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A REVIEW ON GENERAL PRACTICES OF AUTOPSIES IN FORENSIC LABORATORIES WITH EMPHASIS ON MANAGEMENT SYSTEM

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ABSTRACT

Investigating sudden, unexpected, and unnatural deaths is vital for supporting the criminal justice system, aiding in litigation, and providing critical information for public health initiatives, including surveillance, epidemiology, and prevention programs. Analyzing mortality data can reveal trends that inform policy development and resource allocation. As a result, forensic medicine requires efficient data management systems. In order to characterize the present state of knowledge regarding data management procedures in forensic medicine, this study examines the literature. All study designs and English-language publications that addressed unnatural fatalities and concentrated on data practices or management systems in forensic medicine were included in the study. The years 2010 through 2020 saw the publication of these articles. Despite the high rate of unnatural fatalities in lower- and middle-income nations, the study's findings show that there aren't many publications about data management and practice systems in forensic medicine, especially from these nations. In order to help guide policy decisions, this study suggests more research on forensic medicine practice systems and data management in lower- and middle-income nations.

Keywords: Management systems, Autopsy data, Post-mortem examination, Forensic data.

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INTRODUCTION

The global burden of trauma, especially in low- and middle-income countries, places significant strain on resources, highlighting the need to emphasize the diagnostic value of autopsies. Autopsies remain the gold standard for evaluating medical care standards. Despite their recognized value within the medical community, there has been a troubling decline in their use. Forensic Medicine and Forensic Pathology leverage scientific and medical expertise in death investigations, with autopsies often serving as the focal point. Investigating sudden, unexpected, and unnatural deaths supports criminal justice, aids in litigation, and provides critical information for public health, including surveillance, epidemiology, and prevention programs. The evidence gathered from these investigations informs policies aimed at preventing injuries, suicides, violence, and substance abuse [**1**].

Death investigations are conducted globally in accordance with varying national legislation. The coroner system was formalized in England by King Richard I in 1194, with the first coroners being knights. This system was introduced to the American colonies in the 1600s, becoming a crucial element of the death investigation framework in what would later become the USA [**2**]. Over time, however, the role of the coroner evolved to focus primarily on the medicolegal examination of bodies and determining the cause and manner of death. During the Middle Ages, coroners were responsible for conducting inquests, inspecting the deceased, and investigating suspicious deaths [**3-6**].

In the USA, coroners are typically public officials with little to no medical training. Some serve part-time while maintaining other full-time jobs. The medical examiner system was established in

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response to public dissatisfaction, allegations of corruption, and the growing need for skilled personnel in death investigations. This led to the development of a distinct discipline known as Forensic Medicine, which began in the seventeenth century. The first medical examiner system was implemented in Massachusetts in 1877. The field of forensic pathology was formally recognized in 1959, and pathology training for medical examiners was initiated. Forensic pathology is considered a specialization of anatomical pathology in nations such as the UK and Canada. For a minimum of a year, forensic pathology-only training is available in South Africa and Australia, frequently accompanied by further anatomical pathology instruction. The Inquests Act is the main guideline for medicolegal death investigations in South Africa. Although medical professionals undertake medicolegal autopsy, many autopsies are carried out by colleagues with no formal training due to the high frequency of unnatural deaths and the lack of competent forensic pathologists [**7**]. Investigating and reporting the cause of death is the primary duty of forensic pathologists. The Global Burden of Disease Study emphasizes the importance of this endeavor. At the international, national, and regional levels, this comprehensive global observational epidemiological study evaluates mortality and morbidity from major illnesses, injuries, and health risk factors. Good mortality reporting systems can help guide scientific research, monitor progress toward global development goals, and prioritize investments in the health system. Since continuous reporting of cause-specific mortality in many nations is essential for the advancement of global health, the Global Burden of Disease study highlights the need for wider adoption and improvement of these systems [**8-10**].

Traditionally, information from autopsies has been recorded on paper, filed, and archived. However, in today's technological age, this information can be stored and managed electronically, ensuring that reporting remains current, relevant, and beneficial for training, service delivery, policy implementation, and social interventions. The ongoing coronavirus pandemic has underscored the significance of wireless technology and the Internet in facilitating communication. Due to safety concerns, many sectors, including healthcare, have shifted to remote operations. General practitioners have conducted virtual consultations to comply with social distancing and safety measures, making telephonic communication and telemedicine essential during the pandemic. As a result, we are now compelled to embrace technology in our daily work lives [**11-14**].

With an emphasis on their application, advantages, and difficulties, this review sought to map the evidence pertaining to data management and practice systems in forensic medicine. Models appropriate for comparable applications in forensic medicine in lower- and middle-income nations can be informed by the knowledge gathered about the availability and use of digital technology, as well as their advantages and disadvantages in gathering autopsy data.

METHODS

The study's protocol was created beforehand and released. The following procedures were taken in order to carry out the review utilizing the Arksey and O'Malley framework: determining the research topic, finding pertinent studies, choosing studies that are eligible, charting the data, and compiling and summarizing the findings are the first steps in the process [**15, 16**].

