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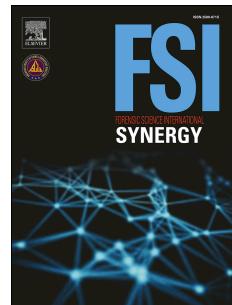


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Forensic Science in Ghana: A review

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1

Forensic Science in Ghana: A review

2

Abstract

The use of forensic science continues to grow across the world. In Ghana, major advancements took off in 2011, including the introduction of modern DNA profiling and the establishment of an automated fingerprint identification system. These developments have led to some positive impacts on the delivery of justice, including the exoneration of a wrongly incarcerated individual. However, a review of the policy-related aspects of forensic science shows gaps in legislation, governance, service provision, quality assurance and accreditation, education and research. An important recommendation to improve forensic science in Ghana is the creation of a “national policy strategy”, a blueprint informed by relevant stakeholders, best practice from other countries and the status of the field. Resolutions to the policy issues identified in this review will ensure a more robust application of forensic science in delivering safe justice and enhancing public security.

Keywords: *Forensic science; policy; legislation; governance; impact; education; Ghana*

17

18 1 Introduction

19 Forensic science is the application of science in answering questions of legal importance. It is an
20 interdisciplinary field comprising different subject areas, actors and organisations across
21 scientific and legal disciplines. Devoted to the administration of safe justice, forensic science
22 plays a crucial role in the criminal justice system (CJS). It can assist law enforcement authorities
23 and the courts in the resolution of crime by facilitating the identification and apprehension of
24 crime perpetrators. The use of forensic science involves a wide array of activities ranging from
25 crime scene evidence gathering, developing investigative strategies, generating investigative
26 leads through different lines of inquiry, and the processing of evidential materials that are of
27 probative value in a relevant case. The different dimensions in which forensic science can be
28 used present several complexities that impact its value within the legal system [1].

29 Forensic science uses several scientific, technological and technical applications. The most
30 common of these are fingerprint and finger-mark analysis, DNA testing, firearm and tool mark
31 examination, drugs and toxicological analysis, and forensic pathological analysis. Modern or
32 new forensic science applications include facial comparison, video and audio analysis, digital
33 forensics and new technologies that improve upon the traditional forensic applications. Efforts to
34 consolidate the benefits of forensic science have improved globally [2], with an increasing trend
35 in cross-border collaborations through the transnational exchange of forensic data [3]. However,
36 harnessing the capabilities of forensic science comes with the costs of establishing laboratories,
37 training personnel, and developing appropriate policies and systems for quality control and
38 assurance. These costs, inevitably, present difficulties in pursuing forensic science and its usage
39 may be limited to the availability of sufficient funds [4]. This may be more pronounced in
40 developing countries.

41 The use of forensic science is recognised in Ghana's adversarial criminal justice and civil
42 systems. The Forensic Science Laboratory (FSL), a division under the Criminal Investigation
43 Department (CID) of the Ghana Police Service (GPS), serves as the main provider of forensic
44 science services to law enforcement agencies across the country. With a history since 1948, the
45 FSL has grown both in infrastructure and scope of forensic science capabilities [5]. In 2011, the
46 FSL was refurbished under the European Union – Ghana Police Project flagship programme with
47 a £3 million funding [6]. The scope of services provided by the laboratory are covered under the
48 sections of Chemistry and Drug Analysis, Ballistic and Firearms, Document Examination,
49 Photography, and DNA analysis [5]. The FSL aims to provide quality scientific analysis to
50 private and public institutions in Ghana and other neighbouring countries in the sub-Saharan
51 region, as well as to strengthen criminal investigations with timely and cost-effective services
52 [6].

53 There is currently limited information about the technical operation and performance of the FSL
54 in the public domain. A review of information from several media sources suggests that the FSL
55 may be functioning below its capacity. For instance, the refurbishment of the laboratory in 2011
56 was regarded as a step forward in obtaining and maintaining international accreditation [7].
57 Notwithstanding, this milestone has not been achieved and the forensic science field is
58 challenged with a limited number of qualified experts [8] and frequent media reports of tampered
59 evidence [9]. The root cause of the challenges in forensic science provision is complex and

60 overlaps in areas of funding and resources, management and governance, and policy, which
61 imply a low-priority status for forensic science in Ghana.

62 Characteristic of other developing countries, crimes such as trafficking of illicit drugs, armed
63 robbery, kidnappings, sexual and violent offences, cybercrime and arson-linked fire outbreaks
64 are not uncommon in Ghana. These crimes presuppose the need for integration of varied
65 innovative forms of crime-solving capabilities into traditional policing operations. Whilst the
66 police continue to receive support in areas of traditional policing [10], capacity building in
67 forensic science is low. This may partly be due to an inadequate appreciation of forensic science
68 as the police rely mainly on public intelligence, tip-offs and witness/suspect interrogations
69 during criminal investigations. The effects of these are evident, with a lack of professionalism in
70 physical/forensic evidence collection and management, and gaps in investigative leads.
71 Sometimes, confiscated drugs evade tracking and possession from law enforcement custody
72 [11,12]. Further, high-profile cases with potential forensic interest continue to make headlines,
73 including rape cases, murder and kidnapping involving local and foreign nationals [13,14]. The
74 investigation of these cases is often met with difficulties of needless delays, poor crime scene
75 management and evidence handling, and sometimes the outcome of investigations are unknown.

76 As a pivot of forensic science, a sound policy ensures that forensic science is delivered in a
77 context that assures justice and identifies and protect against miscarriages of justice. This paper
78 responds to the poor and under-utilisation of forensic science in Ghana by analysing the key
79 policy-related issues of forensic science service provision. The overall aim of the review is to
80 provide relevant recommendations for change based on current international “best practice”. The
81 paper provides a foundation that could assist policymakers in developing appropriate policies to
82 govern forensic science and maximise its utility. The key areas of forensic science provision that
83 are scrutinised in this paper are legislation, governance framework, forensic science service
84 provision, quality assurance and control, impact on the criminal justice system, forensic science
85 education, and research and development. In summary, the review identifies gaps in areas such
86 as legislation governing forensic biometrics and expert witness testimony, leadership for forensic
87 science, funding and investment and quality standards for forensic science.

