Forensic Science International: Synergy 8 (2024) 100476

Contents lists available at ScienceDirect

Forensic Science International: Synergy

journal homepage: www.sciencedirect.com/journal/forensic-science-international-synergy

Quality management system in forensic science: An African perspective

ARTICLE INFO

Keywords:
Africa forensic science
Accreditation
Peer review
Quality management system

ABSTRACT

Critical issues in forensic science quality management have emerged in recent decades. The debate on accrediting quality management systems of forensic laboratories is relevant to the African context. Neuteboom, Ross, Bugeja, Willis, Roux, and Lothridge (2022) have conducted a comprehensive survey exploring critical issues in their article "Quality Management in Forensic Science: A Closer Inspection." Their work is a crucial foundation for our discussion, urging the African forensic community to engage in more in-depth conversations. This letter briefly describes the survey, discussing embracing the Sydney Declaration (SD) for Forensic Sciences and issues of quality management systems comprising standards, accreditation, and potential regulation, and highlights the issue of cognitive competency from an African perspective. This underscores the urgent need for critical dialogue, emphasizing that the time for action is now, and urges practitioners, particularly in Africa, to enhance quality management systems to deliver superior forensic products.

Letter to the Editor,

Neuteboom et al. [1] summarized the findings of an international survey. They highlighted several significant concerns: the fit for the purpose of ISO17025 as a standard for forensic sciences, a lack of agreement on the definition of forensic science, insufficient recognition of crime scene investigation as part of the quality management system, unacknowledged cognitive abilities, and motivation for accreditation and continuous improvement that internal factors rather than customers drive need [1]. The international survey assessed three themes: i) fitness for the purpose of the ISO standards used by forensic laboratories, ii) competencies, and iii) education and training. This survey was developed by the International Forensic Strategic Alliance and six regional networks, including the Southern African Regional Forensic Science Network (SARFS). The targets of this survey were directors, senior managers, and quality managers of forensic science laboratories. These findings have raised crucial issues for the forensic science community, and their insights merit a more in-depth debate in the forensic community [1].

The SARFS was established in October 2008 and comprises forensic science institutes from 16 countries in the Southern African Development Community (SADC). Operating under the SADC's structure, SARFS is affiliated with the Southern Africa Region Police Chiefs Cooperation Organisation (SARPCCO), tasked with combating cross-border crimes. SARFS institutions offer forensic services to law enforcement agencies in SADC countries, aiming to advance forensic sciences through capacity building, proficiency testing, quality management, and collaboration [2]. We observed that SAFRS requires a website, and minimal information on its operations is available in the public domain.

No response was received from SARFS [1]. SARFS participation in this survey was necessary for the forensic community to gain a thorough and crucial understanding of the present status of forensic services and management of quality systems in Africa. We suggest that future surveys targeting African respondents include regional and country-representative professional bodies such as the African Forensic Sciences Academy (AFSA) and the South African Academy for Forensic Science (SAAFS) [3,4]. AFSA aims to promote trace-based, innovative, and multidisciplinary forensic science practices; foster relevant and impactful research; disseminate forensic science knowledge among African practitioners and institutions; develop appropriate standards and guidelines; and facilitate collaboration, partnerships, and training in forensic sciences. SAAFS actively facilitates the voluntary adoption of a member's minimum requirements, best practices, and scientific protocols to support that forensic findings are reliable and reproducible [4]. The SAAFS aims to restore the empirical integrity of forensic sciences and uphold forensic scientists' professional dignity, thereby increasing public confidence in the justice system. The SAAFS seeks to actively collaborate with African and international associations to support, share, and encourage its members to adhere to the highest global standards of conduct and practice [4].

The suggested approach of fostering collaboration and information sharing among international, African regional, and country-specific professional organizations adds value by harnessing the expertise and networks of well-organized professionals who actively champion quality forensic sciences within African and regional contexts. By leveraging these partnerships, the initiative can tap into diverse perspectives and resources, ultimately enhancing the effectiveness and impact of quality forensic science practices in various settings. Liaising and collaborating with various organizations supports the Sydney Declaration for Forensic Sciences (SD) of continuous collaborations, and is expected to increase the likelihood of receiving responses in future surveys.

