning traces to be recovered when the scene is available and actively under investigation. In addition, forensic advisors in the Belgian system provide advice about potential analyses and necessary expertise based on contextual information derived from the incident and the objects collected from the scene (see also Bitzer et al., 2018, which specifically focused in the Belgian system). In the Netherlands, another set of forensic advisors are also present at the court level. Judges can ask them any questions related to forensic science in general or questions that are case-specific. These forensic advisors help judges in their understanding of forensic analyses and also summarize forensic reports for a given case (Forensische Ondersteuning Helpt Strafrechters, 2013). In Sweden, there are also forensic advisor roles within the crime scene units in addition to forensic advisors assigned to the laboratory. In 2020, De Kinder and Pirée (2020) proposed a single centralized unit of forensic science providers and an incorporated case management unit. Within this case management unit, De Kinder and Pirée (2020) advocate for forensic advisors to oversee "management of the evidence material" through contact with police and judicial authorities (p. 5).

Across jurisdictions and countries, various systems are in place, which shape the integration of forensic advisors in the criminal justice process. As formalized in the strategic knowledge dimension by Ribaux et al. (2010), financial and political matters create restrictions and limitations that influence the ways in which forensic advice can be organized. An ideal organization would consider a "procedural" integration model, where the distinctive knowledge-based expertise of forensic scientists is acknowledged and overall emphasis lies on the supporting quality of forensic science (Williams, 2007, p. 772). This is in opposition to the "structural" integration model, which reinforces the separation of forensic science laboratories from law enforcement agencies, with scientists outside of the investigation, not involved in the development of hypotheses regarding the events or aware of the information derived from other traces in the case (Risinger, 2013).

When looking at the different roles forensic advisors have, one has to consider different stages of an investigation. In these different stages, select steps and associated objectives condition the application of forensic science. A different skillset, reasoning and expert knowledge may be required as one progresses through the stages of the investigation. However, what all of these roles have in common is a broad knowledge of general forensic science. Indeed, while it is not expected that any one individual will have unlimited expertise to carry through all investigations, the generalist forensic advisor is meant to have a vast scope of knowledge to apply to investigatory stages and to know when to suggest calling in the necessary expertise. For example, Baechler et al. (2020) proposed five key parameters "to assist forensic scientists [in] assess[ing] the strength and limits of their findings as well as guide their decision making [...] namely utility, credibility, integrity, timeliness and flexibility of forensic science outputs," which the forensic scientist should consider when assessing the value of a trace (p. 5). The forensic advisor role is meant to be active and engaging and filled by a generalist forensic scientist, not intended to be new hires lacking knowledge, skills, and experience or restricted to in-house administrative duties. Figure 1 shows a general schematic of a forensic science system with a forensic advisor incorporated in the system.

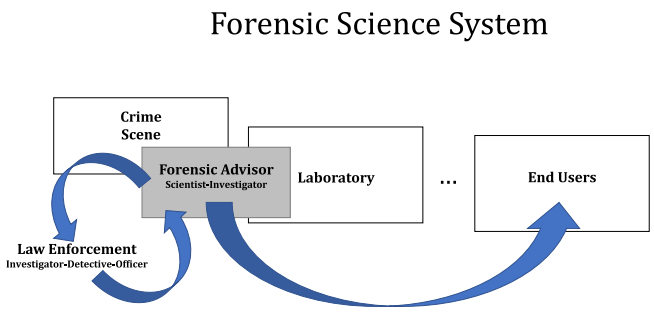


FIGURE 1 General forensic science system incorporating the forensic advisor. Adapted from Bucht et al. (2021)

3 | THE ROLES AND RESPONSIBILITIES OF THE FORENSIC ADVISOR

There are several tasks that the forensic advisor can take responsibility for, and the need for a forensic advisor role to undertake these responsibilities is entirely dependent on the system in which the forensic advisor operates. The advisor role is one that fills in gaps and builds bridges in order to allow for the optimal flow of information and traces, with the aim to maximize the efficacy of the forensic science process while at the same time maintaining the quality and integrity of the scientific aspect of an investigation. The assignment is crucial in the way that it should give a clear mandate of the task at hand. Whatever the position of the forensic advisor in a particular system or institution, there should exist a description of their roles and responsibilities, including authority to make certain decisions or recommendations, which would be documented and retained with the case record. This assignment, and thus the legitimacy of their role, needs to be backed by their leaders, whether these are from police or judiciary management. Hence, a priority is that leaders have an effective perception of the full potential of forensic science with wide-ranging contributions (Crispino et al., 2021). The roles and responsibilities of the forensic advisor can be split into three main stages on a continuum: front-end, midpoint, and back-end. These stages are not mutually exclusive and are iterative, being refined as the investigation progresses.[8]

3.1 | Front-end

The front-end includes crime scene attendance, information gathering from the early stages of the investigation, and oversight of trace submission to the laboratory or laboratories. With initial attendance at the scene, the forensic advisor raises awareness about the transfer and persistence of different types of traces within the framework of the criminal activity and nature of the case. The forensic advisor articulates the potential contribution to and relevance of different types of traces to the investigation, in an effort to support the technical endeavor of crime scene processing. By adding the generalist-scientific approach, the forensic advisor will go beyond searching for those traces that are the most recurrently exploited (i.e., fingermarks and biological traces), extending the focus on a broader diversity of traces. Moreover, the forensic advisor can oversee the proper utilization of crime scene search, processing and recovery equipment and techniques by properly trained individuals. This is done with the overarching objective of centralizing, handling, and exploiting traces and clues in one location in order to feed into an intelligence-led perspective (Crispino et al., 2009).