88

89 **2 Forensic science legislation**

90 The investigative and intelligence function of law enforcement agencies is established by law. In
 91 Ghana, the supreme law from which law enforcement agencies derive their powers is the 1992
 92 Constitution [15]. This provides the scope of their powers to investigate crime and the basic
 93 rights of individuals under investigation and/or prosecution. Chapter 5 of the Constitution
 94 defines the fundamental human rights and freedoms of individuals. Two principal rights linked to
 95 the investigation of crime are Articles 18 and 19, which cover the right to privacy of individuals
 96 and the right to a fair hearing, respectively. Article 18 (2) upholds the principle of proportionality
 97 and necessity in any interference with the right to privacy. This restricts the powers of law
 98 enforcement agencies and other authorities in the collection, retention and use of investigative
 99 material and/or information from individuals (For example, see *Cubagee v Asare and Others*
 100 2018 [16]). Article 19 encompasses the “fair” management and disclosure of evidence in
 101 criminal cases, which can have an impact on the actual hearing by a court. In effect, the
 102 processing and use of evidence, including forensic evidence, must be legal, legitimate,
 103 proportionate, necessary and transparent.

104 In addition to the Constitution, there is specific legislation that layout the powers of law
 105 enforcement agencies in gathering evidence or information during investigations and the
 106 admissibility of evidence. The Criminal and Other Offences (Procedures) Act 1960 (Act 30)
 107 details the procedures for arrest and detention, treatment of suspected individuals, and search and
 108 seizure of evidence [17]. The Act allows the police to search and recover any items on an
 109 arrested person or premises that may be material to a suspected or alleged offence. In the case of
 110 arrestees, the law prohibits the examination of the private person by officers (section 8). Act 30
 111 also specifies the regulation of information or evidence that may be used at trial including
 112 scientific reports (section 121). The law generally allows the courts to only admit into evidence
 113 the reports or testimony of “Scientific Analysts” recognised by the Minister for Justice by
 114 “notification published in the Gazette”.

115 Another important legislation is the Evidence Act 1975 which defines evidence as “testimony,
 116 writings, material objects, or other things presented to the senses that are offered to prove the
 117 existence or non-existence of a fact” (Section179) [18]. The principal test for the collection of
 118 biological samples (i.e. body fluids or substances); information about physical features, physical
 119 and mental health; and data about behavioural characteristics is the necessity of these in the
 120 relevant issue. This test is subject to the discretion of the courts and individuals cannot refuse
 121 such sampling (Sections 96 and 97). The primary test of admissibility of evidence (such as
 122 forensic evidence) is relevance, which is also subject to court discretion (Sections 51 and 52 of
 123 Evidence Act). Further, Section 51 (2) of the Evidence Act states that “all relevant evidence is
 124 admissible except as otherwise provided by any enactment”. Relevant evidence may be excluded
 125 if it is outweighed by other competing interests including the risk of unfair hearing or verdict,
 126 which is consistent with the 1992 Constitution [15].

127 According to the Evidence Act, a court expert may be called upon to provide an expert opinion
 128 within their subject of expertise or qualification (sections 67 and 112 -115). The expert testimony
 129 is required to be of assistance to the court in understanding the evidence or facts in a legal issue.
 130 These rules are consistent with the common law admissibility (CLA) tests of assistance and

131 relevant expertise in England and Wales [19]. Based on section 113 of the Evidence Act, an
132 expert witness is not required to disclose the basis of their opinion before presenting their
133 testimony. Further, the basis of the expert opinion ‘need not be admissible in evidence’ although
134 these may be examined by the court or the parties to the case. The above rules may be
135 incompatible with the tests of impartiality and evidentiary reliability, which are upheld as part of
136 the CLA test and Daubert Standard [20,21]. Internationally, there is a wide consensus to ensure
137 transparency in forensic reporting and reliability, including balanced, logical and robust
138 presentation of evidence [22]. This means a reform of the Evidence Act may be required.
139 Another area of concern is the rule about expert opinion on “the ultimate issue”. Section 115 of
140 the Evidence Act suggests that expert opinion that borders on the ultimate issue to be determined
141 by the trier of facts may be admissible. Expert opinion on the ultimate issue is generally
142 considered to be inadmissible due to their potential to mislead the trier of fact or the jury [23,24].
143 The current admissibility framework in Ghana may pose a risk to the safe delivery of justice.
144 Hence, a reform of the current law on forensic expert witnesses and evidence reporting may be
145 necessary to comply with international standards.

146 Presently, Ghana lacks national forensic information databases such as a national DNA and
147 fingerprint database for criminal investigation/intelligence purposes. The 2016 Interpol Global
148 DNA Profiling Survey found that Ghana holds 1,193 DNA profiles [25]. Of these, 202 are from
149 known individuals, 338 are from crime scenes, 3 from missing persons, 1 from relatives of
150 missing persons, 1 from unidentified human remains and 648 other profiles. The Data Protection
151 Act 2012 (DPA) classifies DNA data as a “special personal data” that can only be processed
152 when necessary or where the individual gives their consent (section 37) [26]. The use of
153 fingerprints has been a core part of police activities in Ghana (formerly Gold Coast) since 1922
154 [6]. The total number of fingerprint records held for policing purposes is not publicly known. In
155 September 2011, the CID implemented an automated fingerprint identification system (AFIS)
156 which holds more than 3,700 records of convicted individuals [27]. The CID plans to include all
157 manual records of convicted individuals in the AFIS database. The existing law allows for the
158 collection of DNA and other biometric information under the discretion of the court when
159 necessary. There are no specific laws to govern the inclusion and retention of forensic biometric
160 information in a database after the conclusion of an inquiry or proceedings. This gap may have
161 both public security (such as failure to solve a crime) and human right implications (breach of
162 privacy), and an urgent adoption of specific forensic biometric legislation is necessary to
163 enhance the effectiveness and legitimacy of forensic science in Ghana.