SD is a global initiative that outlines the principles and guidelines of forensic sciences worldwide [5]. SD consists of the following seven fundamental tenets:" i) activity and presence produce traces that are fundamental vectors of information; ii) scene investigation is a scientific and diagnostic endeavor requiring scientific expertise; iii) forensic science is case-based and reliant on scientific knowledge, investigative

https://doi.org/10.1016/j.fsisyn.2024.100476
Received 1 March 2024; Received in revised form 24 April 2024; Accepted 26 April 2024

methodology, and logical reasoning; iv) forensic science is an assessment of findings in context due to time asymmetry; v) forensic science deals with a continuum of uncertainties; vi) forensic science has multidimensional purposes and contributions; and vii) forensic science findings acquire meaning in context.

SD is a product of collaborative efforts and emphasizes the importance of ethical and scientific standards in forensic science. This ensures the accuracy, reliability, and fairness of the forensic traces in legal proceedings. This calls for continued collaboration among forensic practitioners, researchers, policymakers, and legal professionals to promote best practices and advancements in the field. The key points addressed in SD include quality assurance, training and education, independence and impartiality, research and innovation, ethical considerations, and international collaboration [5]. SD aims to align practices, enhance accountability, and promote expertise among practitioners, particularly in response to emerging technologies, such as artificial intelligence [5,6]. Given the continent's absence of specific frameworks in forensic sciences, SD is deemed crucial in Africa. It can be used as a barometer and beacon to guide the building of forensic sciences on the African Continent on a sound foundation, assisting forensic science professionals in upholding the integrity of their field, acknowledging their boundaries, offering expert judgements based only on facts and scientific evaluation, and enhancing communication with relevant parties [6,7]. Moreover, Implementing the SD can contribute to Africa's development and foster trust in forensic sciences. Several scholars have highlighted the current pragmatic reality of forensic practice in Africa, emphasizing the necessity for regulation, certification, accreditation, and oversight [7–17]. African nations are encouraged to adopt SD in forensic programs [7,8].

Neuteboom et al. [1] discussed the prevalent uncertainty surrounding the definition of forensic science. This uncertainty is exacerbated by the vast array of disciplines encompassed by forensic sciences and the diverse services of individual organizations. A holistic perspective that includes a unified definition and governing principles closely aligned with forensic science and its practices is required to address this issue. It is justifiable to advocate the adoption of SD, which seeks to address this dilemma and promises substantial benefits to the forensic science community [2]. SD redefines and addresses uncertainty in the definition of forensic science. SD defines the concept of *forensic science* as "the oriented research activity based on cases (or on a multiplicity of cases) that uses scientific principles to study traces–the remains of past activities (such as the presence or actions of an individual) through their detection, recognition, collection, examination, and interpretation–to understand anomalous events of public interest (such as crimes and security incidents)".

The concept that criminal activities surpass national boundaries highlights the need to compare forensic science data and results, such as the exchange of forensic DNA profiles, among various international forensic laboratories [7,8]. Establishing international standards in forensic science is essential for improving forensic evidence's dependability, clarity, and trustworthiness. The purpose of these standards is to synchronize work methods internationally, allowing for cooperation in addressing cross-border investigations and catastrophic incidents. Uniform standards promote the transfer of forensic findings, data, and knowledge between nations, ensuring that forensic services are appropriate for the intended objectives. Thus, standardization of forensic techniques is crucial for ensuring uniform interpretation and documentation of evidence, facilitating the exchange of information between different jurisdictions for exculpatory or prosecution purposes [7,8]. Uniform and widely recognized criteria in Africa will benefit all parties involved in the criminal justice system, supporting the SD principles of enhancing scientific proof offered in court. Ensuring the forensic trace's accuracy, reliability, and fairness in legal proceedings.

A quality management system suitable for its intended purpose should maintain a balance that enables organizations to achieve their objectives, foster continuous improvement, effectively manage risks, and cultivate a positive quality culture [18]. The forensic community has followed the ISO17025 standard for many decades and has later adopted the ISO17020 standard.

Neuteboom et al. [1] argued that ISO 17025 and ISO 17020 are not adequately tailored to meet the needs of forensic sciences and thus have inherent limitations. Other scholars have raised similar concerns regarding the suitability of ISO 17025 for forensic sciences [19,20]. Additional guidelines for applying ISO 17025 and ISO 17020 in forensic sciences have overcome these limitations. Australia overcame the limitations of ISO 17025 by developing core forensic standards, AS 5388 1–4, which are being developed into international standards [21–24]. Other institutions and associations have developed forensic guidelines that supplement ISO17025 [25–33]. The South African National Accreditation System (SANAS) has developed additional documents to supplement ISO 17025 standards for forensic laboratories [29–32]. National and regional associations in forensic science have assumed the responsibility of advocating quality management systems and facilitating accreditation [17,33,34].