This stage is further characterized by first level case assessment. In many cases, the first step consists of inventorying available traces and objects.[9] The forensic advisor would be responsible for collecting and reviewing available documentation (e.g., police reports, evidence/chain of custody logs, requests for analysis, photographs, etc.) in order to establish what traces or objects have been collected and where such traces or objects are located. In order to be able to advise on the best analytical strategy to adopt, forensic advisors must have certain case information. Case context information needs to be gained in order to make an informed decision with regard to pertinence of the traces. Furthermore, an overview of all traces and items available in the case is necessary in order to prioritize trace analyses in light of all other available investigatory information. Once traces and objects have been located and accounted for, the forensic advisor would begin evaluation and triaging the items.[10]

During triaging and evaluation, the selection and prioritization of traces to be analyzed is determined. In current systems and depending on an agency's organizational structure, the triaging step may fall under the purview of crime scene investigators, police investigators, or jurists. These actors may be responsible for deciding which traces are processed further (whether in-house or transferred to an external laboratory for analysis) or which are set aside due to shifts in lines of inquiry. The concern with such systems and associated decision-making is with the education and training of these decision-makers. It may not be clear how such decisions are being made by nonscience, nongeneralist actors. Conversely, in systems currently utilizing forensic advisors, police or magistrates are advised (in certain cases) on the forensic analytical strategy to adopt. In the UK, a case assessment is performed prior to DNA analysis in complex cases in order to determine relevant questions and to preassess the value of traces. This is done in an effort to evaluate whether the outcome of the analysis will contribute meaningfully to the investigation and to determine if there is a better course of action. In the Netherlands, such assessments are referred to as in-take discussions, which are held primarily in complex cases that are likely to involve different types of expertise throughout the course of the investigation. In these multidisciplinary cases, it is of utmost importance to collaborate and coordinate the analytical processes. Such approaches not only serve to facilitate the organization and flow of information, but may also serve to ensure the continuity and periodic reassessment of traces and objects.

The forensic advisor as generalist-forensic scientist is equipped to explore opportunities for analysis and the value of traces within the context of the investigation.[11] Not only does the forensic advisor function to advise on which traces to analyze, but also serves to suggest the best analytical strategy (i.e., sequence). The forensic advisor is able to assess and evaluate how traces may be impacted by laboratory procedures (e.g., mechanical actions such as swabbing; chemical exposure from processing fingermarks; the "cleaning" of projectiles prior to examination and recovery of adhering traces, etc.). Clear delineation that potential destruction or alteration of adhering traces in context of the case by the forensic advisor further allows for informed decision-making in the initial stages of an investigation and recovery of valuable traces that may otherwise be lost or altered due to hastily-executed analyses.

One of the key services the forensic advisor can provide on the front-end is assisting the investigator in the formulation of requests to the laboratory that ensure that the appropriate question(s) will be answered by the laboratory results (and any subsequent interpretation by the analyst and/or the forensic advisor). Moreover, the forensic advisor can guide the provision of necessary background information and follow-up such that appropriate reference ("standards") and comparison ("knowns") samples are included in the analysis and compared to "questioned" traces. Here, the forensic advisor would work with investigators to complete laboratory analysis requests while educating the investigators on what to expect from the analyses and resultant information.

3.2 | Midpoint

The midpoint includes coordinating and communicating during ongoing laboratory analysis and postlaboratory analysis. This stage can also include ongoing, nonlaboratory analysis processes, such as: coordinating with the pathologist to recover traces during autopsy, and investigating associated scenes (e.g., recovery of known samples from a suspect's residence or assisting with a secondary scene). This stage is characterized by second level case assessment. As analyses are performed and data is generated and interpreted (within a laboratory's framework of standard operating procedures and quality management), the forensic advisor reflects on front-end triaging decisions and new investigatory information to determine what analyses, if any, are next and what lines of inquiry can be set aside or pursued further. Analytical results and new information may lead to following up on the original traces and objects collected. In addition, traces and objects collected as part of the ongoing investigation may require analysis and comparisons. The forensic advisor is also actively searching for patterns in order to guide the investigation or draw connections between cases (see footnote 7).

When considering the operational coordination, forensic advisors can contribute to different steps of the forensic process by providing information about linked cases. Such proactive approaches to evaluating case linkages may result in the forensic advisor opening new lines of inquiry after consultation with law enforcement and/or jurists. Resnikoff et al. (2015) showed that information collected and shared by examiners and investigators from crime intelligence units influences crime scene investigation attendance and examination. The information about potential links with other cases can thereby shape selection of traces or objects to search for, recover, analyze, and further exploit. This is in addition to the application of a general perspective of forensic science, this time not case-specific, but in consideration of specific criminal phenomenon (Birrer, 2010). In this perspective, the trace collection and any subsequent steps can thus be optimized not only to provide information about a case, but to further corroborate a potential link to other cases, perpetrators, and/or crime scenes. Such functionality of the forensic advisor allows for both a reactive and proactive approach to investigations within the larger criminal justice framework.

The midpoint highlights the logistical part of the forensic advisor's roles and responsibilities, one aligned with that of a coordinator responsible for managing and disseminating information to relevant parties as it becomes available. Organizing the submission and preferred analytical sequence within the laboratory requires coordination that may extend across multiple laboratories or laboratory sections (e.g., one item subject to trace collection and analysis, molecular biology/DNA analysis and firearms analysis) and their respective analysts. The division of case information between the forensic advisor and the analyst in the lab can lend itself to mitigating the issues of cognitive biases, specifically confirmation bias. In addition, the forensic advisor shares relevant case information with investigators that may span multiple agencies or jurisdictions. Logistic coordination of items can begin with finding out whether a specimen or item potentially pertinent for the progression of a case is still available and if so, where it is located and in what condition, in order to then bring it to the laboratory for assessment and analytical sequence decisions. The forensic advisor may also suggest appropriate preservation and storage of traces that do not require further consideration but may become relevant at a later date or stage in the investigation. Coordination continues once the items are within a multidisciplinary institution and a sequential or parallel multidisciplinary forensic investigation needs to be performed.