To find papers about data procedures, usage, advantages, and difficulties in forensic medicine globally, a thorough search of published and gray literature was undertaken. We searched databases such as PubMed, Scopus, Web of Science, Science Direct, and Google Scholar. Study design limitations were not included. To determine whether the databases and keywords selected were appropriate, the search technique was piloted. To confirm the effectiveness of the search method in PubMed, the study team examined the findings [**18-20**].

In accordance with the study's eligibility requirements, the lead investigator performed title screens and database searches. Piloting the search strategy and screening tools helped to improve consistency, calibrate operators, and hone the techniques. A spreadsheet containing bibliographic information, publication year, study design, study setting, forensic medicine data procedures, and details on uses, benefits, problems, conclusions, and suggestions was used to gather the data for this investigation. To collate, summarize, and report the results, a thematic content analysis was performed.

This study is the first review to systematically map global literature on data practices in Forensic Medicine. A key strength of our methodology is its inclusivity of all study designs, along with a protocol that ensures reproducibility. We conducted a comprehensive search strategy that allowed us to capture the most relevant articles to address the review question. However, the selected articles were limited to Forensic Medicine, specifically focusing on keywords and data collection methods related to autopsy records. Consequently, we excluded articles discussing electronic data collection methods in other medical fields. This limitation arose because

the study emphasizes the value of these systems for preventative programs rather than treatment. Additionally, the broad keywords used in our search strategy may not pinpoint specialized studies in data management, and we only included articles published in English. Despite these limitations, the findings of this study are valuable for informing future research, particularly in low- and middle-income countries.

RESULTS

A brief narrative of the findings is organized under three main themes: data management and practice systems, benefits and uses of these systems, and challenges and limitations associated with them.

Data Management and Practice Systems

All reviewed studies described the use of electronic-based systems, which varied in complexity from a simple Excel spreadsheet to more complex systems utilizing web portals and state-level and national systems such as the National Violent Death Reporting System and the National Coronial Information System. Because only one experienced user was involved, the data was deemed appropriate, timely, and of good quality, both representative and particular. Other systems, on the other hand, gathered information from a variety of users and departments, such as the police, psychologists, and forensic medicine department. The forensic medicine departments used a large number of these centralized systems. Access to these systems was strictly controlled, either through single or multiple user authorization or by capturing data in spreadsheets created in Excel. The articles that reported the best utility were those that allowed for greater flexibility and state-based use. In these instances, the systems received government funding and technical support.

Significance of Data Management and Practice Systems

In many of the articles, the broad coverage of cases enhanced the value of the systems for data users. Reported benefits included the formulation of injury prevention policies and the enhancement of epidemiological studies. Numerous systems mentioned assisted and contributed to study. Two systems indicated information security benefits, even though data uniformity was a characteristic of only a few systems. Diagnostic model development has been made easier by the data management and practice systems, which serve as informational archives for global best practices. As long as privacy issues are resolved, these technologies are also seen as conduits for information exchange. The availability of data significantly contributed to the establishment of most databases. Furthermore, these systems have played a crucial role in implementing preventative measures by identifying risk factors and predicting potential outcomes based on the available data. Some studies noted improvements in surveillance and epidemiological statistics, which subsequently informed policy changes, led to the establishment of new policies, and prompted legal reforms.

Challenges and Limitations of the Data Management and Practice Systems

The authors of one system under examination pointed out that because the data were collected voluntarily, there were errors, underreporting, and time gaps that made the data unusable for epidemiology and study. The results of epidemiology and research were adversely affected by underreporting, low case numbers, and reliance on closed cases, among other issues that were mentioned as difficulties in service work and research. Missing information was also identified as a major constraint in articles mentioning problems with data authenticity and quality. Limitations in data exchange and entry were similarly noted as problematic, with some barriers potentially arising from the lack of standardized practices for data capture. Ethical considerations, such as obtaining consent for autopsies or submitting data for analysis and research, also impacted the utilization of these systems. Additionally, factors like case-reporting bias, reporting errors, and biases in case selection affected case numbers and research outcomes.

DISCUSSION

This study aimed to map the evidence on data management and practice systems in Forensic Medicine. The findings reveal the existence of several data management systems; however, most are based in high-income countries, with few from low- and middle-income countries (LMICs) that meet this study's eligibility criteria [**21**]. The need to systematically collect evidence on the data management and practice systems used in forensic medicine, as well as to find possible lessons and applications for LMIC situations where paper reporting is still common, served as the impetus for this review. The examined articles included studies from the LMIC environment, demonstrating the dearth of knowledge on data management systems. Information that is often absent from vital registration statistics is also captured by include forensic pathology reports in databases. Although the forensic medicine data management systems now in use, as reported in the reviewed studies, have many benefits, they also have a number of drawbacks [**22-25**].

To the best of our knowledge, this review is the first to present evidence on data management and practice systems in Forensic Medicine, making

comparisons with other findings difficult. However, studies on preventable deaths, public health efforts, and death investigations all recognize the importance of coronial data, which has led to the development of electronic data reporting systems. The CDC created the National Violent Death Reporting System in response to a report that emphasized the need for a nationwide surveillance system for fatal intentional injuries. The initiative has now expanded to all 50 states and is constantly being updated and modified to better data exchange, according to the CDC website and a 2019 article outlining its future plans [**26**].