The South African National Accreditation System (SANAS) accredits forensic laboratories in South Africa. Many African countries use SANAS to accredit services and products in their countries. SANAS has created multiple technical guidance documents for forensic sciences (for example TG 01–03: Criteria for Laboratory Accreditation in the Field of Forensics TG 41-03: Guidelines for the Verification and Validation of Methods in Forensic Chemistry TG 42-03: Technical Guidance for Forensic DNA Testing Laboratories. TG43-03: Technical Guidance for Forensic Ballistic, Impressions, and Questioned Document Laboratories) to supplement ISO 17025 [29–32].

The International Organization for Standardization (ISO) has recognized that ISO 17025 and ISO 17020 are not fit for purpose and has highlighted the need for standards tailored exclusively for forensic sciences. Consequently, the ISO Technical Committee (ISO/TC 272) produced standards (based on the Australian standard AS 54388 1–4) for forensic sciences in multiple stages. Phases 1 and 2 have been completed and made available to the forensic community and the public. These standards are ISO 21043–1:2018, which focuses on terminology and definitions in forensic sciences, and ISO 21043–2:2018, which deals with recognizing, recording, collecting, transporting, and storing forensic materials. Phases 3 and 4 are under development, and will involve analysis and reporting in forensic sciences. The ISO emphasizes the standardization of quality management and practice in forensic sciences, while execution details are left to best practice manuals, standard operating procedures, and national regulations [22–24]. African countries, alongside their National Accreditation Bodies, will need to assess and adopt the most suitable strategy for transitioning from ISO 17025 to newer, more relevant ISO standards for forensic sciences. We suggest that African countries that have not yet developed a quality management system for crime scene investigation and collecting traces instead develop a quality management system based on ISO21043–1:2018 and ISO21043–2:2018.

South African legislation requires forensic DNA testing laboratories to implement a quality management system for testing DNA traces, following ISO standards and any other additional requirements determined by the local South African Accreditation National System [35]. Legislation in South Africa and other African countries does not require independent peer evaluation of the quality management system or testing procedures through accreditation [36]. While several forensic laboratories in Africa have established and enacted quality management systems (QMS) rooted in ISO 17025, accreditation of these laboratories remains rare despite the successful implementation of functional and effective QMS over several years. One notable exception is the forensic laboratory in Mauritius and the Government Chemist Laboratory in Tanzania, which have achieved accreditation to ISO 17025 [37]. Several scholars have argued that stating in court that their laboratories comply with ISO standards is not enough [15, 16, 37].

Neuteboom et al. [1] correctly asserted that internal factors

primarily drive the impetus for quality management initiatives in forensic sciences. According to the survey, the desire to obtain accreditation and strive for continuous development is driven by internal motivation rather than external pressure from customers. Our African observations show that many laboratory customers, particularly investigators and courts, must attach more significance to and advocate accreditation. In numerous court cases, particularly in South Africa, the integrity of trace evidence or the reliability of results has been questioned, resulting in instances where forensic evidence has been dismissed or challenged [38–41].

Accreditation is crucial for forensic laboratories, as it involves the forensic examination process for independent peer review. Interested parties are assured that there is conformance to minimal standards requirements. Thus, accreditation to standards serves as external validation, indicating that an organization possesses the enduring capability to consistently deliver dependable outcomes in its accredited endeavors [16,42,35,43]. The lack of accreditation in forensic laboratories erodes trust in their conformance with standards, and threatens the integrity and fairness of the justice system [15–17,36]. The absence of accreditation is exacerbated by a lack of statuary regulation in most African countries, underscoring the urgent need to establish and uphold specific standards for forensic sciences [13,15–17,34,36]. Accreditation has been criticized for being "insufficiently rigorous," and the PCAST has asserted that accreditation alone cannot replace empirical evidence of scientific validity and reliability [44]. Quality standards alone do not provide an infallible quality assurance.

Forensic evidence produced in court must be accurate, easily understood, well-explained in methodology, and reliable [36,45]. During the last decade, Forensic Sciences has suffered many vicissitudes [16,17,36]. The recent case of an accredited laboratory exhibiting significant errors in its analysis procedures operating below the ISO 17025 standard requirements is a prime example. This non-conformance demonstrates potential deficiencies in internal and external peer-review audits, suggesting that they may not have been sufficiently rigorous [17,36,46,47].

