

REVIEW

EFFECTIVENESS OF FORENSIC MEDICINE PRACTICES: RWANDA FACING SHORTAGE OF FORENSIC PATHOLOGISTS

Nteziryayo D^{1,2*}, Xinshe L^{1,2,3}, Mushumba H⁴,

¹*Institute of Forensic Injury, Institute of Forensic Bio-Evidence, Western China Science and Technology Innovation Harbor, Xi'an Jiaotong University, Xi'an, People's Republic of China.*

²*Department of Forensic Pathology, College of Forensic Medicine, Xi'an Jiaotong University Health Science Center, Yanta Road W.76, Xi'an, 710061, Shaanxi, People's Republic of China.*

³*College of Forensic Medicine, Xi'an Jiaotong University Health Science Center, Yanta Road W.76, Xi'an, 710061, Shaanxi, People's Republic of China.*

⁴*Department of Legal Medicine, Rwanda Forensic Laboratory, Kigali, Republic of Rwanda.*

ABSTRACT

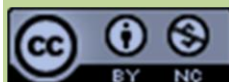
Forensic pathology has often been disregarded in both Western and non-Western countries, including the African nations. In this article, we highlight the shortage of forensic pathologists in Rwanda and make recommendations to encourage physicians to pursue the subspecialty of forensic pathology. Critically, we analysed issues and challenges related to the inadequate supply of forensic pathologists in the healthcare sector of Rwanda. The authors referred to scientific and legal literature from books, journals, national and international reports, and electronic sources on forensic pathology training and workforce. As a result, authors have identified several reasons for the shortage, including lack of exposure to forensic pathology, absence of a direct path for forensic pathology training, and insufficient funding for fellowships in forensic pathology. It is important to note that there is a global shortage of forensic pathologists, which hinders the effective practice of forensic medicine, including examinations and assessments of various types of deaths and incidents. This ultimately affects the administration of justice. However, it is hopeful that Rwanda's efforts in the field of forensic medicine will have a positive influence on other African nations in the coming years.

Keywords: *Forensic Medicine; Forensic Pathologist; Forensic Practice; Medical Education; Rwanda*

Corresponding author: Nteziryayo D
d.nteziryayo@stu.xjtu.edu.cn
ORCID iD: <https://orcid.org/0000-0001-6546-8294>

ARTICLE HISTORY

Received: 11.03.2023 Received in revised form: 18.08.2023
Accepted: 18.09.2023 Available online: 22.12.2023



This article is licensed under the terms of the Creative Commons Attribution-Non Commercial 4.0 International License.

in the field of forensic sciences primarily focus on equipping young scientists and medical doctors with foundational skills in all forensic sciences. This will enable them to provide basic medico-legal opinions whenever required in courts of law. Forensic pathologists have the responsibility of investigating deaths that may involve possible terrorism, biohazards, emerging infectious diseases resulting in unexplained death, mass fatality incidents, disaster-related deaths, and other types of deaths that could pose national security, public health, or public safety concerns^{1,2}.

The Republic of Rwanda is a landlocked nation in Central Africa, sharing borders with Uganda to the north, Tanzania to the east, Burundi to the south, and the Democratic Republic of Congo to the west^{3,4}. Rwanda is home to over 12.6 million people live in Rwanda, covering an area of 26,338 square kilometres, resulting in a population density of 445 individuals per square kilometer³. Due to its high

INTRODUCTION

Following the 1994 Genocide against the Tutsi, Rwanda continues to face numerous challenges in the areas of economy, education, and health as well as other socio-cultural aspects. Currently, initiatives

elevation, Rwanda is often referred to as the "land of a thousand hills", and its landscape features mountains and savannah. Additionally, the country is blessed with numerous lakes. Rwanda has received international recognition for its progress towards universal health coverage⁵. Through the *mutuelle de santé*, more than 84% of Rwandans insured through the *mutuelle de santé* have access to primary healthcare services⁶. The healthcare system in Rwanda is highly decentralized and efficiently operated, comprising 1700 health posts, 500 health centers, 42 district hospitals, and 5 national referral hospitals. Moreover, Rwanda boasts a thriving private healthcare sector, which includes two preferred hospitals, eye hospitals, 50 clinics and polyclinics, eight dental clinics, four eye clinics, and 134 dispensaries⁷. However, like many other countries around the world, Rwanda also faces a significant shortage of board-certified forensic pathologists or those with equal qualifications⁸⁻¹⁰.

This article delves into the causes behind the shortage of forensic pathologists in Rwanda and presents suggestions for addressing this issue. Firstly, despite the presence of three medical schools in Rwanda—namely, the University of Rwanda School of Medicine, the University of Global Health Equity, and the Adventist School of Medicine of East-Central Africa¹¹, there are currently no accredited training programs for forensic medicine. As a result, medical students do not have a direct pathway to pursue forensic pathology training. Additionally, the medical school curriculum in Rwanda offers limited exposure to forensic pathology, leaving most students with little to no knowledge in this field. Moreover, the absence of mentors in forensic medicine further compounds the negative experience of forensic autopsy during pathology training¹².