164

165 **3 Governance framework**

166 As stated earlier, the major provider of forensic science services in Ghana is the GPS CID FSL.
 167 The GPS is headed by the Inspector General of Police (IGP), who is appointed by the President
 168 of Ghana. The IGP is responsible for the operation of the GPS and administers the service with
 169 the support of directors of several departments including the CID. The GPS is one of the
 170 agencies of the Ministry of Interior (MOI), which provides policy guidance and standards. The
 171 main statutory oversight body for the GPS is the 10-member Police Council which is made up of
 172 the Vice President as chairman, stakeholders within the Executive and Judiciary arms of
 173 Government and the CJS, and appointees of the President (section 201 of the Constitution) [15].
 174 There are limited specific policy guidance or standards for forensic science from the MOI or the
 175 Police Council, and the current governance framework could be described as a police-led system.
 176 This orientation may be prosecution biased and may have an adverse impact on the application
 177 of forensics in the CJS [28,29].

178 One of the aims of forensic science is objectivity, and this has been recognised as an essential
 179 consideration in the institutional structure for forensic providers [28]. In Scotland, for example,
 180 forensic science is managed under the Scottish Police Authority (SPA), which is independent of
 181 the Scottish Police Service [30]. This governance framework (i.e. institutional independence) is
 182 considered to provide more independence and impartiality in forensic investigations [31].
 183 Another model governance framework is the England and Wales system which provides a good
 184 level of transparency and independence in the governance of forensics. A unique feature of this
 185 framework is the establishment of an independent Forensic Science Regulator (FSR) that
 186 provides guidelines on the quality of forensic services. The mandate of the FSR includes setting
 187 quality standards that are consistent with international standards. The FSR is also responsible for
 188 investigating quality failures, producing codes of practice and conduct, and ensuring compliance
 189 [32]. Although the forensic market in England and Wales is mixed (includes both police and
 190 private providers) [33], the role of the FSR allows for consistency in forensic science practice
 191 and service quality across a wider marketplace. It is worth noting that the governance
 192 frameworks in the UK have their roots in miscarriages of justice and distrust of the police [31].
 193 Boateng and Darko [34] highlight a considerable distrust between the GPS and the public. This
 194 may be influenced by public perceptions of the police as a corrupt institution [35]. In
 195 consideration of the above, a possible improvement to the governance of forensic science in
 196 Ghana could be a transfer of the FSL from the direct command of the GPS to an independent
 197 body such as the MOI or the Ministry of Justice or a newly formed public body. Alternatively, an
 198 independent Forensic Science Regulator or Oversight Body could be established to govern
 199 forensic science service provision. This clear leadership structure could enhance the utilisation of
 200 forensic science and maintain public confidence and transparency in its application.

201

202 **4 Forensic science service provision**

203 Against the backdrop of the legal and governance context detailed above, this section reviews the
 204 provision of forensic services in Ghana. The approach of forensic science service provision
 205 varies across jurisdictions. With law enforcement agencies being the primary customers, forensic
 206 science services are mostly provided by state-owned forensic science laboratories, with few
 207 exceptions such as in the UK where a commercialised private sector exists. In Ghana, both a
 208 monopoly and a monopsony system of service provision exist where the police service is the
 209 largest provider and user of forensic science services. Other forensic services are provided by
 210 state institutions, hospitals and private organisations such as E-Crime Bureau [6,36]. Some
 211 specialised disciplines, such as analysis of controlled substances, is also carried out by the Ghana
 212 Narcotics Control Board. Adequate information about the caseload of the FSL is not publicly
 213 disclosed. However, the commonly reported areas of forensics in the media are drug testing and
 214 DNA analysis in civil paternity testing, with a handful of opportunities for serious crime
 215 investigations and immigration-related disputes. According to the GPS website [5], the
 216 chemistry and drugs analysis section of the FSL examines an average number of 800 cases of
 217 confiscated drug samples per year. In addition to providing forensic services to the police, the
 218 FSL operates a fee-for-service to the public and the court. For instance, document examinations
 219 for civil cases are provided at a fee of GH¢1000 (~\$185) while the DNA section charges a fee of
 220 at least GH¢1500 (\$277) for DNA analysis for relationship testing [5]. These charges are
 221 reported to generate funds for the State.

222 The outlook of crime history, statistics of crime and recent high-profile cases in Ghana suggest a
 223 positive prospect for forensic science. However, the underutilisation of forensic science may
 224 contradict this perspective. This challenge may be due to inadequate resourcing and funding of
 225 forensic science across the country. In fact, forensic science is considered an expensive
 226 enterprise in terms of facilities, equipping and staffing of laboratory, quality management
 227 systems and training of scientists. Even in countries with advanced forensic capabilities,
 228 resourcing and funding of forensic science are problematic and the need for spending on forensic
 229 science must be justified. The demographic characteristics of a jurisdiction, crime levels and
 230 availability of funding are considered as some of the critical issues for justification of spending
 231 on forensic science [4].