Quality management systems and accreditation processes are frequently promoted as effective self-regulation methods in the forensic sciences. Nevertheless, this strategy is vulnerable to selective application because not all practitioners or laboratories meet the same criteria. Despite diligent attempts to obtain accreditation, many abnormalities still need to be discovered in the field, diminishing the trustworthiness and dependability of forensic evidence in courtrooms. To overcome these limitations, forensic sciences must go beyond self-regulation and adopt oversight from statutory authorities through authoritative regulatory enforcement procedures.

An organization with statutory powers is a custodian of standards, ensuring compliance with established rules and optimal methods throughout the industry [17,36,47]. This regulatory entity should optimally embrace and uphold the ideals delineated in SD, which significantly emphasizes the crucial role of credibility and integrity in forensic sciences. By creating a statutory organization for forensic sciences, the forensic scientific community can reduce the dangers of biased enforcement and irregular compliance with quality benchmarks. This regulatory entity should possess the power to develop codes of practice, oversee, control, and ensure adherence to standardized procedures, enhancing the trustworthiness and dependability of forensic evidence presented in court proceedings. Furthermore, it should establish a structure for ongoing enhancement and responsibility within the discipline, ultimately bolstering public trust and confidence in the forensic research results.

Zambia developed a legal framework for forensic practice that addresses areas of weakness by establishing the National Forensic Authority [48]. This statuary authority regulates the country's forensic sciences and pathology practices and possesses statutory power to enforce standards and guidelines for forensic facilities. The aim is to ensure that both public and private forensic facilities in Zambia adhere to the minimum quality standards and guidelines. This regulatory framework represents the first in Africa and the second globally, following the UK's Forensic Science Regulator for England and Wales [49]. We support the proposals of various scholars and institutions advocating for the creation of a national statutory body responsible for regulating forensic practices [7–18, 36]. While accreditation of forensic laboratories is voluntary, adherence to statutory regulatory codes of practice is obligatory and subject to regulation. Regulatory bodies should establish and regularly update codes outlining safeguards and standards and oversee performance, including procurement practices.

ISO 17025 does not explicitly address supplier products (i.e., trace material submitted by the crime scene examiner to the laboratory); it emphasizes a risk-based approach. Forensic laboratories must evaluate the quality and dependability of products acquired from suppliers (crime scene examiners), which impacts their testing and calibration procedures. This evaluation is essential for maintaining the overall quality of laboratory operations and guaranteeing accurate and reliable results. A central tenet for SD-defining forensic science is that traces are the fundamental components of the physical or digital record of an event or sequence of events [5].

We agree with Neuteboom et al. [1] that processing and collecting traces at crime scenes is an integral component of a comprehensive quality management system in the criminal justice system. This viewpoint is aligned with the SD principles. In the context of crime scene processing, it is essential to note that while correct procedures may not eliminate associated risks and issues, they significantly diminish the chances of errors like cross-contamination or mishandling of evidence. If these errors occur at the crime scene, they can adversely affect subsequent laboratory processing. The crime scene serves as the initial point in the workflow where risks may arise. Tracking and collecting traces at crime scenes and forensic laboratory operations are treated as independent procedures in many African countries and are managed separately. In South Africa, crime scene processing, forensic trace analysis, and the administration of fingerprint and forensic DNA databases fall under the jurisdiction of the division in charge of forensic sciences, which is a national competency [4]. This structure permits the implementation of an integrated quality management system to effectively mitigate the risks at the various steps of the forensic value chain.

The degree to which forensic laboratories optimize the analytical value of traces is inextricably linked to the identification, documentation, collection, and preservation of the traces collected at the crime scene. Crime scene processing entails more than just documenting the scene and gathering traces; it involves a significantly complex semiotic processes of collecting, performing tests, and interpretation. SD emphasizes that crime scene processing and tracing are both scientific and diagnostic in supporting investigative and intelligence work. Both digital and physical traces are crucial in the broader framework of the criminal justice system. When laboratories receive traces that have been painstakingly gathered, carefully documented, and skilfully preserved, their confidence in the quality of the analysis is significantly boosted, thanks to the effective risk mitigation implemented at the crime scene. Addressing these aspects effectively reduces the likelihood of errors stemming from faulty or compromised trace collection, thereby enhancing the overall quality of the laboratory efforts. Forensic sciences in Africa should focus on serving justice or being motivated by legal disputes and prioritize its potential impact on policing, security, and broader criminal justice issues.