The lack of exposure to forensic pathology during medical school and basic pathology training, or the negative experiences encountered during such exposure, creates a situation where students and residents do not recognize forensic medicine as a worthwhile pursuit¹³. This limited exposure to pathology may subsequently result in fewer medical students selecting pathology as their chosen residency speciality, which is a prerequisite for pursuing a career in forensic pathology⁸. Another issue is the absence of funding from the Ministry of Health for forensic pathology fellowship. Currently, in Rwanda, there are no incentives in place to encourage medical students to pursue a career in forensic pathology, nor are there any specific loan forgiveness programs related to the field of forensic

medicine. Importantly, by identifying the reasons behind the shortage of forensic pathologists and implementing the recommendations outlined in this study, the government of Rwanda can enhance medico-legal death investigations by increasing the number of trained forensic pathologists and promoting research in this field.

MATERIALS AND METHODS

The methodology utilized in this present article is purely doctrinal. The authors extensively relied on scientific and legal literature from books, journals, national and international reports, and Google Scholar, to gather information regarding forensic medicine training and workforce. The primary objective of this article is to conduct a critical analysis, shedding light on the issues and challenges related to the shortage of forensic pathologists in the Rwandan healthcare sector. The ultimate goal is to improve the effectiveness of the criminal justice system, as the lack of experts proficient in the examination of deceased individuals poses a significant hurdle in delivering justice in murder cases in today's society.

Medico-Legal Death Investigation of Rwanda

The primary objective of the Forensic Medicine division goes beyond the conventional applications of scientific methods in assisting criminal law enforcement. Forensic medicine concerns the application of scientific medical knowledge to the administration of law, the advancement of justice, and the legal relations of the medical practitioner. Practitioners of this branch of medicine assist the law in assessing the liability of medical practitioners in issues such as consent to treatment, therapeutic intervention, and post-death phenomena.

In Rwanda, until a few years ago, forensic medicine was not considered one of the typical medical specialities a doctor would pursue as a career, and the use of autopsies for medico-legal purposes was uncommon. It was only less than ten years ago that a forensic medicine specialist at the Rwanda Forensic Laboratory started performing autopsies.

A forensic pathologist, a trained medical doctor, plays a crucial role in conducting post-mortem examinations to determine the cause of death. These experts in forensic medicine are specifically tasked with investigating deaths that may have broader implications for the public. As part of their educational journey, undergraduate students in the medical faculty and aspiring forensic pathologists

pursuing diploma, master's, and doctoral degrees in forensic medicine undergo comprehensive coursework in this specialized field¹⁴. However, the education and training in forensic medicine in Rwanda are currently lacking, and there is an absence of qualified or adequately trained forensic pathologists. Rwanda faces a severe shortage of skilled forensic medical examiners.

Rwanda currently boasts an efficient decentralized healthcare public service system, comprising 1700 health posts, 500 health institutions, 42 district hospitals, and 5 national referral hospitals¹⁵. However, it is unfortunate that there are no forensic medicine centers affiliated with the Ministry of Health (MOH), leading to a lack of accessible, high-quality forensic medicine services across the country.

The roles and responsibilities of forensic pathologists vary across different countries. In some nations, these examiners visit death scenes, perform autopsies, and conduct histopathological examinations. However, in other countries like the Kingdom of Saudi Arabia, forensic medical examiners are involved in preliminary examinations at crime scenes in collaboration with investigative authorities. They conduct external examinations, and autopsies, collect samples for toxicology screening and histopathological examinations, and prepare medico-legal reports for relevant authorities such as the general prosecutor, court, director of health affairs, or higher MOH committees. Additionally, in cases of sexual assault or injuries, forensic medical examiners conduct clinical forensic medical examinations on living individuals with authorization from law enforcement officials¹⁷.

While Rwanda has seen an increase in the utilization of autopsies for medico-legal purposes, government medical officers in the country still lack advanced training in this area. Furthermore, Rwanda currently does not have a specific forensic science act that mandates autopsies to be performed by trained forensic medical experts. As a result, the responsibilities typically assigned to forensic pathologists in Rwanda are carried out by anatomical pathology specialists and non-pathology medical doctors.

While Rwanda's medico-legal death investigation system strives to uphold justice and ensure accurate determination of deaths, it is imperative to shed light on the challenges and shortcomings that exist within the system. Comparisons with other systems

worldwide further highlight areas where improvements can be made.

One of the significant hurdles faced by Rwanda's medico-legal death investigation system is the scarcity of resources. Limited funding and inadequate infrastructure hamper the efficiency and effectiveness of investigations. Insufficient equipment, outdated forensic technologies, and a shortage of trained personnel hinder the system's ability to carry out thorough examinations and analyses.

