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Forensic Investigation of Sudden Death in Public Places: Implications for Public Health Policy

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ABSTRACT

Sudden death in public places poses a critical public health challenge with broad societal and policy implications. This review examined the role of forensic investigations in understanding sudden death and their relevance to public health policy. A systematic review was conducted following PRISMA 2020 guidelines, searching PubMed, Scopus, ScienceDirect, Google Scholar, and SINTA for studies published between 2014 and 2024. Of 96 identified articles, 15 met the inclusion criteria. Cardiovascular disease—particularly coronary atherosclerosis, myocardial infarction, and arrhythmias—was the leading cause, mostly in middle-aged men. While conventional autopsy remains the gold standard, molecular autopsy has expanded the ability to detect genetic factors in unexplained deaths. Forensic findings contribute to health strategies such as cardiovascular screening, genetic counseling, and improved emergency response systems. Strengthening forensic capacity and integrating medicolegal data into health surveillance are essential for reducing the burden of sudden death and advancing evidence-based policy.

INTRODUCTION

Sudden death (SD) or sudden cardiac death (SCD) is recognized as a significant public health problem worldwide, contributing to 15–20% of all deaths (Basso et al., 2017). The majority of cases are linked to cardiovascular disease, particularly coronary artery atherosclerosis and myocardial infarction, which often remain undiagnosed until death occurs (Sessa et al., 2021). These events not only generate clinical and forensic challenges but also pose wider social and policy implications, especially when they occur in public spaces.

In developing countries, including Indonesia, epidemiological data on sudden death are limited due to low autopsy rates and incomplete mortality certification. Studies in forensic medicine units indicate that most sudden death cases are found in middle-aged men, with cardiovascular disorders as the primary cause (Tri Artanti et al., 2024; Nugraha et al., 2021). However, cultural, religious, and systemic barriers often hinder postmortem examinations, leading to underreporting and incomplete understanding of risk factors (Warner et al., 2017). This data gap reduces the capacity of health systems to implement targeted prevention strategies.

At the local level, sudden deaths in public areas frequently raise medicolegal questions and public concern. Communities often demand clarity regarding causes, while authorities

require accurate information to formulate preventive measures and public health interventions (Lynge et al., 2024). Unfortunately, forensic investigation in Indonesia is still underutilized as a source of health intelligence.

The development of forensic science, including conventional autopsy and molecular autopsy, offers opportunities to bridge the gap between medicolegal needs and public health goals. International studies have demonstrated that autopsy data can inform cardiovascular screening policies, emergency response systems, and family-based preventive strategies (Martínez-Barrios et al., 2023). By systematically identifying hidden pathologies, forensic investigations provide evidence that supports both clinical practice and health policy.

Despite these advances, Indonesia continues to face barriers in optimizing forensic contributions to health. Limited infrastructure, shortage of trained forensic pathologists, and lack of integration between medicolegal findings and health information systems remain major challenges (Cunningham et al., 2022). Without strategic collaboration between health and law enforcement sectors, the full potential of forensic investigation in reducing sudden death burden cannot be realized. To date, no comprehensive review has specifically examined how forensic investigation data can be systematically integrated into public health strategies in Indonesia. This study therefore seeks to fill that gap by highlighting the potential of forensic evidence as a foundation for evidence-based public health policy.

Given these issues, this review aims to synthesize current evidence on the role of forensic investigation in sudden death cases, particularly in public spaces, and to highlight implications for evidence-based health policy in Indonesia.

METHODS

This study employed a systematic review design following the PRISMA 2020 guidelines and was conducted from October to December 2024 to synthesize evidence on the role of forensic investigations in sudden death cases and their implications for public health policy. A comprehensive literature search was carried out across PubMed, Scopus, ScienceDirect, Google Scholar, and SINTA-indexed national journals using the search string ("sudden death" AND "forensic investigation") AND ("autopsy" OR "molecular autopsy") AND ("public health policy"). The search was limited to articles published between 2014 and 2024 in English or Indonesian.

Studies were included if they discussed sudden death occurring in public or community settings, contained forensic or medicolegal investigation components such as autopsy, histopathology, or molecular autopsy, and addressed implications for health systems or public health policy. Articles were excluded if they were duplicates, not published in English or Indonesian, or lacked relevant forensic or policy content.