We agree with Neuteboom et al. [1] that forensic sciences must adequately address continuous cognitive competency, particularly in Africa. SD serves as a universal foundation for informing forensic science competencies and, in turn, should shape education, training, and quality management programs. Continuous cognitive competency in forensic sciences refers to the ongoing maintenance and development of cognitive skills such as critical thinking, problem-solving, decision-making, and analytical reasoning among forensic practitioners. This involves staying current with advancements in scientific methodologies, technologies, and best practices relevant to forensic analysis. Continuous

cognitive competency also entails recognizing and mitigating the cognitive biases that affect forensic analysis and interpretation [50–53]. This ongoing process ensures that forensic practitioners maintain high proficiency and accuracy in their work, contributing to the reliability and credibility of the forensic evidence presented in legal proceedings.

Noncompliance with continuous cognitive competency in forensics and Africa can be mainly ascribed to the general need for more awareness among forensic practitioners. or fully understanding the importance of this concept. African forensic laboratories experience many challenges, including insufficient resources, time, and funding [54–56]. They may give lower priority to implementing comprehensive programs for continuous cognitive competency awareness training and assessment. Moreover, assessing cognitive competency in forensic science in Africa may be challenging because of the subjective nature of many forensic analyses and the difficulty in objectively measuring cognitive skills. Moreover, the need for an appropriate uniform forensic standard and guidance to assess cognitive competency in forensic science makes it challenging to ensure consistent and continuous cognitive competency.

Forensic sciences has undergone continual evolution, necessitating ongoing evaluation to ensure the relevance of quality management procedures and practices. Forensic science networks in Africa can entrench the SD principle of comprehensive international engagement by actively promoting discussions with legal professionals and public regulators, mirroring practice standards in Africa and other parts of the world. This collaborative approach can expedite legislative reform, ensuring that advancements in our field translate into actionable changes in our justice systems [6,7,57]. By doing so, those working at the intersection of science and law can better align with science's knowledge and insights into the court and the justice system.

ISO standards necessitate risk assessment and management [36,46]. A stronger focus should be on ongoing risk identification and effective risk management in forensic sciences. Creating customized courses in forensic sciences and mandating regular attendance for all employees to cultivate a heightened awareness of risk, have a continual improvement mindset, be mindful of contextual bias, and minimization of risk would be beneficial.

The inherent drive for accreditation and desire for continual improvement exemplifies the unwavering dedication of the international forensic community to advancing the acceptability and reliability of forensic sciences. The ongoing improvement and development highlighted in the landmark Sydney Declaration illustrates this commitment. It is our experience that many forensic practitioners in Africa are highly committed to performing sterling work to ensure that necessary steps are taken and implemented to support the reliability of their findings.

Neuteboom et al. [1] stimulated critical discussion within the forensic science community. Their contributions to forensic sciences have inspired practitioners, especially in Africa, to adopt SD and take a more proactive approach to continually improve the quality management system, ultimately providing high-quality forensic goods to laboratory consumers. SD provides a foundation for harmonizing practices and fostering consensus, essential for navigating the changing landscape of forensic techniques, including emerging technologies.

Consent

Consent is not applicable because this manuscript is a Letter to Editor.

Ethical approval

Ethics approval is not applicable because this manuscript is a Letter to Editor.

Funding

There are no sources of funding to declare.

Guarantor

Guarantor is not applicable because this manuscript is a Letter to Editor.

Research registration number

Research registration number is not applicable because this manuscript is a Letter to Editor.