Another critical aspect that negatively impacts the system is the shortage of skilled forensic professionals. Insufficient training opportunities and a lack of specialized education programs limit the expertise of forensic pathologists, anthropologists, and toxicologists. This deficiency in knowledge and skills can lead to errors in the determination of cause and manner of death, potentially compromising the integrity of the investigations.

Rwanda's medico-legal death investigation system faces challenges in maintaining standardized procedures across different regions or districts. Inconsistent protocols and varying levels of expertise among investigators can result in discrepancies in the quality and reliability of investigations. This lack of uniformity undermines the credibility and fairness of the system.

Cultural and social factors can impede the effectiveness of the system in Rwanda. Traditional beliefs and practices may clash with scientific methodologies, leading to difficulties in obtaining consent for autopsies or other necessary procedures. Additionally, societal stigmas, fear, and intimidation can deter witnesses from coming forward, hindering the gathering of crucial evidence.

The lack of awareness among the general public about the importance of medico-legal death investigations poses a significant challenge. Limited understanding of the system's role and processes can result in misconceptions, mistrust, and reluctance to cooperate. Encouraging public education and engagement is crucial for fostering trust and cooperation in the investigations.

Medico-legal death investigation systems vary across countries due to variations in legal frameworks, available resources, and cultural contexts. For instance: a) United States: In the U.S., the system operates at both state and federal levels, with forensic pathologists playing a crucial role in death investigations. b) United Kingdom: The UK

employs a coroner-based system, wherein coroners oversee investigations into sudden, unexpected, or suspicious deaths. c) Australia: Australia has a decentralized system, with each state and territory having its own medico-legal death investigation processes.

Rwanda's medico-legal death investigation system combines traditional practices with modern forensic methodologies, emphasizing collaboration and holistic approaches. While variations exist globally, the ultimate goal remains the same: to ensure accurate determination of the cause, manner, and circumstances surrounding deaths for justice and public safety. Increased investment in resources, enhanced training programs, standardized procedures, and public awareness campaigns are necessary steps toward improving the system's efficacy and ensuring justice for all.

Literature concerning the shortage and need for more forensic pathologists

The outcomes of medico-legal death investigations can have profound implications for the safety and well-being of vulnerable populations and society as a whole. Within the legal system, forensic physicians play a crucial role, intersecting with the law more than any other branch of medicine¹⁷. Even though forensic pathology in crime investigations in recent years¹⁸, many professionals in the criminal justice field remain unfamiliar with the term^{8,13}. The shortage of forensic pathologists significantly impacts various types of cases, including suicide, child deaths, maternity and domestic abuse deaths, work and product safety deaths, new illnesses, and natural disasters. Resolving the substantial workforce shortage in the field of forensic medicine¹⁹ is essential to ensure effective investigations within the medico-legal system.

However, in the real world, the forensic team at a hospital performs painstaking labour that is anything but glamorous to determine how and why death happens. Forensic science may appear to be an exciting vocation in literature and on television²⁰. However, a global scarcity of forensic pathologists exists. The paucity of fresh forensic pathologists continues to be a severe global concern, according to research studies on medical education. The demand for forensic pathologists is rising in tandem with the prevalence of new diseases and criminality^{0,13}. There are not enough board-certified forensic pathologists in the US and Canada at the moment to meet the country's needs. Additionally, forensic pathologists who are currently

in practice in Canada, particularly in Ontario, are overworked due to the severe lack of these professionals²¹. The forensics center for the province, the Saint John Regional Hospital, is run by forensic pathologist Dr. Ken Obenson, who also supervises autopsy services there. Dr. Ken Obenson says there is a shortage of trained forensic pathologists in Canada. According to him, Canada only has a small number of 30 to 40 trained certified forensic pathologists because it takes so many years (Four years of undergrad, four years of medical school, five years of residency, and one year of sub-speciality training, so it's quite long) to obtain the necessary credentials. Therefore, some people would be deterred from pursuing a career in the industry²².

Medical examiners are in low supply in the United States. Like everything else, the COVID-19 pandemic has just made this long-standing issue worse. The opioid problem has contributed significantly to the nationwide increase in mortality before the pandemic. The president of the National Association of Medical Examiners at the time, Dr. Brian Peterson, told The New York Times in October 2017 that the crisis had resulted in staff burnout, financial issues, and accreditation threats because many offices had to conduct more autopsies than were permitted by industry standards. Unfortunately, things didn't get any better as time went on. Another New York Times piece, titled "Piled Bodies, Overflowing Morgues: Inside America's Autopsy Crisis," reaffirmed this on February 25, 2020. Peterson once again expresses his worries, this time giving readers a graphic view inside America's overcrowded morgues and observing that there aren't many remedies to the issue²³.