232 In Ghana, regardless of the importance of forensic science in criminal justice, spending on
 233 forensic science competes with other social amenities and other agencies within the CJS.
 234 However, for the safety of society, equal attention to forensic science should be a genuine
 235 concern. Although the FSL received a facelift in 2011,¹ its capacity to meet all the demand for
 236 forensics across the 16 regions of Ghana is limited. The FSL is located in Accra, the capital city

¹ Some of the available equipment include a comparison microscope for tool-mark analysis; Gas Chromatography-Mass Spectrometer system (GC-MS), Gas chromatography – Flame Ionization Detector system (GC-FID), High Performance Liquid Chromatograph (HPLC) and Infra-Red (IR) spectrophotometer for chemistry and drugs analysis; 7500 Real-Time PCR, 9700 GeneAmp thermal Cyclers, and 3500 Capillary Electrophoresis for DNA analyses; and Video Spectral Comparator (VSC), and Electrostatic Detection Apparatus (ESDA) for documents examination.

237 of Ghana, hence other regions of the country may not receive adequate scientific support in a
238 timely manner. This highlights a need to establish forensic facilities or units across other regions
239 of Ghana whilst sustaining the development of the central FSL in Accra. The refurbishment of
240 the FSL was, partly, in response to some expensive cost of criminal investigations where
241 evidential samples had to be taken to other jurisdictions for forensic analysis, with the extra cost
242 of airfare and risks to the integrity of evidential materials. This risk may still exist without a
243 sustainable decentralisation strategy for forensic science across Ghana. One approach of ensuring
244 decentralisation, as well as improving the resourcing of forensic science, could be through
245 regulated public-private partnerships, collaboration with university laboratories and hospitals.
246 This approach will promote the development of the central FSL as a national lab, and the
247 creation of regional forensic units.

248 Without the necessary funding for forensic science, delays in criminal proceedings, abbreviated
249 and biased forensic investigation, and unresolved crimes would always pose a threat to the
250 administration of justice in Ghana. Through an independent leadership framework (section 4),
251 the provision of forensic services could be improved nationally through a sustainable funding
252 and grant scheme. For example, even though the demand for forensic science may be driven by
253 police forensic needs, direct funding may come from an institution such as the Ministry of
254 Justice and Attorney General's Department (MOJAGD) through its high bargaining power for
255 adequate government funding to support forensic science provision for both prosecution and
256 defence. In the US, the Department of Justice through the National Institute of Justice provides
257 funding for forensic science practice and research for federal, state and local forensic science
258 laboratories [37]. Such funding arrangement is also desired for forensic science practice in the
259 UK [38].

260 Another additional scheme to sustain and develop the forensic science market could be based on
261 the East Midlands Special Operations Unit – Forensic Services (EMSOU – FS) system in the
262 UK. For this approach, forensic science and investigation service are provided on behalf of five
263 police forces of the East Midlands region from a combined forensic science unit. Funding is
264 shared across all collaborating police forces in an agreement. Financial contribution is calculated
265 in accordance with apportionment ratios proportional to the operational policing grant of each
266 collaborating force [39]. The advantages of this system include cost-effective and timely
267 deployment of forensic science for criminal investigation. In Ghana, similar arrangements could
268 be established by police stations in the same region or district. The financial contribution could
269 be based on specifications, such as the size of policing area and individual forensic science
270 needs. The combined forensic unit would provide analytical services for all the police stations in
271 the collaboration. This approach will reduce the burden on the current central FSL, allowing the
272 unit to operate at the national level and focus on the development of national forensic capabilities
273 such as the creation and operation of national forensic information databases (DNA, fingerprints,
274 footwear marks and others) and national research to support forensic science. Further, funding
275 from police forces would be a relatively easier approach, which will complement direct funding
276 from a dedicated national organisation or public department such as the MOJAGD.

277

278 **5 Quality assurance, accreditation and regulation**

279 The justice system in which forensic science operates is expected to maintain a zero tolerance of
280 errors as the consequences of error can be grievous [40]. Moreover, forensic science labs are also
281 regarded as high-risk organisations where any error carries a high possibility of causing harm
282 [41]. Any errors can result in miscarriages of justice or ‘near-misses’, which can also lead to
283 public distrust in forensic science and the legal system. To avoid miscarriages of justice, there is
284 a need for quality and standardisation among both state and private forensic service providers.
285 Consideration for forensic science quality, according to the ISO 17025 standards, comprises
286 issues of management requirements and technical requirements which ensure organisational,
287 practitioners and analytical competencies. These quality standard requirements are termed
288 quality management system (QMS) which determines customers’ satisfaction about a service or
289 product. This satisfaction is demonstrated via accreditation assessment of the policies,
290 procedures, and processes that exist in laboratories to control and assure the quality of forensic
291 science service and outcome. Accreditation provides an external inspection of the availability of
292 minimum procedures that exist to prospectively ensure quality, reliability, efficiency, and
293 consistency in forensic science service provision. Even though this is not indicative of the
294 highest quality of forensic science outcomes, it ensures that systems are available to mitigate
295 risks of quality failings and non-conformities. Without standards, the competence of forensic
296 personnel and the reliability of equipment and results cannot be assessed [40–44]. As stated
297 earlier, forensic science practice is still in its nascent stages in Ghana and therefore forensic
298 science QMS is in a developmental state. This is evident in the frequent media reports of missing
299 and contaminated forensic evidence material. For example, there was an instance where the
300 police hospital crime lab issued conflicting DNA reports on a rape case which raised questions
301 about the quality of the results and standards used in the lab [9].

302 To initiate accreditation for the FSL would require the establishment, implementation and
303 maintenance of QMS appropriate to the scope of forensic science activities undertaken by the
304 lab. The assessment of these systems would also require the availability of accredited
305 organisations that are certified to accredit forensic science labs in Ghana. With regards to the
306 latter, there exist various organisations in Ghana who are mandated by law to regulate various
307 professions and laboratories. Specifically, the Ghana Standards Authority (GSA) is responsible
308 for the development and enforcement of standards for laboratories under the Weights and
309 Measures Act 1975 (NRCD 326) [45]. The GSA undertakes testing, inspection, certification and
310 conformity assessment activities. One of the key departments of the GSA is the drugs, cosmetics
311 and forensic unit which undertakes tests and analysis on products and samples for the purposes
312 of quality, investigation and medical diagnoses. The specific areas of analysis for the GSA
313 forensic laboratory include drugs of abuse, toxicology and handling of evidential materials [42].
314 To enhance the quality of forensic services in Ghana, the GSA, in consultation with relevant
315 stakeholders, should adopt the appropriate ISO standards (ISO 17025:2017 [46] for lab analysis
316 and 17020:2012 [47] for crime scene examinations) for the accreditation of forensic science
317 providers. The accreditation assessment should be facilitated by the availability of competent
318 assessors as well as competent personnel within laboratories and adequate funding to pay
319 assessment visits.