CRediT authorship contribution statement

J.H. Smith: Writing – review & editing, Writing – original draft, Conceptualization. **J.S. Horne:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] W. Neuteboom, A. Ross, L. Bugeja, S. Willis, C. Roux, K. Lothridge, Quality Management in Forensic Science: A Closer Inspection, FSI: Synerg, vol. 358, 2023 111779, https://doi.org/10.1016/j.forsciint.2023.111779.
[2] International Forensic Strategic Alliance (IFSA), Introducing Dr Helen B. Tumediso, PhD, New IFSA Representative for SARFS, https://www.ifsa-forensics.org/introducing-dr-helen-b-tumediso-phd-new-ifsa-representative-for-sarfs/(accessed 26 March 2024).
[3] African Forensic Science Association (AFSA), https://africanfsa.org/(accessed 26 March 2024).
[4] South African Academy of Forensic Science (SAAFS), https://africanfsa.org/(accessed 26 March 2024).
[5] C. Roux, R. Bucht, F. Crispino, P. DeForest, C. Lennard, P. Margot, M.D. Miranda, N. Daeid, O. Ribaux, A. Ross, S. Willis, Sydney declaration: revisiting the essence of forensic science through its fundamental principles, Forensic Sci. Int. 332 (2022) 111182, https://doi.org/10.1016/j.forsciint.2022.111182.
[6] A. Olckers, M. Ben Khelil, The Sydney declaration: unique opportunity for Africa, Forensic Sci. Int. 357 (2024) 111969, https://doi.org/10.1016/j.forsciint.2024.111969.
[7] J.H. Smith, J.S. Horne, Establishing forensic DNA databases in Africa, Forensic Sci. Res. (2024) owae024, https://doi.org/10.1093/fsr/owae024.
[8] A. Olckers, Z. Hammatt, Science serving justice: opportunities for enhancing integrity in forensic science in Africa, Forensic Sci. Res. 6 (4) (2021) 295–302, https://doi.org/10.1080/20961790.2021.1989794.
[9] A.O. Amankwaa, E.N. Amoako, D.O.M. Bonsu, M. Banyeh, Forensic science in Ghana: a review, FSI: Synerg 1 (2019) 151–160, https://doi.org/10.1016/j.fsisyn.2019.07.008.
[10] J.T. Bouzin, G. Sauzier, S.W. Lewis, Forensic science in Seychelles: an example of a micro-jurisdictional forensic delivery system, FSI: Synerg 3 (2021) 100139, https://doi.org/10.1016/j.fsisyn.2021.100139.
[11] M. Heyns, A. Olckers, G. Saayman Saafs, Establishment of a representative body for forensic science in South Africa, Aust. J. Forensic Sci. 29 (51) (2019) S285–S288, https://doi.org/10.1080/00450618.2019.1568569, sup.1.
[12] W. Jilala, N. Lwoga, A brief history of forensic services in Tanzania: current challenges and mitigation efforts, FSI: Synerg 4 (2022) 100227, https://doi.org/10.1016/j.fsisyn.2022.100227.
[13] A. Koomson, E.M. Gaisie, D.T. Ayitey, A.A. Antiaye, Forensic Science: a unique interdisciplinary tool helping to combat crimes in Africa, a review, FSSGH 2 (1) (2020) 1–7. https://www.researchgate.net/profile/Albert-Koomson/publication/338355085_Forensic_Science_A_unique_interdisciplinary_tool_helping_to_combat_crimes_in_Africa_a_review/links/5fe3008e45851553a0e33eed/Forensic-Science-A-unique-interdisciplinary-tool-helping-to-combat-crimes-in-Africa-a-review.pdf. (Accessed 26 March 2024).
[14] H. Bernitz, M. Kenyhercz, B. Kloppers, N. L'Abbe, G.N. Labuschagne, A. Olckers, J. Myburgh, G. Saayman, M. Steyn, K. Stull, The history and current status of forensic science in South Africa, in: D.H. Ubelaker (Ed.), The Global Practice of Forensic Science, Wiley & Sons, Florida, 2014, pp. 241–259.
[15] A. Olckers, R. Blumenthal, A. Greyling, Forensic science in South Africa: status of the profession, Forensic Sci. Int. Genet. 4 (1) (2013) e146–e147, https://doi.org/10.1016/J.FSIGSS.2013.10.076.
[16] A. Olckers, P.G. Erasmus, A. van der Merwe, Unaccredited and unregulated: when science does not serve justice, Aust. J. Forensic Sci. 51 (sup1) (2019) 1–5, https://doi.org/10.1080/00450618.2019.1568568.
[17] J.H. Smith, An Exploration of the Identification and Processing of Forensic Investigative Leads to Investigating Crime in the South African Police Service, University of South Africa, 2023 [Thesis] Pretoria.