In the United States, even though forensic pathologists operate as medical examiners in medical examiner and coroner agencies, there are still not enough forensic pathologists to serve the entire country, according to numerous published reports, testimonials, research studies, and data gathered⁰. In fact, despite there being approximately 2000 coroner offices and 400 medical examiner offices in the United States, only about half of the population is served by a medical examiner²⁴. Shockingly, less than 500 forensic pathologists are working in the United States, which is not sufficient to handle even half of the annual deaths that require autopsies, as warned by the National Research Council eleven years ago²⁰. This means that one forensic pathologist is responsible for serving at least 5 coroner offices. Due to this shortage, autopsies may not be conducted on time or within the local area. The scarcity of future

forensic pathologists is not limited to the United States but is a critical issue worldwide^{9,24}.

After 1960, autopsies performed for medical and legal reasons in Nepal started to become popular. In Nepal, three aspects of forensic sciences are practised in forensic medicine: forensic pathology (autopsy), clinical forensic examination (examination of sexual assault victims and perpetrators, victims of injury and torture, age estimation, mental status examination, drunkenness examination),¹⁵ and forensic anthropology (examination of human skeletal remains). However, it is important to note that while it excludes histological examination, it includes the additional work of clinical forensic examination and forensic anthropology, making it a condensed type of forensic pathology. Unfortunately, the medico-legal investigative system in Nepal falls significantly behind that of developed countries. Doctors performing medico-legal and post-mortem work at local level hospitals are frequently unskilled in this delicate task. Medico-legal work in Nepal is primarily performed by medical officers, the majority of whom lack forensic qualifications. Additionally, the lack of a centrally designated unit or department is one of the reasons why the medico-legal sector in Nepal has not developed as much as it could²⁵. In cases of unnatural deaths, a police inquest is held²⁶, after which the body is subjected to a medico-legal autopsy at the nearest government hospital²⁷. It is concerning to note that there are currently less than 50 forensic medicine experts practising in a country with a population of approximately 30 million people²⁷. Furthermore, there is a lack of adequate equipment in forensic science labs in Nepal.

A shortage of forensic pathologists in Africa is having a significant impact on the efficiency of death investigation systems. In the Eastern African region, where Rwanda is located, the current state of medico-legal services in Uganda is being discussed, with a particular focus on forensic pathology and plans for improvement to ensure the delivery of high-quality services. In Uganda, these services are provided partly by pathologists attached to universities, medical officers employed by the police, and medical officers attached to hospitals²⁸.

Similarly, in Burundi, there have been numerous recorded murder cases in recent years, and some perpetrators have been apprehended^{29,30}. However, many of these crimes remain unsolved due to a lack of evidence that can be used to charge the offenders. Unlike Uganda, Burundi does not employ any forensic science methods in criminal investigations of murder. Instead, investigations rely

solely on traditional methods of testimony. While some forensic methodologies are employed in Uganda, the police officers responsible for conducting criminal investigations often lack the necessary training and technical competence to effectively analyse and interpret the various pieces of evidence obtained at crime scenes²⁹.

In Kenya, forensic pathology is managed by the government under the Ministry of Health. However, the National Public Health Laboratory in Kenya faces a shortage of forensic pathologists, with only four capable of covering the entire country. Consequently, the state of forensic investigation in Kenya is severely lacking. The field has not yet reached its full potential due to issues such as inadequate infrastructure and tools, a lack of standardized procedures, a lack of policies governing forensic investigation, and a shortage of specialized experts to handle crime scenes. Furthermore, there are no international credentials or qualifying procedures for forensic pathologists practicing in the country³⁰⁻³³.

The main difficulty faced by Tanzania's forensic science services is the lack of access to its own accreditation services, which would assist forensic units in meeting both local and international accreditation criteria. There is a shortage of expertise in forensic fields, such as forensic pathology^{33,34}, in Tanzania. Additionally, forensic science has been used only in cases involving more serious crimes rather than in minor events, as noted by Jilala and Lwoga. This limited usage has made the profession less visible to the general public and its services accessible to only a small number of people.

Suggested recommendations on how to increase the availability of forensic pathologists in health faculties

In research conducted in the USA, recommendations were made to boost the supply of forensic pathologists in the country. To encourage young doctors to pursue forensic medicine as a solid career in our setting, we may need to adopt certain measures. One key measure is to make the specialization of forensic medicine and death investigation more prominent in the pathology residency curriculum at medical schools³⁴. The Higher Education Council (HEC), medical universities, and the Ministry of Health, through the National Strategy for Health Professions Development (NSHPD), should collaborate to develop a comprehensive course on forensic pathology and medicolegal death investigation. This course, as

detailed by the Scientific Working Group on Medico-legal Death Investigation (SWGMDI)³⁵, would cover various important topics such as obtaining permission for hospital autopsies, reporting cases to the medico-legal death investigation systems, understanding the death certificate and how to complete it accurately, the training path required for anatomic pathology and subsequent specialization in forensic pathology, and the different types of job opportunities available to forensic pathologists^{34,35}. The Ministry of Health and the HEC, through the NSHPD, could play a crucial role in supporting the development and widespread implementation of this course. It is not enough for the HEC to merely endorse this project; they should also mandate medical schools to include this course in their curricula. Furthermore, to further promote the field of forensic pathology, the Ministry of Health, university teaching hospitals, and medical universities should collaborate on establishing a forensic pathology mentoring program for medical students. This program could introduce students to the exciting field of forensic pathology and encourage them to pursue it as a career option³³. One potential component of such a program could involve medical students using intriguing forensic pathology cases as the basis for writing case reports, which could be presented or published^{33,34}. By implementing these recommendations, we can aim to address the shortage of forensic pathologists and ensure a strong pipeline of professionals in this field.