Forensic advisors can help organize the correct and timely flow of the item through the different stages of analyses by facilitating the collaboration of experts from different fields. This may make the forensic advisor especially useful in cold cases or wrongful conviction cases in which tracking down old evidence and case files should be followed by a systematic review and assessment in order to support informed decision-making and maximize throughput and outcomes. The forensic advisor is in an excellent position to conduct periodic reviews of cold and unsolved cases.

3.3 | Back-end

The back-end stage includes interacting with and providing up-to-date information to end users with one of the primary functions of assisting with the understanding of forensic science as it pertains to the case at hand. Forensic advisors help end users understand the pathway of traces and objects from recovery at the crime scene, through the analysis of the traces and the methods employed, and to the interpretation of the results, and the uncertainties involved, once the analyses have been completed. The forensic advisor must know and be able to explain the meaning behind results and conclusions, and how such conclusions contribute (meaningfully or not) to the investigation and outcome of the case.[12] Moreover, the forensic advisor should be actively applying scientific methodology, being able to explain their reasoning behind decisions and the iterative process related to the development, acceptance, and rejection of alternate hypotheses that occurred throughout the investigation.

The judicial process involves a diversity of actors with a wide range of backgrounds and knowledge (via education, experience, and professional development practices), and the forensic advisor must be able to communicate clearly and effectively to all interested parties, as studies have shown that there are differences in the understanding of the conclusions reached by a forensic expert (Arscott et al., 2017; Martire et al., 2014). Such studies demonstrate the need for a generalist-forensic scientist to explain and articulate scientific concepts to law enforcement officials and jurists alike, resolving any inconsistencies that may arise. In addition, the forensic advisor must be knowledgeable and available to answer any questions posed in response to the results of trace examination and analysis, and any decisions that were made regarding their ultimate disposition.

In essence, forensic advisors have an information-centralizing role within the case framework. As shown by Bitzer (2019b), individuals in a forensic advisory capacity in five European countries all share the task of collecting information, whether it is police or forensic information; disseminating the information to the different stakeholders; and where necessary, explaining the resultant data and articulating any interpretations, conclusions, and relevance to the case.

4 | THE KEY ATTRIBUTES OF THE FORENSIC ADVISOR

The ideal attributes of the forensic advisor can be broadly approached based on the acquisition of knowledge, in which knowledge can be subdivided into formal undergraduate and graduate education; experience (in the field and/or laboratory); and training and professional development. Additional attributes include soft skills and skills that are operational in nature. In some agencies, forensic advisors are recruited exclusively from laboratory specialists, meaning they are already experts in one particular field of science. In other agencies, this is not a prerequisite, and scientists with an appropriate educational background are trained into the forensic advisor role to build experience. In yet another model, the role of forensic advisor is fulfilled by qualified crime scene investigators.

The key attributes are based on the generalist forensic scientist as discussed earlier in Section 1—having a broad, multidisciplinary knowledge base, and an understanding of forensic science, crime scene investigation, and traces. Knowledge of traces is not limited to the scientific foundations and analytical methods (i.e., laboratory standard operating procedures) of specific types of traces (fibers, paint, gunshot residue, tool marks, biological fluids, etc.), but also includes understanding the nature of traces. Such matters include: creation (genesis), discovery (detection and recognition), interpretation (significance, relevance, and probative value), and all related matters therein (transfer, persistence, perpetrator/victim/scene interactions, and environmental background). Soft skills of the forensic advisor include communication (including coherence in articulating ideas and concepts verbally and in writing), collaboration, and strategizing.

The forensic advisor should have knowledge of scientific methodology, including observation; inferential reasoning (abduction, induction, and deduction); the process of generating multiple hypotheses and assessing the probabilities of

propositions; and, in general, the ability to ask the right questions within the context or framework of a case (see, e.g., Jackson et al., 2006). The forensic advisor should understand the decision-making process through the stages of inquiry and reasoning. In 1974, Peterson (1974) reported an evidence screening model with decision-making process that set the stage for the importance of establishing and articulating the process of making decisions in forensic science (p. 12). In 2016, Bitzer et al. (2016) evaluated and refined the decision-making processes involved in criminal investigations, describing front-end decision-making as including the decisions to search for, collect and analyze recovered traces. It is recommended that the forensic advisor develop this (analytical thinking-centric) knowledge base at an undergraduate level through the pursuit of a degree in the natural sciences (e.g., biology, chemistry, or forensic science degree with a strong science and critical-thinking based curriculum [corresponding to the generalist approach described herein]).