[18] L. Wilson-Wilde, International development of forensic science standards: a review, Forensic Sci. Int. 288 (2018) 1–9, https://doi.org/10.1016/j.forsciint.2018.04.009.
[19] A. Jones, S. Vidalis, Rethinking digital forensics, ann emerging tech, Computing 3 (2019) 41–53, https://doi.org/10.33166/AETiC2019.02.005.
[20] L.E. Wilson, M.E. Gahan, J. Robertson, C. Lennard, Fit for purpose quality management system for military forensic exploitation, Forensic Sci. Int. 284 (2018) 136–140, https://doi.org/10.1016/j.forsciint.2018.01.004.
[21] J. Robertson, Australian forensic science reaches new standards, Aust. J. Forensic Sci. 45 (4) (2013) 345–346, https://doi.org/10.1080/00450618.2013.859730.
[22] International Organisation for Standards (ISO). Standards ISO/TC272 Forensic Sciences. https://www.iso.org/committee/4395817/x/catalogue/p/0/u/1/w/0/d/0 (accessed 26 March 2024).
[23] International Organisation for Standards (ISO). ISO 21034-1:2018(en): Forensic Sciences- Terms and Definitions. https://www.iso.org/obp/ui/en/#iso:std:iso:21043:-1:ed-1:v1:en (accessed 26 March 2024).
[24] International Organisation for Standards (ISO). ISO 21034-2:2018: Recognition, recording, collecting, transport, storage of items. https://www.iso.org/standard/72041.html (accessed 26 March 2024).
[25] European Network for Forensic Science. Working Groups. ENSI. https://enfsi.eu/about-enfsi/structure/working-groups/(accessed 26 March 2024).
[26] International Laboratory Accreditation Cooperation (ILAC). ILAC G19:06/2022 Modules in a Forensic Science Process. https://ilac.org/publications-and-resources/ilac-guidance-series/(accessed 26 March 2024).
[27] National Institute for Science and Technology (NIST). Forensic Science. https://www.nist.gov/forensic-science (accessed 26 March 2024).
[28] Organization of Scientific Area Committees for Forensic Science. https://www.nist.gov/organization-scientific-area-committees-forensic-science (accessed 26 March 2024).
[29] South African National Accreditation Standard (SANAS). TG 01-03: Criteria for Laboratory Accreditation in the Field of Forensics. https://www.sanas.co.za/Publications%20and%20Manuals%20Files/TG%2001-03.pdf (accessed 26 March 2024).
[30] South African National Accreditation Standard (SANAS). TG 41-03: Guidelines for the Verification and Validation of Methods in Forensic Chemistry. https://www.sanas.co.za/Publications%20and%20Manuals%20Files/TG%2041-03.pdf (accessed 26 March 2024).
[31] South African National Accreditation Standard (SANAS). TG 42-03: Technical Guidance for Forensic DNA Testing Laboratories. https://www.sanas.co.za/Publications%20and%20Manuals%20Files/TG%2042-03.pdf (accessed 26 March 2024).
[32] South African National Accreditation Standard (SANAS). TG43-01: Technical Guidance for Forensic Ballistic, Impressions and Questioned Document Laboratories) https://www.sanas.co.za/Publications%20and%20Manuals%20Files/tg_4301.pdf (accessed 26 March 2024).
[33] US Department of Justice. Office of Justice. Scientific working groups. https://www.ojp.gov/ncjrs/virtual-library/abstracts/scientific-working-groups (accessed 26 March 2024).
[34] A. Ross, W. Neuteboom, Implementation of quality management from a historical perspective: the forensic science odyssey, J. Forensic Sci. 53 (3) (2019) 359–371, https://doi.org/10.1080/00450618.2019.1704058.
[35] South Africa, Criminal Law (Forensic Procedures) Amendment Act (No. 37 of 2013), Government Printers, Pretoria, 2013, in: https://www.saps.gov.za/resource_centre/acts/downloads/criminal_law_forensic_procedure_amendment_act_2013_act_no_37_of_2013.pdf. (Accessed 26 March 2024).
[36] J.H. Smith, J.S. Horne, Wat is deoksiribonukleïensuur (DNS) bewyse se geloofwaarding in strafregtelike verrigtinge? LitNet Akademies 20 (3) (2023) 491–522, https://doi.org/10.56273/1995-5928/2023/j20n3b12.
[37] Southern African Development Community Cooperation in Accreditation (SADCA) in SADCAS, 2022. Annual Report, https://www.sadca.org/Media%20Centre%20Files/SADCA%20Annual%20Report%20-%202022.pdf. (Accessed 26 March 2024).
[38] v S. Bokolo, 1 SACR 44 (SCA), 2014.
[39] S v Maqhina, 1 SACR 241 (T), 2001.
[40] S v Orrie, 1 SACR 162 (C), 2004.