In Rwanda, new medical schools are opening to increase the production of primary care physicians who can serve areas in need. As detailed by SWGMDI³⁵, these schools could also place an emphasis on forensic pathology to cultivate the production of forensic pathologists to serve areas in need. Additionally, efforts to recruit students into medical schools, pathology, and forensic pathology should begin at the undergraduate level. Strategies should be developed to specifically target college students in a way that will pique their interest in the medical field and foster an early passion for pursuing forensic pathology as a career.

In pathology residency programs, there is a need to improve and promote autopsy, forensic pathology, and death investigation exposure. This will help establish forensic pathology as a legitimate medical and academic career³³⁻³⁵. Medical schools and university teaching hospitals should request that anatomic pathology training programs provide opportunities for exposure to forensic pathology. Moreover, pathology residency programs should ensure that their residents spend at least 1 or 2 years³⁶, in a forensic pathology fellowship after

completing their training in anatomical pathology, clinical pathology, or forensic medicine. This will enable them to gain the necessary expertise and experience to become certified forensic pathologists in Rwanda Forensic Laboratory, Department of Legal Medicine, and assist forensic pathologists in conducting medico-legal autopsies. The Legal Medicine department should consider providing a stipend to pathologists for their services, even if they are not regular members of the department. Furthermore, the Legal Medicine department should ensure that the pathologists assigned the responsibility of supervising the autopsy service possess the requisite autopsy skills and a genuine interest in autopsy performance and reporting. By addressing these areas, we can strive to strengthen the field of forensic pathology in Rwanda and meet the growing demand for qualified professionals.

Ministry of Health (MOH) and HEC need to encourage faculty to support residents who are considering a career in forensic pathology. The RMDC needs to enforce its requirement for meaningful exposure to forensic pathology during pathology residency. Without these rotations, pathology residencies would not be able to function properly, and it is crucial for the MOH to recognize this and provide appropriate support to the forensic pathology service and faculty. Recently, the establishment of the National Association of Forensic Pathology has become necessary to address some of these issues.

Financial incentives must be provided to attract medical students and pathology residents to pursue a career in forensic medicine^{34,35}. The Higher Education Council (HEC), in collaboration with the medical schools in Rwanda, should develop a medical school loan forgiveness program specifically for medical students entering the field of forensic pathology. Loans should be deferred for a significant period following the completion of forensic pathology training, and if the student continues to practice forensic pathology, their loan should be forgiven. The HEC, university teaching hospitals, and medical schools should seek national support for this program, potentially through proposed legislation related to the forensic sciences. Additionally, it would be beneficial to make more affordable loans available alongside any loan forgiveness programs.

Wages for forensic pathologists must be brought up to par with other medical professions with similar educational qualifications^{34,35}. The MOH, in collaboration with the National Public Prosecution Authority (NPPA), should establish relationships and

liaise with the Ministry of Justice (MINJUST) to educate them about the crucial roles played by forensic pathologists and medico-legal death investigation systems in areas such as public health, vital statistics, criminal justice, civil courts, public safety, homeland security, the medical profession, and the wide range of state and national agencies and programs that rely on information generated through death investigations. Simultaneously, it is important to educate these organizations about the challenges in recruiting forensic pathologists into the field, one of the major factors being the relatively low salaries for individuals with medical degrees and advanced postgraduate training. By addressing these aspects, we can work towards strengthening the field of forensic pathology and ensuring its attractiveness as a career option in Rwanda. The numerous national agencies that rely on death investigation information, including hospitals, Rwanda Biomedical Centre (RBC), and Rwanda Forensic Laboratory (RFL), should collectively develop a comprehensive plan to assist states and local jurisdictions in funding their forensic pathology positions. For example, RFL could shift some funding and support away from novel research and towards the practical aspects of forensic pathology practice, which could facilitate research. Rwanda Forensic Laboratory and hospitals should strengthen relationships with medical schools to offer stipends and other benefits to forensic pathologists involved in pathology resident training. The HEC, university teaching hospitals, and graduate medical schools should work together to ensure that funding for forensic pathologist positions in forensic pathology training programs includes salaries that will attract well-qualified individuals with teaching skills. Finally, as described by SWGMDI³⁵, forensic pathology fellowships should not be tied to the postgraduate year level. Instead, salaries should be increased to attract pathology residents into the field. The state should provide stipends that could augment fellow salary funding provided by medical schools, with strings attached to the funding to keep the fellow in forensic pathology practice, perhaps even within the state that provided the funding directly or with state assistance.