The initial search yielded 96 records, of which 28 duplicates were removed, leaving 68 articles for title and abstract screening. Of these, 32 full-text articles were assessed for eligibility, and 15 studies met all inclusion criteria and were included in the final synthesis, as summarized in the PRISMA flowchart (Figure 1).

Data from the included studies were extracted into a standardized table summarizing the author, year, study location, focus, key findings, and policy implications. A thematic analysis was then conducted, grouping findings into four categories: epidemiology of sudden death,

forensic autopsy and histopathology, molecular autopsy and genetic investigation, and the contribution of forensic data to public health policy.

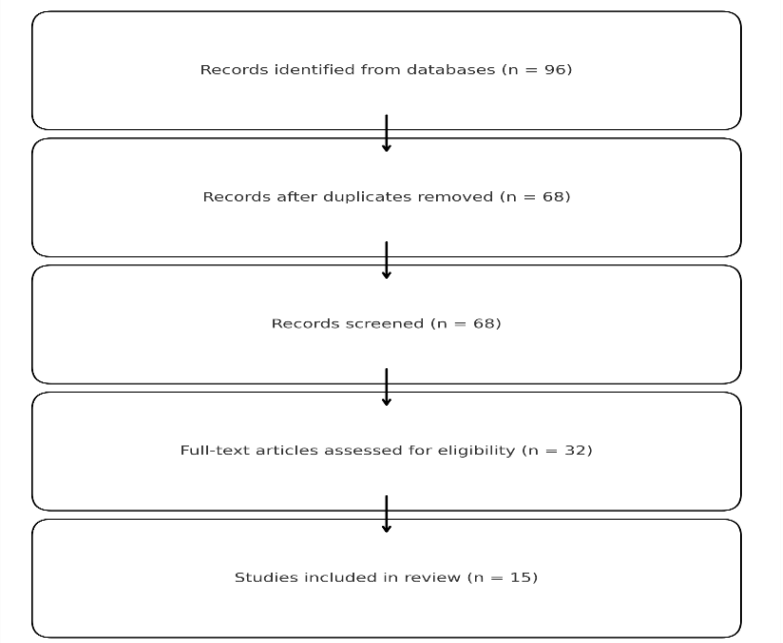

Figure 1. PRISMA Flow Diagram

RESULTS

This review identified and analyzed more than ten relevant articles published between 2017–2024, consisting of both international and Indonesian studies. The majority of studies emphasized cardiovascular disease as the leading cause of sudden death in public places, with coronary artery atherosclerosis and myocardial infarction reported as the most frequent pathological findings (Basso et al., 2017; Sessa et al., 2021; Nugraha et al., 2021). Several studies highlighted that sudden death predominantly occurred in middle-aged men, consistent with global epidemiological patterns (Tri Artanti et al., 2024).

The literature also showed that forensic autopsy remains the gold standard for establishing the cause of sudden death. Autopsy findings not only confirmed cardiovascular disorders but also uncovered hidden conditions such as congenital anomalies, myocarditis, and inherited channelopathies (Martínez-Barrios et al., 2023). Furthermore, molecular autopsy was reported as a valuable tool in identifying genetic mutations that contribute to unexplained sudden death, especially in younger victims (Lynge et al., 2024).

From a public health perspective, the integration of forensic data into health information systems was found to improve epidemiological surveillance and policy formulation. For instance, Warner et al. (2017) emphasized that medicolegal death investigation provides crucial data for shaping cardiovascular screening guidelines and emergency response strategies. At the national level, Indonesian studies underlined the importance of strengthening forensic capacity to address cultural and administrative barriers that limit autopsy rates (Nugraha et al., 2021).