320 With regards to enforcing accreditation requirements for forensic science practice, jurisdictional
321 differences exist but have been primarily via voluntary accreditation requirements. Both
322 mandatory and voluntary requirements may be feasible depending on the availability of statutory
323 instruments for enforcement and behaviour of forensic science providers, including adequate
324 funding and resources. In some instances, even though voluntary accreditation may be widely
325 applied, mandatory accreditation would be required for some aspects of forensic science practice,
326 such as for biometric-related activities [48]. To recommend a model of accreditation for forensic
327 science practice in Ghana, consideration must be given to a cost-effective regime that ensures
328 flexibility and innovation in forensic science practice, encourages the maintenance of quality
329 culture, and promotes best practice.

330 In South Africa, the South African Council for Natural Scientific Professions (SACNASP) is the
331 body mandated by law to regulate the forensic science service profession while the South
332 African National Accreditation System (SANAS) inspects and certifies all laboratories [44]. In
333 Ghana, there are various statutory bodies to regulate specific professions and accreditation
334 processes. A typical example is the health sector where the Allied Health Professions Council
335 (AHPC), Medical and Dental Council (MDC), Pharmacy Council and the Nurses and Midwifery
336 Council (NMC) are mandated by law to regulate relevant health professions in the country. In
337 2017, the GSA adopted ISO 15189:2012 as the standard for all medical laboratories in Ghana
338 [49]. Several hospital laboratories have since been assessed and accredited based on ISO
339 15189:2012 requirements. A similar model like the health sector could be adopted for the
340 accreditation of forensic science providers in Ghana through the proposed Ghana National
341 Accreditation Services (GNAS) [50]. In fact, accreditation system for forensic science providers
342 modelled after that of clinical laboratories, such as the Clinical Laboratory Improvement
343 Amendments of 1988 (CLIA) of the US has been suggested by experts [51].

344 To regulate the forensic science profession, a statutory body like the health sector councils
345 should be established. The benefit of such a body is the prevention of quackery and unreliable
346 forensic investigation which can affect the fair administration of justice. This body should
347 continuously assess the competence of practitioners and provide certifications which can inform
348 the Court about the competence of forensic science experts. There is presently an informal
349 Forensic Science Society of Ghana (FSSGH) which is hosted at the Forensic Department of the
350 University of Cape Coast. The FSSGH is made up of scientists trained in Ghana, the UK,
351 Australia and Europe. The Society, in consultation with relevant stakeholders, may be backed by
352 statute to support the accreditation of forensic science practices and certification of practitioners
353 in Ghana.

354 **6 Impact of forensic science on the criminal justice system**

355 The primary aim of forensic science is to assist law enforcement agencies and the legal system in
 356 fulfilling their primary functions such as the prevention, detection, and investigation of crime,
 357 and the delivery of justice. The outcome of legal cases in Ghana is underreported, particularly
 358 cases from the lower courts [52]. This challenge makes it difficult to ascertain the contribution of
 359 forensic science in legal inquiries. The main sources of information about criminal and other
 360 legal cases are through the media. A major area of police inquiry and prosecutions, where
 361 forensic science plays a routine role is illegal drug possession and use. In most of these cases,
 362 forensic science (drug testing) is used for corroboration purposes to confirm whether an alleged
 363 substance is an illegal drug or not. One such example is the case of Iddrisu Yobi [53] described
 364 in Box 1. As can be seen in the case, the accused acknowledged possession of the alleged
 365 substance prior to forensic testing and this is common in most drug offences. Forensic drug
 366 testing is essential because it allows the court to accurately assess the weight of the evidence and
 367 inform any verdict and sentence given by the trier of fact or jury.

Box 1 – Case Study on the use of forensic drug analysis

Iddrisu Yobi

On 18 May 2017, two law enforcement officers (a police officer and a Bureau of National Investigation (BNI) officer) at Asankragwa in the Western Region of Ghana found a group of young men smoking a substance that was suspected to be cannabis. The officers were able to arrest one member of the group, Iddrisu Yobi, while the other suspects fled. The officers recovered money, 104 wrappers of suspected cannabis in a bag and other items from Yobi. At the police station, Yobi declared in a statement that the items (exhibits) belonged to him. The statement was made in the presence of an independent witness. Yobi was accused of illegal drug possession in an arraignment hearing before the Tarkwa Circuit Court and remanded pending forensic testing of the substance by the FSL of the Ghana Police Service. On 27 August 2017, the report of scientists at the FSL confirmed the seized substance (the 104 wrappers) to be cannabis, including 144.87g of dried leaves and 757.72g of seeds. Yobi was subsequently charged with the offence which he pleaded guilty and was sentenced by the Circuit Court to 10 years in prison custody.

Source: Addo, A. E. (2018, May 26). Drug dealer jailed 10 years in Tarkwa. Retrieved June 17, 2019, from <http://www.ghananewsagency.org/human-interest/drug-dealer-jailed-10-years-in-tarkwa-133206>

368
 369 Another example of a case that involved forensic science is the exoneration of Eric Asante in
 370 2017 (Box 2). In contrast to the above, this case study illustrates how forensic science can be
 371 used to resolve or correct miscarriages of justice. It also shows the potential dangers of eye
 372 witness account. Further, the case study supports the importance of ensuring that the overriding
 373 duty of a forensic scientist is to justice rather than working for either prosecution or defence.
 374 This reinforces the argument about adopting a forensic science governance framework that is
 375 transparent and independent and protected from organisational biases.