Medical universities should develop forensic pathology-centered initiatives to attract students^{12,23}. In medical schools, there is a lack of pathology training programs, forensic pathology training programs, and an adequate number of fully qualified forensic pathologists working in the universities³⁸. As detailed by SWGMDI, these universities should develop an incentive program to attract forensic pathologists to the institution³⁵. For example, the state could provide scholarships to

individuals who wish to study forensic pathology subspecialty in medical school. Currently, students who want to train in forensic pathology (Forensic Medicine) would have to leave the country to do so. Efforts to improve and modernize the physical facilities in hospitals for medicolegal death investigations may also assist in recruiting forensic pathologists and encouraging their long-term employment⁶. Another option could be to implement a system similar to primary care practice, with special considerations and incentives to attract physicians to underserved areas³⁵.

The number of forensic pathology training programs, as well as the number of sponsored forensic pathology fellowship posts, need to be raised^{33,34}. The lack of forensic pathology training programs should be addressed by providing government incentive funds to develop new programs. Existing medical colleges and universities should be encouraged to train forensic pathology talents and job transfer training should be implemented to involve medical personnel in forensic work. International cooperation can also be utilized to expand the number of forensic teachers in Rwanda and train more forensic reserve talents.

Pathology training schools must actively inform their students about the forensic pathology profession^{32,35}. Program directors should ensure that their interviews of potential trainees thoroughly evaluate the candidate's intent to practice forensic pathology and to what extent. This is crucial since there is currently a shortage of forensic pathologists and a lack of available training positions. The Higher Education Council (HEC) should establish requirements for training programs in forensic pathology that better reflect the unique aspects of the field. The HEC needs to understand that forensic pathology requires distinct qualities and that the patient-care-focused requirements may not be directly applicable. Training should primarily focus on learning forensic pathology subject matter and developing the skills necessary for conducting medico-legal post-mortem examinations and investigations. During the training years, direct observation and supervision should allow supervisors to determine the trainees' capability for independent practice.

Medical schools and pathology departments in hospitals should have more formal links with the Rwanda Investigation Bureau (RIB). These institutions should provide support services to forensic pathologists, such as consultations with experts, peer support, research assistance, and specialized laboratory and diagnostic services.

Academic collaborations can enhance the professionalism and professional development of forensic pathologists. The government should prepare a document that addresses the relationships between pathology departments and RIB, including recommendations regarding death investigations and other relevant factors. Spencer et al.⁹ suggested that while formal relationships with medical schools and pathology departments are beneficial for supporting forensic pathology practice, it is important to consider revising the training path for forensic pathologists and exploring alternative models.

New funding methods for death investigation systems must be developed^{35,38}. As an example of novel funding mechanisms, the NPPA and RIB should collaborate with medical care funding sources and hospitals to ensure that hospitals whose patients undergo autopsies by the medico-legal death investigation system provide funding to support these services. Insurance companies should also contribute financially to the medico-legal death investigation system, as it is in their best interest to have autopsies conducted in quality settings by qualified personnel^{8,9}. However, these measures alone are insufficient and do not align with international standards for evidence-based medico-legal practice. For instance, medico-legal autopsies primarily conducted in peripheral district hospitals are performed by young non-specialist medical officers who have only received a theoretical 3-credit forensic and legal medicine course during their undergraduate medical studies at the University of Rwanda Medical School. Even in the more specialized RFL located in the capital city of Kigali, medico-legal autopsies are performed by an anatomical-pathology expert who is not board-certified in forensic pathology. This poses challenges whenever the delivery of medico-legal expertise is required in courts of law. Moreover, without the necessary skills to respond to catastrophes, disasters, migration, or other situations of violence, the deceased are not managed in a dignified manner, which creates difficulties for their families seeking clarity about the fate of their loved ones. Equipping these medical officers with basic skills is thus an essential starting point to enable them to respond effectively to these challenges. The shortage of forensic pathologists at the national, regional, and global levels should be acknowledged^{0,12}, to encourage government authorities and legislators to take action and provide adequate funding and support to address this problem.

CONCLUSIONS

In conclusion, this article has examined the shortage of forensic pathologists, provided background information on the problem, and proposed suggestions that could help increase the number of forensic pathologists available in healthcare facilities in Rwanda, the region of East Africa, and around the world. The next research will assess the historical progression of forensic medicine in Rwanda and the need for further advancements.

ACKNOWLEDGEMENTS

None

CONFLICTS OF INTEREST

The Authors declare that there is no conflict of interest.

ETHICAL ISSUES

None.

SOURCES OF SUPPORT

None.

AUTHOR CONTRIBUTIONS

DN: Conception or design of the work; acquisition, analysis, and interpretation of data for the work; drafting the work and revising it critically for important intellectual content; and final approval of the version to be published. **HM:** Conception or design of the work; acquisition, analysis, and interpretation of data for the work; drafting the work and revising it critically for important intellectual content; and final approval of the version to be published. **LX:** Conception or design of the work; acquisition, analysis, and interpretation of data for the work; drafting the work and revising it critically for important intellectual content; and final approval of the version to be published.