Other systems developed in the USA include a state-wide comprehensive multisource drug overdose fatality surveillance system in Kentucky, created in response to the public health crisis of drug overdoses, and a database concerning infant and child abuse. The burden of sudden infant death syndrome and the significant number of unexplained cases led to legislation in Italy (2006) mandating that fetuses and infants, from 25 weeks of gestation to one postnatal year, who die suddenly and unexpectedly must be sent to the University of Milan for a postmortem examination with parental consent. An Italian research center established a web portal for a national bank registry intended to centralize records from various regions across Italy, aiming to contribute data for epidemiological studies and the investigation of risk factors for sudden unexpected death in infants. Canada implemented a National Coroner and Medical Examiner database to identify emerging trends and hazards for the prevention of avoidable deaths. Tokyo, recognized as a technology hub, has recently incorporated a Legal Medicine Information System for forensic applications, as discussed in an article. This information system allows forensic pathologists and staff to register and search for institutional autopsy information, print death certificates, and extract data for research and analysis. Switzerland developed a tool called Virtopsy, a centralized database in forensic medicine for analyzing and comparing radiological and autopsy findings. Although the database has been created, it is not yet in routine use as it has not been validated. The database features a photo storage system and allows comparisons between radiological and autopsy data. The authors created an electronic injury surveillance system in response to the shortcomings of the current mortality injury tracking method. The National Injury Mortality Surveillance System (NIMSS), a South African program that was abandoned owing to financial constraints and logistical difficulties, served as the model for some of the components of this new system. NIMSS-related articles did not fit the current study's inclusion requirements. Although the new system's tools were previously accessible, making it viable and sustainable, system maintenance requires an appropriate infrastructure [**27**].

In order to identify and comprehend violent deaths, precise, timely, and thorough surveillance data must be gathered in order to put prevention measures into place. Public health and safety programs, regulations, and laws can make good use of the wealth of data collected by forensic pathologists. These databases have been recognized as an essential source of evidence for campaigns to raise awareness and prevent deaths, guiding the creation of policies, research, and coroner investigations. The initiative promotes the exchange of information, standardization, and implementation of investigation protocols and research. It has led to the publication of over a hundred articles across various journals. Accessing, tracking, and centralizing data can enhance scientific and investigative processes by applying international standards and best practices. The system's implementation improved the quality and standardization of surveillance data. Additionally, integrating multiple data sources facilitated the extraction of valuable information for identifying at-risk populations and provided evidence for new legislation. This approach can be cost-effective, reducing resource waste and enhancing public health initiatives. The collected data can also be utilized to develop diagnostic models that inform clinical decision-making. It is essential that the tools used are comprehensive and adaptable, as data management systems are crucial for forensic investigations. The system can be transitioned to an online platform to streamline operations, enhance reporting timeliness, and increase adaptability, creating opportunities for expansion across multiple sites.

Several limitations were noted, primarily concerning system feasibility, data accuracy, availability, completeness, stakeholder involvement, and the lack of morbidity data. Collaboration can help address challenges related to data sharing, merging, and analysis. Developing policies for data storage, quality review, and access can mitigate privacy concerns. Key issues included data privacy protection, which can be ensured through data anonymization on central servers while sensitive case information is stored locally. Utilizing the Internet can provide a cost-effective solution, whereas more sophisticated databases demand significant time, resources, and a framework that includes policies, staff training, quality control, and support. Limited resources for death investigations, both in technology and human elements, are one of

the system's challenges. Financial costs can be reduced by enlisting the help of different stakeholders to assist forensic pathology data-sharing initiatives. Given their crucial position in provincial and national data reporting, forensic medicine departments can use easy-to-use systems to improve the consistency of data collection, storage, and reporting. A wide range of systems appropriate for usage in low- and middle-income country (LMIC) environments were demonstrated in the evaluated studies. Autopsy and coronial data reporting systems are acknowledged as essential instruments for tracking the frequency and occurrence of violence associated with fatal injuries, notwithstanding their drawbacks [**28, 29**].

CONCLUSIONS

This review summarizes the evidence regarding data management and practice systems in forensic medicine, highlighting both their benefits and challenges. Extracting statistically relevant and representative data from autopsy records can be a time-consuming and arduous process. Electronic systems, ranging from advanced platforms to those designed with resource constraints in mind, are noted for their benefits to pathologists, researchers, and public health. However, implementing electronic systems may face challenges, including the reluctance of various stakeholders, such as government agencies, to participate and the need for additional funding to support more sophisticated database systems. Nonetheless, simpler and more accessible tools, can still yield statistically relevant data for impactful research.

Research, policymaking, preventative measures, and the sharing of educational knowledge all benefit from a data management system that integrates coronial, medical examiner, and forensic pathology data. With the limited resources available in certain LMICs, a restricted database can be created. Given its thorough coverage of preventable deaths, involving a variety of stakeholders in the creation and funding of a nationally representative information system would have a substantial positive impact on the community, the government, private businesses, and product development and reform.

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