The forensic advisor should have a fundamental understanding of criminal investigation and how scientific methods apply to event investigations and scene reconstructions. Direct connections to the potential collaboration between detectives and forensic advisors are abundant. Eck and Rossmo (2019) assert that investigative thinking and problem solving are central to a detective's function, with the authors specifically mentioning required skills in deductive, inductive, and abductive reasoning. Moreover, they state the need for careful evaluation and analysis of the evidence collected during an investigation and to understand its significance, reliability, and independence and patterns ("SRIP") as well as its viability of other explanations for the evidence (Eck & Rossmo, 2019, p. 610). Scientific crime scene investigation extends far beyond crime scene processing, which is often limited to documentation, collection, packaging, and transport of items from within a scene, criticisms, which have been described in the Introduction. Reversing the trend in dilution of crime scene investigation to technical duties of present day is an important role of the forensic advisor. The true complexity of proper crime scene investigation, the recognition, and detection of traces (not merely processing by technicians) continues to be overlooked although it has been acknowledged in the literature, as noted above (De Forest & Peter, 1999; Ludwig & Fraser, 2014; Wyatt, 2014). For example, Nickolls (1956) does not focus on the rote technical processes (e.g., photography, note-taking, and "bagging and tagging") in his description of the role of the scientist at the scene of the crime:

> To examine the general circumstances of the crime and form an opinion from the scientific angle of the nature of the events preceding the police investigation. To examine the scene of the crime for any unusual articles or fragments of material which have meaning to him in his special capacity as an expert but for some reason might not be suspected as being of value to the lay mind. To suggest from the examination of the scene what possibilities of future scientific action exist and, therefore, what kind of samples the police can expect to find of scientific value. Most important—to see for himself what the exact circumstances of the crime have been so that at the subsequent examination of the various scientific exhibits and also, if necessary, at the trial, the expert will know these circumstances. He will not be making examinations or giving evidence when he has no first-hand knowledge of the reason why he is making the examination or of what value or purpose is his subsequent evidence (p. 29).

It is expected that the forensic advisor be aware of cognitive biases and their mitigation. In 2016, Rossmo (2016) addressed thinking errors that can impact the outcome of a criminal investigation: premature judgment (faulty assumptions and probability errors) and tunnel vision (confirmation bias and groupthink). In response to these biases, Rossmo (2016) presents four aspects of criminal investigations that require reflection: evidence, patterns, analysis, and visualization. These aspects are intended to serve as a scientific method of developing alternate hypotheses and affirming support for conclusions in order to avoid unsupported hunches. In 2017, Dror (2017) presented seven sources of bias in what he described as forensic decision-making. These sources of bias were based on external forces: human nature; environmental, cultural, and experiential; and case specific. In general, Dror advocates for best practices in an effort to "maximize the quality of forensic decision making by lessening potential cognitive contamination such as bias" (Dror, 2017, p. 542). The integration of forensic advisors in the judicial process places them in a potentially good position to act as safeguards of the process with respect to bias. Restricting information sharing to strictly necessary participants in an effort to maintain the integrity of the analyst's work product, also known as sequential unmasking would be one additional task of forensic advisors (Koppl, 2019; Krane et al., 2008).

The forensic advisor should have knowledge of police and judicial processes, especially as they pertain to their jurisdiction and criminal justice system in which they are employed. This includes police procedure and the scope of criminal investigations as conducted by law enforcement personnel. It is highly recommended that the forensic advisor has understanding of the nature of criminal behavior in order to consider methods and patterns of criminal acts, especially

within the context of the crime scene (criminal phenomena as described by Resnikoff et al. (2015)). Also beneficial is basic knowledge of forensic pathology and toxicology to allow for meaningful exchanges with the pathologist (medical examiner) and toxicologist, specifically with respect to the persistence of, search for and interpretation of traces associated with their cases. As the role of digital traces increases in forensic investigations, forensic advisors should have basic knowledge in cybercrime and cyber investigations should they need to coordinate efforts, physical item transfers, and case findings with digital forensic investigators (see Miranda, 2021).

In addition, the forensic advisor should have an understanding of case interpretation, review, and assessment. The forensic advisor should be trained in project management; a prerequisite for the successful completion of the assignment of the forensic advisor is the availability and access to and organization of relevant information and people. In many aspects, the main role of the forensic advisor is to be a translator between the different actors, and as an excellent communicator of information and priorities. A successful advisor is one who is able to build a good working relationship with the different actors involved in the case. It is important to note that collaboration and communication between all actors are essential to prevent tunnel vision and limitations to creativity and viewpoint—each person brings different knowledge, experiences, and points of view to an investigation, thereby having the power to contribute uniquely to lines of inquiry and hypothesis generation (and rejection). Moreover, the forensic advisor must be familiar with the capabilities and procedures of the forensic laboratory and other service providers (subcontractors). It is also important that they be familiar enough with the quality assurance systems and regulations in order to be able to operate within established frameworks even in the case of nonroutine questions and samples.

While it should go without saying, the forensic advisor has a responsibility to remain current on the practices within the broad scope of forensic science. This includes staying up to date on developments within various disciplines through continuous professional development. Professional development includes reading journal articles, attending national and international conferences, and participating in training seminars and workshops on topics ranging from laboratory management and best practices to the development of new analytical methods, technologies, and databases. Such seminars include localized inter- or intra-agency meetings that may deal with organizational and operational matters specific to the forensic advisor's institution.

5 | CHALLENGES

Setting up and operating a forensic advisor position is not without its challenges. Some challenges have to do with the system and environment in which the forensic advisor is embedded, others pertain to the recruitment and training of forensic advisors themselves. There are myriad systems in places across different jurisdictions and countries, and there is no one-size-fits-all solution for how a forensic advisor position is best placed within those systems; rather the placement of the forensic advisor needs to be tailored to the system in which they operate. In addition to financial considerations, there are also legal and political matters to consider. Where new forensic advisor positions or teams are being introduced, there is also potential for issues to arise relative to culture and resistance to change.