REFERENCES

- Schuliar Y, Knudsen PJ. Role of forensic pathologists in mass disasters. *Forensic Science, Medicine, and Pathology*. 2012;8(2):164-173. <https://doi.org/10.1007/s12024-011-9300-3>.
- Bogdanović M, Atanasijević T, Popović V, Mihailović Z, Radnić B, Durmić T. Is the role of forensic medicine in the COVID-19 pandemic underestimated? *Forensic Science, Medicine, and Pathology*. 2021;17(1):136-138. <https://doi.org/10.1007/s12024-020-00308-2>.
- About Rwanda. Overview. Available from: <https://wtcd2022.rw/about-rwanda/> [Accessed 2nd February 2023].
- United Nations. *List of countries by population*. Available from: <https://en.m.wikipedia.org/wiki/Rwanda> [Accessed 2nd January 2023].
- Lagomarsino G, Garabrant A, Adyas A, Muga R, Otoo N. Moving towards universal health coverage: health insurance reforms in nine developing countries in Africa and Asia. *Lancet (London, England)*. 2012;380(9845):933-943. [https://doi.org/10.1016/S0140-6736\(12\)61147-7](https://doi.org/10.1016/S0140-6736(12)61147-7).
- Abbott P, Sapsford R, Binagwaho A. Learning from success: how Rwanda achieved the millennium development goals for health. *World development*. 2017; 92:103-116. <https://doi.org/10.1016/j.worlddev.2016.11.013>.
- Rwanda Development Board (RDB). Available from: <https://rdb.rw/investment-opportunities/health-services> [Accessed 20th September 2022].
- Paknahad S, Akhgari M, Ghadipasha M. An alarming rise in the prevalence of deaths with methamphetamine involved in Tehran, Iran 2011-2018. *Forensic Science, Medicine, and Pathology*. 2021;17(2):208-215. <https://doi.org/10.1007/s12024-020-00339-9>.
- Spencer A, Ross WK, Domen RE. Forensic Pathology Education in Pathology Residency: A Survey of Current Practices, a Novel Curriculum, and Recommendations for the Future. *Academic Pathology*. 2017;4:2374289517719503. <https://doi.org/10.1177/2374289517719503>.
- Sara G. Autopsies delayed, families waiting for answers due to forensic pathologist shortage. Available from: https://www.cleveland19.com/2022/11/17/autopsies-delayed-families-waiting-answers-due-forensic-pathologist-shortage/?outputType=amp#amp_ct=1673350885073&_tf=From%20%251%24s&aoh=16733507977867&referrer=https%3A%2F%2Fwww.google.com [Accessed 20th September 2022].
- Wikipedia. *List of medical schools in Rwanda*. Available from: https://wikimili.com/en/List_of_medical_schools_in_Rwanda [Accessed 20th September 2022].
- Subedi ND, Deo S. Status of medico legal service in Nepal: Problems along with suggestions. *Journal of College of Medical Sciences-Nepal*. 2014;10(1):49-54. <https://doi.org/10.3126/jcmsn.v10i1.12769>.
- Murakami M, Matoba K, Terazawa K. Raising future forensic pathologists (first report): results of a preliminary questionnaire survey. *[Hokkaido igaku zasshi] The Hokkaido Journal of Medical Science*. 2012;87(4-5):153-157.
- Kharoshah MA, Zaki MK, Galeb SS, Moulana AA, Elsebaay EA. Origin and development of forensic medicine in Egypt. *Journal of Forensic and Legal Medicine*. 2011;18(1):10-13. <https://doi.org/10.1016/j.jflm.2010.11.009>.
- Nteziryayo D, Xinshe L. Development of forensic medicine in Rwanda- past, present, and future perspectives [published online ahead of print, 2023 Aug 2]. *Journal of Forensic and Legal Medicine*. 2023;98:102573. <https://doi.org/10.1016/j.jflm.2023.102573>.
- Al Madani OM, Kharoshah MA, Zaki MK, Galeb SS, Al Moghannam SA, Moulana AA. Origin and development of forensic medicine in the Kingdom of Saudi Arabia. *The American Journal of Forensic Medicine and Pathology*. 2012;33(2):147-151. <https://doi.org/10.1097/PAF.0b013e318221b895>.
- Al Madani OM, Kharoshah MA, Zaki MK, Galeb SS, Al Moghannam SA, Moulana AA. Origin and development of forensic medicine in the Kingdom of Saudi Arabia. *The American Journal of Forensic Medicine and Pathology*.