376

Box 2 – Case Study on the use of forensic DNA analysis***Eric Asante***

In early November 2003, a 14-year old junior high school girl was found by her uncle-in-law writing a love letter to one Mr Eric. The content of the letter indicated she had met Mr Eric the previous day and “given him what he wanted”. She thanked Mr Eric for giving her money and expressed her love for him. She further explained that she was unwell and thus will not be able to visit him. The uncle-in-law alerted the mother and auntie of the girl who questioned her about the letter. She disclosed that Mr Eric is her teacher and boyfriend. The case occurred at Nyohini in the Northern Region of Ghana. The family confronted Mr Eric Asante and he denied the affair. A report of defilement was subsequently made to the Women and Juvenile Unit (WAJU) of the Tamale Police on 14th November 2003. The victim was issued a medical form to attend a medical examination at the Tamale Teaching Hospital where she disclosed to the medical officer that Mr Eric is her boyfriend. She also mentioned that the last time she had sex with Mr Eric was on 12 November 2003. A pregnancy examination of the victim returned positive, showing that she was 23 weeks pregnant. She stated that Mr Eric was responsible for the pregnancy. Although Mr Eric maintained his innocence, he was convicted and handed a 15-year prison sentence for defilement on 5 September 2005 at the Tamale High Court. The Court of Appeal upheld the conviction in April 2006. A further appeal was made to the Supreme Court and an order was issued to conduct a DNA test of the child in 2014. The test was carried out by the Forensic Science Laboratory in July 2015. The appellant was released from prison in September 2015 for good conduct.

The report of the DNA test was adduced as new evidence in the appeal case in July 2016. The DNA result excluded Mr Eric Asante as the father of the child and the initial conviction was quashed in January 2017. However, the Court stated that the “appellant is not entitled to an acquittal on the sole ground that the DNA evidence excludes him”. Nevertheless, in their “judgment, the DNA evidence does tremendous damage to the credibility of the victim and her disposition to speak the truth, in this case, is put in serious doubt”.

*Source: Asante v Republic [2017] GHASC J3/7/2013
(Available from <https://ghalii.org/gh/judgment/supreme-court/2017/3>)*

377

378 In summary, the two case studies above show the dual effects of forensic applications in
 379 convicting and exonerating individuals in the criminal justice system. There is also a wide range
 380 of opportunities for the application of forensic science in humanitarian cases. For example, on 3
 381 June 2015, more than 150 individuals lost their lives in the “twin” fire and flood disaster [54].
 382 Some of the challenges encountered in this case included poor scene management and
 383 inadequate forensic science support. As a result, burnt bodies were crammed into vehicles and
 384 deposited at various morgues. Further, there were no or inadequate processes (such as DNA
 385 identity testing) to identify the bodies and missing persons. Lastly, there was a poor forensic
 386 investigation into the cause of the fire and flood due to lack of expertise [55]. The benefits of
 387 forensics and the wide range of opportunities for its application emphasise a need for
 388 government and stakeholder investment in advancing forensic science in Ghana. This includes

389 capacity building in areas of infrastructure, evaluation of impact, training, research and
390 education.

Journal Pre-proof

391 **7 Forensic science education**

392 Forensic science degree programmes have become ubiquitous in global higher education systems
 393 [56,57]. For example, there are at least 150 institutions/centres in the USA [58], 36 accredited
 394 institutions across the United Kingdom [59] and 17 universities in Australia [56]. In Ghana, very
 395 few institutions have recognised forensic science programmes. The University of Cape Coast
 396 (UCC) received accreditation to run a B.Sc. Forensic Science degree in 2013 but only began
 397 enrolment in the 2015/2016 academic year [60]. It is the only institution that runs such
 398 undergraduate programme in the country as well as in the West African sub-region, in a
 399 dedicated Department of Forensic Sciences (DFS). At the postgraduate level, the Kwame
 400 Nkrumah University of Science and Technology (KNUST) offers three specific forensic
 401 programmes: MPhil/MSc Forensic Science, MPhil/PhD Human Anatomy and Forensic Science,
 402 and MPhil/MSc Cyber-Security and Digital Forensics [61]. The introduction of these
 403 postgraduate programmes begun in 2014. One crucial gap in these developments is the limited
 404 availability of qualified/trained forensic science academics and researchers. This may be
 405 addressed through collaborations with advanced forensic institutions in other countries. The
 406 collaborative model is currently a core part of the UCC programme. This will not only ensure
 407 that graduates are adequately prepared to meet the challenges of forensic science practice but
 408 also enhance the quality of forensic services to the legal system and law enforcement.

409 **7.1 Accreditation of educational programmes/courses**

410 The forensic science programmes at UCC and KNUST have been accredited by the National
 411 Accreditation Board (NAB) of Ghana [62]. Accredited tertiary institutions in Ghana are required,
 412 by law, to submit their academic and professional programmes to the NAB for accreditation
 413 before enrolling students. A typical programme accreditation process in Ghana, as spelt out in
 414 the NAB's Roadmap to Accreditation [63], consists of completing and submitting extensive
 415 paperwork, an inspection of facilities, resources, logistic implication and staff needs of the
 416 institution, and a review of assessment reports by an Accreditation Committee (AC). The NAB,
 417 based on the recommendations of the AC, decides the outcome of the accreditation process. If
 418 required, the institution has within 30 days to challenge the decision, and the NAB is stipulated
 419 to conduct a review and communicate a final decision within 90 days of receipt of such
 420 application. As specified in the Legislative Instrument LI 1984 [64], an institution can appeal to
 421 the Minister responsible for Education, where necessary, within 30 days of receipt of the NAB's
 422 review decision.