Such matters fall under the strategic dimension of knowledge, which includes legal frameworks, political guidance, policing, and managerial aspects (Delémont et al., 2018; Ribaux et al., 2010). In many cases, these elements have restrictions and limitations that influence the ways in which forensic advice can be organized, as well as what roles and responsibilities the forensic advisor can be given (as discussed above). Besides the more obvious legal and financial implications, the authority that the forensic advisor is given also impacts how they are integrated into the system and on how other actors in the forensic process interact with the forensic advisor. Particularly in the case of new forensic advisors or forensic advisory units, it is imperative that the forensic advisor be seen as a necessity in complex cases, rather than merely an optional add-on. If the forensic advisor has no or limited responsibility or authority over decisions being made in the forensic process, they will quite often be overlooked in favor of those who have the authority over such decisions. This is despite the fact that the forensic advisor may be best suited to make such decisions on the basis of their generalist knowledge. While key decisions (such as the decision of which trace to submit for analysis), and the legal responsibility that goes with such decisions may lie with the entity in charge of the investigation, the forensic advisor should not be precluded from contributing to the dialogue regarding best practices with respect to the disposition of traces. Moreover, there are other auxiliary decisions, which can be delegated to the forensic advisor. Examples of authority that would fit the knowledge skills and abilities of forensic advisors, and have proven to help cement their role in the process, include the authority to fast-track examinations, to override exhibit number restrictions and to approve subcontracting examinations.

Besides the authority that the forensic advisor position has, the location in which the advisor is housed can also pose a challenge for them in their task of collecting, collating, and disseminating information. Often the forensic advisor position is associated with the institution in which they serve, and they can get caught up in the silos that exist between law enforcement, crime scene, the lab, and the end users. Bridging the silos between these actors requires a conscious effort, as well as authority to access all of the other entities including their personnel and relevant case-related data. Having a forensic advisor physically rotate between these different actors has proven to be one effective way of promoting integration, facilitating communication, and building relationships between actors. When forensic advisors (from the Belgian forensic institute) had an office at the prosecutor's office, where they worked part time instead of only working out of the institute, they became more visible to the end user, which resulted in a diversification of the cases they were requested for (Bitzer et al., 2018).

The question of which cases receive the support of a forensic advisor is also a decision, which can cause challenges. In some jurisdictions, the forensic advisor can only get involved in a case upon the request of an investigating entity, such as a principal investigator. In other jurisdictions, the forensic advisor can also select cases to review based on screening during the laboratory intake process and following requests coming into the laboratory as well as based on requests from the laboratory experts themselves. Another approach is to require all cases of a certain kind (e.g., sexual assaults, murders, etc.) or with a certain number of traces collected to pass through a forensic advisor review (see Bitzer, 2019a).

The intake policy for the forensic advisory unit and the number of advisors assigned to the unit are key elements that influence the number of cases the unit can handle and the throughput of the unit. Another key factor is the type of output that the forensic advisor is expected to produce. Does the advisor have to produce a longer, more detailed written report of their advice and the reasoning behind it, or is it sufficient that the information on which the decisions are made is documented in case notes and the advice is given verbally or by email? Forensic advice tends to be invested in more prominent ("high-profile") and severe cases, which often require a fast turnaround time, particularly in the early stages of the investigation. Reconciling this need for a fast turnaround time with the appropriate documentation required is not easy. If forensic advice is not available at the critical points of the investigation and forensic process, there is a risk that the input of the forensic advisor is overlooked or ignored all together, and in jurisdictions where forensic advice is only dispensed on request, the demand for forensic advice can decrease as a result of overly long turnaround times.

Besides issues with the placement and role of forensic advisor from a systems point of view, there are also challenges relating to the recruitment, training, and career path of a forensic advisor. Generalist education is not as abundant as specialist education, and providing in-house training for the knowledge, skills, and abilities required of a forensic advisor is very resource-intensive and challenging. Only parts of generalist education overlap with existing training provided to specialists in a forensic laboratory, or to crime scene staff in a crime scene unit. It is also more difficult to teach and train people in the reasoning required to approach complex problems than to teach them how to perform an analytical method and adhere to a standard operating procedure. Therefore, we argue for reassessment and refocusing of forensic science education; specifically, a reintroduction of educational programs tailored to the generalist forensic scientist. Moreover, attracting suitable candidates to apply for a forensic advisor position requires that the position be of a high enough grade to reflect the complexity of the tasks, and for there to be attractive options for career advancement available.

6 | MOVING FORWARD: CONCLUSIONS AND CONSIDERATIONS

Implementing the forensic advisor role is not without its challenges. No "one size fits all" model is realistic, therefore flexibility across jurisdictions is essential. The position requires buy in and support from stakeholders, and the forensic advisor must remain independent, serving as an advocate for forensic science and traces. We further recognize that there are implementation and utility considerations that add to the burden of carving out the forensic advisor's niche (e.g., a large endeavor that may start small; time to build relationships between actors). From a quality perspective, the utility of forensic advisors can be difficult to measure using traditional production metrics and benchmarks most commonly used in forensic science. Using a purely economic metric, such as "return on investment", that is, the number of analyzed samples and reports produced per working hour (Kurimski et al., 2017), does not adequately capture the complexity of the contribution. It is also more difficult to measure or demonstrate the ability to reason. Despite challenges, implementation of a forensic advisor provides substantial benefits that are worth exploring. In fact, it has been

demonstrated that by providing more investigative and intelligence information, having a forensic advisor position contributes positively to the larger goals of the criminal justice system (Bitzer et al., 2018).

Looking at Figure 1 we acknowledge the forensic advisor is not meant to replace or preclude the utilization of forensic practitioners within the current forensic science system (e.g., the SOCO, the specialist forensic scientist in the laboratory), but rather the advisor has an additional, overarching role, connecting the different stakeholders within the forensic science system.