- 2012;33(2):147-151.
<https://doi.org/10.1097/PAF.0b013e318221b895>.
18. Bolcato M, Fassina G, Rodriguez D, Russo M, Aprile A. The contribution of legal medicine in clinical risk management. *BMC Health Services Research*. 2019;19(1):85.
<https://doi.org/10.1186/s12913-018-3846-7>.
 19. Becas D, Adriansen A, Baccino E, Peyron PA. Autopsies judiciaires et expertises anatomopathologiques complémentaires : état des pratiques sur le ressort de la cour d'appel de Montpellier. Étude rétrospective de 630 autopsies [Forensic autopsies and pathological examination: Current practice in Montpellier's jurisdiction. A retrospective study of 630 autopsies]. *Annales de pathologie*. 2022;42(5):412-423.
<https://doi.org/10.1016/j.annpat.2021.11.002>.
 20. Jordan K. *Piled Bodies, Overflowing Morgues: Inside America's Autopsy Crisis Medical examiners provide crucial insights into public health and safety. What happens when we don't have enough of them?* Available from: <https://www.nytimes.com/2020/02/25/magazine/piled-bodies-overflowing-morgues-inside-americas-autopsy-crisis.html> [Accessed 2nd January 2023].
 21. Forensic pathologist. *Future demand*. Available from: <https://forensicpathologistcareer.weebly.com/future-demand.html> [Accessed 3rd January 2023].
 22. Forensic medicine not like C.S.I. says Saint John pathologist. Available from: <https://www.cbc.ca/news/canada/new-brunswick/forensic-pathology-nb-1.3704109> [Accessed 5th January 2023].
 23. Alyse G. *Perspective: Pathologists' Assistants Can Alleviate Burdens on Forensic Pathologists*. Available from: <https://www.medscape.com/viewarticle/967530> [Accessed 6th January 2023].
 24. Choo TM, Choi YS. Historical development of forensic pathology in the United States. *Korean Journal of Legal Medicine*. 2012;36(1):15-21. Available from: <https://docplayer.net/19967542-Historical-development-of-forensic-pathology-in-the-united-states.html> [Accessed 6 January 2023].
 25. Dixit H. A Forensic Tale of Nepal. *JNMA; Journal of the Nepal Medical Association*. 2018;56(213):883-885.
<https://doi.org/10.31729/jnma.3715>.
 26. Inquests and Investigations. *Inquest Definition and Types of Inquest*. Available from: <https://www.inquest.org.uk/investigation> [Accessed 7th January 2023].
 27. Atreya A, Menezes RG, Subedi N, Shakya A. Forensic medicine in Nepal: Past, present, and future. *Journal of Forensic and Legal Medicine*. 2022;86:102304.
<https://doi.org/10.1016/j.jflm.2022.102304>.
 28. Prahladh S, Van Wyk J. Advantages of an electronic recording system for medicolegal autopsies in resource-constrained contexts. *Journal of Forensic and Legal Medicine*. 2022;88:102336.
<https://doi.org/10.1016/j.jflm.2022.102336>.
 29. Bimenya GS, Bhootra BL, Mukasa N. Forensic medicine services in Uganda--present and future. *Journal of Clinical Forensic Medicine*. 2005;12(2):81-84.
<https://doi.org/10.1016/j.jcfm.2004.08.004>.
 30. Namy S, Carlson C, O'Hara K, et al. Towards a feminist understanding of intersecting violence against women and children in the family. *Social Science & Medicine*. 2017;184:40-48.
<https://doi.org/10.1016/j.socscimed.2017.04.042>.
 31. Bundi M. *The state of forensic investigation in Kenya* (Doctoral dissertation, University of Nairobi). 2016. Available from: <http://erepository.uonbi.ac.ke/handle/11295/97571> [Accessed 8th January 2023].
 32. Textbook Reviews. *Pathology Resident Wiki*. Available from: https://pathinfo.fandom.com/wiki/Textbook_Reviews [Accessed 2nd September 2022].
 33. Hung T, Jarvis-Selinger S, Ford JC. Residency choices by graduating medical students: why not pathology? *Human Pathology*. 2011;42(6):802-7.
<https://doi.org/10.1016/j.humpath.2010.10.018>

34. The Citizen. *Forensic exhumation a big challenge for Tanzanian medics*. Available from: <https://www.thecitizen.co.tz/tanzania/news/national/forensic-exhumation-a-big-challenge-for-tanzanian-medics--4058280> [Accessed 10th January 2023].
35. Scientific Working Group on Medicolegal Death Investigation (SWGMDI). *Increasing the Supply of Forensic Pathologists in the United States*. Available from: https://www.nist.gov/system/files/documents/2018/04/24/swgmdi_increasing_the_supply_of_forensic_pathologists_in_the_us.pdf [Accessed 10th January 2023].
36. University of Toronto. *Fellowship Training Programs*. Available from: <https://imp.utoronto.ca/fellowship-training-programs> [Accessed 10th January 2023].
37. American Osteopathic Board of Pathology. Available from: <https://certification.osteopathic.org/pathology/> [Accessed 3rd February 2023].
38. Tara L. *Experts Fear a Shortage of Forensic Pathologists Will Leave Deaths Unexplained*. Available from: <https://time.com/6234125/forensic-pathologist-shortage/> [Accessed 3rd February 2023].