[41] S v Van der Vyver, (SS190/06), 2007. ZAWCHC 69.
[42] P. Sommer, Accrediting digital forensics: what are the choices? Digit, Invest 25 (2018) 116–120, https://doi.org/10.1016/j.diin.2018.04.004.
[43] v S. Tshantsani, (CS225/20114), 2016. ZAECGHC 3.
[44] G. Tully, N. Cohen, D. Compton, G. Davies, R. Isbell, T. Watson, Quality standards for digital forensics: learning from experience in England and Wales, FSI: Digit. Invest. 32 (2020) 200905, https://doi.org/10.1016/j.fsidi.2020.200905.
[45] President's Council of Advisors on Science and Technology (PCAST), Report to the President, Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature Comparison Methods (U.S. Executive Office of the President Washington, D.C., USA), 2016. https://obamawhitehouse.archives.gov/blog/2016/09/20/pcast-releases-report-forensic-science-criminal-courts. (Accessed 26 March 2024).
[46] A. Samuels, Forensic science regulator: the forensic science regulator act, 2021, Med. Leg. J. 90 (2) (2022) 86–89. https://journals.sagepub.com/doi/pdf/10.1177/00258172211068227.
[47] S. Doyle, QHFSS DNA laboratory–ISO/IEC 17025 conformance and accreditation, Forensic Sci. Int. 8 (2024) 100449, https://doi.org/10.1016/j.fsisyn.2023.100449.
[48] A.O. Amankwaa, J.A. Addo, Forensic DNA analysis and database governance in Ghana, in: Law, Practice, and Politics of Forensic DNA Profiling, Routledge, 2022, pp. 56–71. https://www.taylorfrancis.com/books/mono/10.4324/9780429322358/law-practice-politics-forensic-dna-profiling?refId=a28d5e1f-0ec9-453a-b426-8be8372bd9a1&context=ubx. (Accessed 26 March 2024).
[49] Zambia, The national forensic act, act No. 2 of 2020. https://www.parliament.gov.zm/node/8571, 2020. (Accessed 26 March 2024).
[50] United Kingdom. The Forensic Science Regulator, https://www.gov.uk/government/organisations/forensic-science-regulator (accessed 26 March 2024).
[51] A. Camilleri, D. Abarno, C. Bird, A. Coxon, N. Mitchell, K. Redman, N. Sly, S. Wills, A risk-based approach to cognitive bias in forensic science, Sci. Justice 59 (2019) 533–543, https://doi.org/10.1016/j.scijus.2019.04.003.
[52] I.E. Dror, J. Kukucka, Linear sequential unmasking-expanded (LSU-E): a general approach for improving decision making and minimizing noise and bias, FSI: Synerg 3 (2021) 100161, https://doi.org/10.1016/j.fsisyn.2021.100161.
[53] D.E. Krane, S. Ford, J.R. Gilder, K. Inman, A. Jamieson, R. Koppl, I.L. Kornfield, M. D. Risinger, N. Rudin, M.S. Taylor, W.C. Thompson, Sequential unmasking: a means of minimizing observer effects in forensic DNA interpretation, J. Forensic Sci. 53 (2008) 1006–1007, https://doi.org/10.1111/j.1556-4029.2008.00787.x.
[54] D. Miano, K. Anangwe, K. Kiemo, Disparities in forensic science adoption for crime investigation in Kenya: the role of Police demographics, Sage Open 14 (1) (2024) 21582440231225900, https://doi.org/10.1177/21582440231225900.
[55] Z.N. Sarki, G.A.M. Saat, Nigeria Police and forensic criminal investigations: a review of critical issues, Int. J. Crim, Justice Sci 15 (1) (2020) 21–34, https://doi.org/10.5281/zenodo.3818290.
[56] A. Uzabakiriho, Role of forensic science in criminal investigations in Rwanda, Res. J. Forensic Sci. 3 (2015) 1–4. https://www.researchgate.net/publication/342435128_Nigeria_Police_and_forensic_criminal_investigations_A_review_of_some_critical_issues.
[57] M.S. Pepper, C. Dandara, J. de Vries, A. Dhai, M. Labuschaigne, F. Mnyongani, K. Moodley, A. Olckers, A. Pope, R. Ramesar, M. Ramsay, ASSAf consensus study on the ethical, legal, and social implications of genetics and genomics in South Africa, South Afr. J. Sci. 114 (2018) 1–3. http://orcid.org/0000-0001-6406-2380.

J.H. Smith*
School of Criminal Justice, University of South Africa, Preller St, Muckleneuk, Pretoria, 0002, South Africa

J.S. Horne
Department of Police Practice, School of Criminal Justice, College of Law, University of South Africa, Preller St, Muckleneuk, Pretoria, 0002, South Africa
E-mail address: hornejs@unisa.ac.za.

* Corresponding author. University of South Africa, Preller St, Muckleneuk, Pretoria, 0002, South Africa.
E-mail address: 38761556@mylife.unisa.ac.za (J.H. Smith).