It must be established and accepted that traces are a central component to forensic science and have considerable, underutilized investigatory capabilities within the broader criminal justice system. In the traditional perspective, traces contribute to the outcome of the case through their evidential value as established by the courts. This approach is largely reactive and focused on individual incidents, functioning as a tool for prosecutors (justice-driven). However, when expanding the scope beyond courtrooms, the focus shifts to the investigation. Traces have the ability to provide leads and elicit patterns that can broaden the scope of their utility. As Casey et al. (2019), assert that "the utilisation of traces in the earlier phases of evidential inquiries... has greater potential value, impact and overall investigative usefulness" (p. 130). In the hands of knowledgeable experts, traces have immense capability to contribute to larger criminal justice matters such as crime prevention and intelligence-led policing, contributing to a more proactive approach to criminal justice. Criminologists Eck and Rossmo (2019) argue for a shift from a reactive approach to a proactive, crime prevention approach within criminal investigation practices in an effort to detect and understand crime patterns, with such knowledge providing increased opportunities for early intervention and crime mitigation. Forensic scientist De Kinder and Pirée (2020) agree, asserting that their proposed centralized, forensic science unit has the capability of contributing "to intelligence led and problem-oriented policing [and] through their frequent contacts with police and juridical authorities, they are ideally positioned to start the dialogue" (p. 5).

The forensic advisor, utilizing a generalist approach to forensic science, would function to oversee the logistics of traces and the exchange of information between actors, triage traces, suggest methods of trace analysis in an analytical sequence, and explain and interpret analytical results. This interaction is more than passive communications via phone or email to convey messages between interested parties, and instead is an active role engaging with crime scene investigators and case detectives, laboratory analysts and specialists such as pathologists and toxicologists, and jurists. Where necessary, the forensic advisor would attend crime scenes or autopsies to guide the search, collection, and preservation of traces within a contextual framework, and work with the laboratory to carry the traces through their analytical sequences.

The scientific processes of detection, collection, and examination of relevant traces at the scene of a crime should be based on investigative pursuits, extending beyond the focus of courtroom presentation and case adjudication. A generalist forensic scientist in the role of forensic advisor is best equipped to oversee the potential contribution of traces in investigatory efforts and function as the connection between stakeholders within the broader criminal justice framework. In the delivery of forensic science services, both specialists and generalists have important roles to play. The current forensic science system weighs heavily on the specialist with less attention being given to the importance of the generalist. The generalist serves an important function in the forensic science system and serves to augment the work of the specialists within the laboratory. Moreover, the generalist forensic scientist, in the role of forensic advisor, helps bridge gaps and break down silos.

This manuscript provides an overview and introduction to the forensic advisor role, highlighting existing examples of implementation within Europe, along with ideas of how the position could be further developed. We present this with the goal of promoting the forensic advisor role within different jurisdictions, challenging institutions to adapt and implement the model that works best within their framework, based on the approach we have presented herein.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest for this article.

AUTHOR CONTRIBUTIONS

Sonja Bitzer: Conceptualization (equal); writing – original draft (equal); writing – review and editing (equal). **Michelle Miranda:** Conceptualization (equal); writing – original draft (equal); writing – review and editing (equal). **Rebecca Bucht:** Conceptualization (equal); writing – original draft (equal); writing – review and editing (equal).

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

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ENDNOTES

[1] For clarification purposes, the definition and roles of forensic science presented here are aligned with that of Roux et al. (2012). In addition, the definition of criminalistics is defined as the scientific discipline concerned with the detection, recognition, identification, individualisation, and interpretation of (physical and digital) traces.

[2] Throughout this manuscript, "jurist" serves to encompass those individuals within the myriad international legal systems including lawyers (e.g. defense), prosecutors, magistrates, and judges.

[3] End users includes those individuals that receive the analytical results toward some end, such as litigation, case closure, and so on.

[4] This would also extend to other disciplines within the forensic science system (e.g., anthropologists) depending on the nature of the case and the potential for trace persistence, recovery, and relevance.

[5] These two points correspond to the decision points of "attending the crime scene" and "searching for traces," which are influenced by different knowledge dimensions as described in Ribaux et al. (2010).

[6] Here we are referring to the lead investigator whether designated by law enforcement agency or through the legal system (e.g., prosecutor's office).

[7] We are referring to criminological patterns that may indicate repeat offenders and/or linked crimes and subsequently contribute to forensic intelligence efforts.

[8] Aligned with the general scientific methodology of observation, hypothesis generation, testing, and the continual application of analytical reasoning and decision-making, iterative reviews of trace assessment, and relevance along with refinement and consideration of alternate hypotheses is expected to occur throughout all three stages as the investigation progresses and new information becomes available. As such, with respect to the following sections, what is covered at the front end should be considered at other stages as necessary.

[9] For purposes of this manuscript, objects are those items that require trace processing to search for and recover traces for further analysis. For example, a section of pressure sensitive adhesive tape has value as a trace within itself, but also requires processing in order to collect traces adhering thereon (e.g. fibers, cosmetics, fingermarks, biological fluids, etc.). As such, the tape would be an object. Other examples of objects include bed linens, car seat covers, digital devices, and so on.

[10] Refer to Kind (1987), who designates a chapter in his text to the "conversion, or refining of information into degrees of relevancy" (p. 205).

[11] This could be done by applying, for instance, the case assessment (CAI) model as described by Cook et al. (1998).

[12] For example, the forensic advisor would function to explain why a result does *not* support a hypothesis, which may be a more complex undertaking when compared to the converse.

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REFERENCES

Arscott, E., Morgan, R., Meakin, G., & French, J. (2017). Understanding forensic expert evaluative evidence: A study of the perception of verbal expressions of the strength of evidence. *Science & Justice*, *57*(3), 221–227. https://doi.org/10.1016/j.scijus.2017.02.002

Baechler, S., Morelato, M., Gittelson, S., Walsh, S., Margot, P., Roux, C., & Ribaux, O. (2020). Breaking the barriers between intelligence, investigation and evaluation: A continuous approach to define the contribution and scope of forensic science. *Forensic Science International*, *309*, 110213. https://doi.org/10.1016/j.forsciint.2020.110213

Birrer, S. (2010). Analyse systématique et permanente de la délinquance sérielle: Place des statistiques criminelles; apport des approches situationnelles pour un système de classification; perspectives en matière de coopération. Université de Lausanne.