423 The NAB accreditation process is not only centralised but unnecessarily cumbersome and
 424 requires an urgent review. Per their roadmap, a hitch-free application takes at least 162 working
 425 days to arrive at a decision and at least 282 working days if an unfavourable decision is
 426 challenged. These timelines are, however, only for guidance since actual turnaround times are
 427 stringently tied to how long it takes to assemble the relevant elements of the process.
 428 Decentralisation of operations through the establishment of regional NAB secretariats with
 429 decision-making powers should reduce accreditation time span. Further, elimination of the
 430 manual-based application forms for an online one, the progress of which is trackable via an
 431 applicant login upon submission of a full application (and paying the required fee), would be
 432 efficient as well as ensure effective documentation and institutional memory. Institutions will be

433 able to respond to any queries promptly online and would not have to travel to the NAB
 434 headquarters in Accra - as is currently the case – to follow up and or resubmit corrections.
 435 Finally, the establishment of web-based platforms with audio-visual online meeting functionality
 436 should eliminate the need for assessment panels to be physically present at meetings, given its
 437 voluntary nature. This will also ensure that personnel with field-specific expertise -home or
 438 abroad- are drafted instead of those ‘general knowledge’ or from ‘closely related area’ as was the
 439 case during the accreditation of UCC Forensics.

440 In the United States, there are agencies accredited by the Department of Education with either
 441 regional or national scope of providing accreditation to degree-granting institutions [65,66].
 442 While the United Kingdom does not operate an accreditation system as done in the US, it has the
 443 Quality Assurance Agency for Higher Education (QAA) [67,68] which is authorised to safeguard
 444 standards and quality in UK higher education. The foregoing bodies are parallel to Ghana’s
 445 NAB. However, the importance of forensic evidence in the civil/criminal proceedings means that
 446 organisations with highly skilled personnel with expertise in academia and practice in the diverse
 447 fields of forensic science have become essential to the national and international recognition of
 448 forensic science programmes. For instance, the US Forensic Science Education Programs
 449 Accreditation Commission (FEPAC) [69] and the UK Chartered Society of Forensic Sciences
 450 [70] provide professional accreditation to institutions to run high-quality undergraduate and
 451 postgraduate programmes. Accreditation from such bodies is very relevant because they see the
 452 programme suitability, core content, practical and/or training components from a multi-faceted
 453 perspective instead of just through a purely academic lens. This degree accreditation model will
 454 ensure:

- 455 1. the integration of “current global best practices”; and
- 456 2. the feasibility of the proposed training given the indicated resources rather than “enticing
 457 course content”.

458 In this respect, the FSSG, in collaboration with NAB and other international bodies, could be
 459 instrumental in the development, evaluation, monitoring and enforcement of forensic education
 460 standards. This collaborative initiative will ensure that forensic education policies and
 461 accreditation are robust, safeguarding high-quality education and training of forensic scientists
 462 in Ghana.

463 **7.2 Infrastructural Capacity**

464 The Forensic science programmes at KNUST primarily rely on the already well-established
 465 teaching and research facilities in departments at sciences, medicine and computer science
 466 faculties. The institution has, however, strived to acquire discipline-specific facilities to enhance
 467 content delivery and training. KNUST has partnered the E-Crime Bureau, a Cyber Security
 468 Company, to establish a Digital Forensics Laboratory [71]. The UCC Forensics, similarly, tap
 469 from the facilities available at the schools in the College of Agriculture and Natural Sciences
 470 [72]. The DFS has recently inaugurated a purpose-built Forensic Sciences Laboratory with four
 471 sections: Analytical Sciences & Toxicology; DNA Analysis; Fingerprint & Questioned
 472 Documents; and Ballistics/Firearms, each of which houses modern equipment and supplies to
 473 meet student training and research needs.

474 Moreover, the DFS won the 2018 Instrumental Access grant from the Seeding Labs [73] and
475 subsequently received different equipment and reagents [74] to enhance students' training. To
476 internationalise its forensic science education and imprint world-acclaimed practitioners, DFS
477 has working agreements with the Gujarat Forensic Sciences University, India [75], the
478 University of Lincoln, UK [76] and the University of Cordoba, Spain which allows students to
479 go for internships and, most significantly, learn to use equipment and techniques which are
480 presently not available at the UCC. Where necessary, both UCC and KNUST are given
481 supervised access to the facility and resources at the GPS FSL for some training. The above
482 progress notwithstanding, more investment in tailor-made infrastructure and equipment, is
483 required to raise training and research to standards with world acclaim.

484 **7.3 Employability of Graduates (The Case of DFS UCC)**

485 The key focus of every degree programme should not be limited to the competence and expertise
486 of the graduates it churns out, but most importantly, the alignment of student outcomes with the
487 future work environment. Thus, the job market-readiness of its graduates, vis-à-vis availability of
488 jobs. The NAB, therefore, requires institutions to provide an unambiguous statement of
489 employability of potential graduates as part of the accreditation process. UCC Forensics has
490 subsequently liaised with institutions within Ghana to highlight the need for forensic science
491 education and the impact that graduates could bring to bear in the performance of their core
492 functions. This has been done through a National Symposium that brought together all industry
493 players, including government and security agencies, where the employment of graduates was
494 strongly justified and advocated [77]. Furthermore, close engagements of DFS with the GPS
495 [78,79], Ghana Military Police and Ghana National Fire Service (GNFS) [80] where current
496 students have undertaken internships; Ghana Immigration Services and some private security
497 firms, should ensure high prospects of graduate employment. Notably, the exclusive
498 collaboration with GPS culminated into DFS winning the Sustainable Development Fund (SDF)
499 to develop training programmes beneficial to security agencies and, ultimately, DFS students
500 [81]. By cooperating with national and international partners, graduates will be able to work in
501 several jurisdictions, especially in the sub-Saharan Africa region where there is a massive human
502 resource gap.