Bitzer, S. (2019a). The influence of Forensic Advisors on the use of forensic science in the Belgian criminal justice system. *Forensic Science International*, *296*, 123–131. https://doi.org/10.1016/j.forsciint.2019.01.019

Bitzer, S. (2019b). Forensic case coordination in Europe—Their role within 5 European institutes. *Forensic Science International*, *300*, 1–5. https://doi.org/10.1016/j.forsciint.2019.04.016

Bitzer, S., Heudt, L., Barret, A., George, L., Van Dijk, K., Gason, F., & Renard, B. (2018). The introduction of forensic advisors in Belgium and their role in the criminal justice system. *Science & Justice*, *58*(3), 177–184.

Bitzer, S., Ribaux, O., Albertini, N., & Delémont, O. (2016). To analyse a trace or not? Evaluating the decision-making process in the criminal investigation. *Forensic Science International*, *262*, 1–10. https://doi.org/10.1016/j.forsciint.2016.02.022

Bucht, R. E., Willis, S., Wilson, L., George, L., & Miranda, M. D. (2021). Searching for the silver bullet of a unified system to deliver forensic science. *Proceedings of the American Academy of Forensic Sciences. 73rd Annual Scientific Meeting*.

Casey, E., Ribaux, O., & Roux, C. (2019). The Kodak syndrome: Risks and opportunities created by decentralization of forensic capabilities. *Journal of Forensic Sciences*, *64*(1), 127–136. https://doi.org/10.1111/1556-4029.13849

Collins, R. L. (1961). Improved crime scene investigations. *The Journal of Criminal Law, Criminology, and Police Science*, *52*(4), 469. https://doi.org/10.2307/1141278

Cook, R., Evett, I. W., Jackson, G., Jones, P. J., & Lambert, J. A. (1998). A model for case assessment and interpretation. *Science & Justice*, *38*(3), 151–156.

Crispino, F., Brault, J., & Burgueyre, P. (2009). Le coordonnateur en criminalistique Un nouvel acteur du renseignement criminel. *Revue de La Gendarmerie Nationale*, *4*, 7–15.

Crispino, Frank, Vincent Mousseau, Simon Baechler, Olivier Delémont, Claude Roux, and Olivier Ribaux. "Forensic science understanding by police managers: New opportunities to re-think its involvement in policing." In Policing in an Age of Reform, edited by James J. Nolan, Frank Crispino, and Timothy Parsons, 117–31. *Palgrave's critical policing studies*. Springer International Publishing, 2021. https://doi.org/10.1007/978-3-030-56765-1_8.

De Forest, P. (2004). Crime scene investigation. In L. Sullivan, M. Rosen, D. Schulz, & M. Haberfeld (Eds.), *Encyclopedia of law enforcement* (Vol. 1–3). SAGE Publications. https://doi.org/10.4135/9781412952415

De Kinder, J., & Pirée, H. (2020). The future of the forensic science providers – Time to re-think our structures? *Forensic Science International*, *316*, 110471. https://doi.org/10.1016/j.forsciint.2020.110471

DeHaan, J. D. (2008). Stuart Kind memorial lecture. Forensic Science Society. November 2, 2007. *Science & Justice*, *48*(2), 91–94. https://doi.org/10.1016/j.scijus.2008.03.005

Delémont, O., Bitzer, S., Jendly, M., & Ribaux, O. (2018). The practice of crime scene examination in an intelligence-based perspective. In Q. Rossy, D. Décary-Hétu, O. Delémont, & M. Mulone (Eds.), *The Routledge international handbook of forensic intelligence and criminology*. Taylor & Francis.

Delémont, O., Lock, E., & Ribaux, O. (2014). Forensic science and criminal investigation. In *Encyclopedia of criminology and criminal justice* (pp. 1754–1763). Springer.

Dror, I. E. (2017). Human expert performance in forensic decision making: Seven different sources of bias. *Australian Journal of Forensic Sciences*, *49*(5), 541–547. https://doi.org/10.1080/00450618.2017.1281348

Eck, J. E., & Rossmo, D. K. (2019). The new detective: Rethinking criminal investigations. *Criminology & Public Policy*, *1745-9133*, 12450. https://doi.org/10.1111/1745-9133.12450

Forensische Ondersteuning Helpt Strafrechters. (2013, April 11). https://www.rechtspraak.nl/Organisatie-en-contact/Organisatie/Raad-voor-de-rechtspraak/Nieuws/Paginas/Forensische-ondersteuning-helpt-strafrechters.aspx

Forest, D., & Peter, R. (1999). Recapturing the essence of criminalistics. *Science & Justice*, *39*(3), 196–208. https://doi.org/10.1016/S1355-0306(99)72047-2

Fraser, J. (2007). The application of forensic science in criminal investigation. In N. Tim, T. Williamson, & A. Wright (Eds.), *Handbook of criminal investigation* (pp. 381–402). Willan.

Gremaud, J.-L., Girod, A., Bonfanti, M., Schnetz, B., Bruegger, C., Guéniat, O., & Schuwey, P. (2015). La voix des décideurs d'aujourd'hui. In O. Ribaux (2011), *La science forensique: Le futur d'une discipline*. Presses Polytechniques et Universitaires Romandes.

Gross, H. (1893). *Handbuch Für Untersuchungsrichter Als System Der Kriminalistik*. Leuschnen und Lubensky.

Jackson, G., Jones, S., Booth, G., Champod, C., & Evett, I. W. (2006). The nature of forensic science opinion—A possible framework to guide thinking and practice in investigations and in court proceedings. *Science & Justice: Journal of the Forensic Science Society*, *46*(1), 33–44.

Kind, S. S. (1987). *The scientific investigation of crime*. Forensic Science Services.

Kirk, P. L. (1954). Progress in criminal investigation. *The Annals of the American Academy of Political and Social Science*, *291*(1), 54–62. https://doi.org/10.1177/000271625429100108

Koppl, R. (2019). Strategic choice in linear sequential unmasking. *Science & Justice*, *59*(2), 166–171. https://doi.org/10.1016/j.scijus.2018.10.010

Krane, D. E., Ford, S., Gilder, J. R., Inman, K., Jamieson, A., Koppl, R., Kornfield, I. L., Michael Risinger, D., Rudin, N., Taylor, M. S., & Thompson, W. C. (2008). Sequential unmasking: A means of minimizing observer effects in forensic DNA interpretation. *Journal of Forensic Sciences*, *53*(4), 1006–1007. https://doi.org/10.1111/j.1556-4029.2008.00787.x

Kurimski, L. M., Speaker, P. J., & Bassler, J. R. (2017). Project FORESIGHT and return on investment: Forensic science laboratories and public health laboratories. *Forensic Science Policy & Management*, *8*, 1–12.

Laurin, J. (2013). Remapping the path forward: Toward a systemic view of forensic science reform and oversight. *Texas Law Review*, *91*, 1051–1118.

Ludwig, A., & Fraser, J. (2014). Effective use of forensic science in volume crime investigations: Identifying recurring themes in the literature. *Science & Justice*, *54*(1), 81–88. https://doi.org/10.1016/j.scijus.2013.09.006

Margot, P. (2011). Forensic science on trial—What is the law of the land? *Australian Journal of Forensic Sciences*, *43*(2–3), 89–103. https://doi.org/10.1080/00450618.2011.555418

Martire, K. A., Kemp, R. I., Sayle, M., & Newell, B. R. (2014). On the interpretation of likelihood ratios in forensic science evidence: Presentation formats and the weak evidence effect. *Forensic Science International*, *240*, 61–68. https://doi.org/10.1016/j.forsciint.2014.04.005

Miranda, M. D. (2021). Investigations: Cybercrimes. In L. R. Shapiro & M.-H. Maras (Eds.), *Encyclopedia of security and emergency management*. Springer International Publishing.

National Academy of Sciences. (2009). *Strengthening forensic science in the United States: A path forward*. National Research Council.

Nickolls, L. C. (1956). *The scientific investigation of crime*. Butterworth & Co.

O'Hara, C. E., & Osterburg, J. W. (1949). *An introduction to criminalistics: The application of the physical sciences to the detection of crime*. The MacMillan Company.

Peterson, J. L. (1974). *The utilization of criminalistics services by the police*. U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice.

Reiss, R. A. (1911). Manuel de police scientifique (technique). Vols et homicides. Payot Alcan.

Resnikoff, T., Ribaux, O., Baylon, A., Jendly, M., & Rossy, Q. (2015). The polymorphism of crime scene investigation: An exploratory analysis of the influence of crime and forensic intelligence on decisions made by crime scene examiners. *Forensic Science International*, *257*, 425–434. https://doi.org/10.1016/j.forsciint.2015.10.022

Ribaux, O., Baylon, A., Lock, E., Delémont, O., Roux, C., Zingg, C., & Margot, P. (2010). Intelligence-led crime scene processing. Part II: Intelligence and crime scene examination. *Forensic Science International*, *199*(1–3), 63–71.

Ribaux, O., Crispino, F., & Roux, C. (2015). Forensic intelligence: Deregulation or return to the roots of forensic science? *Australian Journal of Forensic Sciences*, *47*(1), 61–71. https://doi.org/10.1080/00450618.2014.906656

Ribaux, O. & Margot, P. (2011). Science forensique. Dictionnaire de Criminologie En Ligne.

Risinger, M. (2013). Reservations about likelihood ratios (and some other aspects of forensic 'Bayesianism'). *Law, Probability and Risk*, *12*(1), 63–73. https://doi.org/10.1093/lpr/mgs011

Rossmo, D. K. (2016). Case rethinking: A protocol for reviewing criminal investigations. *Police Practice and Research*, *17*(3), 212–228. https://doi.org/10.1080/15614263.2014.978320

Roux, C., Crispino, F., & Ribaux, O. (2012). From forensics to forensic science. *Current Issues in Criminal Justice*, *24*, 7–24.

Schuliar, Y. (2009). *La Coordination Scientifique Dans Les Investigations Criminelles. Propositions d'organisation, Aspects é Thiques Ou de La Nécessité d'un Nouveau Métier*. Université Paris Descartes.

Tilley, N., & Ford, A. (1996). *Forensic science and crime investigation*. Home Office.

Vollmer, A. (1930). The scientific policemen. *American Journal of Police Science*, *1*, 8–12.

Weyermann, C., & Roux, C. (2021). A different perspective on the forensic science crisis. *Forensic Science International*, 110779. https://doi.org/10.1016/j.forsciint.2021.110779, *323*, 110779

Williams, R. (2007). Policing and forensic science. In T. Newburn (Ed.), *Handbook of policing* (pp. 760–793). Willan.

Wyatt, D. (2014). Practising crime scene investigation: Trace and contamination in routine work. *Policing and Society*, *24*(4), 443–458. https://doi.org/10.1080/10439463.2013.868460

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