503 **8 Forensic Science research and development**

504 Research across forensic science practice has generally improved understanding of the
505 significance of forensic science within the legal system. This spans across forensic technologies
506 and innovations, the validity and reliability of forensic science, interpretation of forensic
507 evidence, forensic science management and education, and forensic science law and ethics.
508 These research areas may be tailored to the specific research needs of a particular jurisdiction. In
509 the UK, for example, a recent report highlighted research gaps for technological developments,
510 foundational research into the scientific basis for some forensic methods, and leadership and
511 oversight functions [82]. Further research to investigate the effectiveness/impact of forensic
512 science, DNA database systems [83], and regulation of forensic science in the UK [84] are
513 highlighted by academics. The demand for such impact research has increased [85], given the
514 fact that forensic science practice in the UK has persisted for a long time. This is essential
515 because it can help improve existing practices and justify continuing support and effective
516 distribution of resources for forensic science.

517 This paper, by highlighting some policy issues of forensic science in Ghana, concomitantly,
518 identifies some research gaps for forensic science. For instance, for issues of underutilisation of
519 forensic science in criminal investigations, challenges could be exacerbated by lack of research
520 which disseminates the value of forensic science. As a result, basic research which shadows
521 crime levels and patterns, illuminates effect on national security, identifies investigative needs of
522 the police and areas where forensic science could be beneficial, should boost further desirability
523 for forensic science practice within the legal system. Addressing these research gaps should also
524 inform and justify the need for spending on forensic science in Ghana. Currently, research in
525 Ghana, generally, are stifled by lack of funding. A new educational policy proposes an increase
526 in funding for research in public tertiary institutions in Ghana from 0.3% of GDP to 1% [86].
527 The limited national research funding may proffer some difficulty in promoting forensic science
528 research. This may be addressed through national and international collaborations among
529 relevant research institutions, law enforcement agencies, forensic science providers and
530 governmental and non-governmental funding agencies. A specific Forensic Science Research
531 Institute (FSRI) could be established to coordinate, oversee and disseminate all forensic research
532 activities and outputs. The FSRI could liaise with relevant agencies such as the FSL and
533 Universities to develop and carry out projects that address gaps in practice. An advantage of this
534 approach is the prevention of duplicated research by different research institutions. Further, the
535 FSRI will serve as a unified source of forensic research information in Ghana. Specific funding
536 grants could be established under the FSRI in collaboration with agencies such as the Research
537 and Grant Institute of Ghana, and the Council for Scientific and Industrial Research to support
538 such research projects.

539 **9 Conclusion and recommendations**

540 This review examined the status of the different aspects of forensic science in Ghana. The areas
 541 scrutinised included legislation, governance, provision of forensic services, quality management,
 542 impact, education and training, and research and development. The main objective of the review
 543 was to identify key policy issues and provide relevant recommendations drawn from ‘best
 544 practice’ in countries that are more advanced in forensic science. The review is important
 545 because it provides a groundwork to assist policymakers in implementing appropriate policies to
 546 improve the application of forensic science in Ghana. As highlighted in the review, the
 547 realisation of the ultimate purposes of forensic science (including the safe delivery of justice) is
 548 dependent on the quality of its fundamental policies and legislation. The key issues identified in
 549 the review and corresponding recommendations are summarised below.

550 **Legislation:** Policymakers should consider best practice from other countries and implement
 551 appropriate legislation to govern the use of DNA, fingerprints and other biometrics. This is
 552 relevant because the police have already begun creating forensic information databases.

553 To prevent miscarriages of justice, it is highly recommended that policymakers and relevant
 554 stakeholders codify the admissibility tests for expert opinion evidence by drawing from
 555 international best practice.

556 **Governance:** An independent forensic governance approach through the creation of an
 557 independent forensic institution or through the leadership of an independent Regulator or Board
 558 is recommended. This can help prevent the potential risk of bias in the current police-led
 559 framework of governance, ensure discipline and priority for forensic needs, budgetary allocation
 560 and generation of funds.

561 **Forensic service provision:** Clear guidance on terms of service provision by the FSL to the
 562 police and other forensic users should be drafted. Further, a national policy on forensics should
 563 include appropriate funding and resourcing arrangements to sustain the forensic market. This
 564 may include public-private partnerships and national-regional grant schemes or collaborations to
 565 address resource and funding needs.

566 A decentralised model of service provision should also be developed to ensure the timely
 567 deployment of forensic services across the regions of Ghana.

568 **Quality assurance:** The lack of accreditation and regulatory bodies to oversee the quality of
 569 forensic science provision poses a risk to justice. Thus, a national forensic quality policy should
 570 be established that requires the adoption of the ISO 17025 and ISO 17020 for forensic service
 571 providers. This should be supported by the GSA, the proposed GNAS, the FSSGH, GPS and
 572 other relevant bodies.

573 **Impact of forensic science:** An evaluative programme should be established under an
 574 appropriate governing body to monitor and report on the impact and effectiveness of forensic
 575 science in the legal system. This will ensure that key challenges/issues are identified and
 576 resolved. Further, such information may enhance public support for the application of science in
 577 the legal system.

578 **Forensic science education:** To develop existing degree programmes into internationally
 579 acceptable standards, an accreditation model led by a forensic society (such as the FSSGH) or
 580 experts should be adopted.

581 Also, the curriculum for forensic degree programmes should integrate close partnership and
582 interaction with practitioners, forensic service providers and international higher education
583 institutions.

584 **Forensic science research:** A national policy on forensic science should include a research
585 framework that coordinates all forensic research activities in the country. A Forensic Science
586 Research Institute (FSRI) may be created for this purpose with a focus on addressing research
587 gaps in industry or practice.

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Conflict of interest

None