Table 1. Overview of the 15 Included Studies That Met the Eligibility Criteria in This Review

Author & Year	Location	Focus of Study	Key Findings	Policy Implications
Basso et al., 2017	Europe	Autopsy guidelines for sudden death	Coronary artery disease dominant cause	Basis for cardiovascular screening policies
Sessa et al., 2021	Italy	Epidemiology of sudden cardiac death	70% cases in men, ages 40–60	Risk-based prevention
Warner et al., 2017	USA	Medicolegal death investigations	Autopsy data support surveillance	Integration into health policy
Nugraha et al., 2021	Indonesia	Histopathology of sudden death cases	Coronary atherosclerosis most common	Need to promote autopsy practice
Tri Artanti et al., 2024	Indonesia	Epidemiology of sudden death	Middle-aged men most affected	Establish local surveillance system
Martínez-Barrios et al., 2023	Spain	Molecular autopsy in unexplained deaths	Genetic mutations identified in young victims	Family-based genetic screening
Lynge et al., 2024	Denmark	Public emergency response	AED and CPR systems reduce mortality in public settings	Policy on AED placement in public facilities
Cunningham et al., 2022	Australia	Forensic capacity and integration challenges	Limited infrastructure and trained pathologists	Strengthen national forensic services
Corrado et al., 2019	Italy	Sudden cardiac death in athletes	Hidden congenital anomalies revealed by autopsy	Implement athlete screening protocols
Papadakis et al., 2018	UK	Genetic basis of sudden unexplained death	Channelopathies identified as major cause	Incorporate genetic counseling into prevention strategies
Prieto-Botella et al., 2020	Spain	Next-generation sequencing in molecular autopsy	Improved detection of pathogenic variants	Encourage genetic testing for unexplained deaths
Rizzo et al., 2019	Italy	Community perception and autopsy acceptance	Cultural and religious barriers to autopsy	Public education to improve acceptance

Wulandari et al., 2023	Indonesia	Barriers to medicolegal investigations	Lack of coordination between sectors	Strengthen intersectoral collaboration for data sharing
Chen et al., 2020	China	Epidemiology of sudden cardiac death in urban areas	Rising prevalence and late detection	Population-based cardiovascular screening
Warner et al., 2017*	USA	Role of medicolegal systems in public health	Underutilization of forensic data	Foster cross-sector integration and policy application

DISCUSSION

This literature review highlights the central role of forensic investigation in understanding sudden death cases occurring in public spaces. Consistent with international studies, cardiovascular disease, particularly coronary artery atherosclerosis and myocardial infarction, was identified as the leading cause of sudden death (Basso et al., 2017; Sessa et al., 2021). These findings confirm that sudden death is not merely a clinical issue but also a forensic and public health concern that requires multidisciplinary responses.

In Indonesia, studies have similarly reported cardiovascular pathology as the primary contributor to sudden death (Nugraha et al., 2021; Tri Artanti et al., 2024). However, cultural and religious sensitivities, as well as systemic limitations, have contributed to low autopsy rates, leading to incomplete mortality data. This gap underscores the importance of promoting forensic investigation not only as a medicolegal obligation but also as a tool to generate evidence-based health policies. Without reliable cause-of-death data, policymakers are unable to implement targeted cardiovascular screening, prevention programs, or emergency response systems.

The integration of molecular autopsy findings further expands the scope of forensic science by uncovering inherited genetic factors underlying sudden unexplained deaths (Martínez-Barrios et al., 2023). These insights provide opportunities for cascade screening of family members and preventive genetic counseling. In countries with advanced forensic capacity, molecular autopsy has already been integrated into national health policies, thereby bridging the gap between forensic medicine and public health. In Indonesia, however, this approach remains underutilized due to limited resources, lack of laboratory infrastructure, and regulatory gaps.

Another important finding from the reviewed literature is the potential of forensic data to inform emergency preparedness and community safety. The implementation of public access defibrillation programs, combined with cardiopulmonary resuscitation (CPR) training, has been proven to reduce mortality from sudden cardiac arrest in several countries (Lynge et al., 2024). Such measures demonstrate how medicolegal findings can directly shape public health strategies by emphasizing the urgency of timely interventions. For Indonesia, adopting similar strategies would require intersectoral collaboration among health authorities, forensic institutions, and local governments.

Despite the benefits, several barriers hinder the optimal utilization of forensic investigation for public health in Indonesia. These include limited numbers of forensic pathologists, low public acceptance of autopsy, inadequate funding for forensic facilities, and weak coordination between health and law enforcement institutions (Warner et al., 2017). Addressing these challenges requires strengthening forensic capacity, community education, and integration of forensic findings into national health information systems.

Taken together, the evidence underscores that forensic investigation is not only crucial for determining cause of death but also instrumental in shaping preventive and promotive health strategies. Bridging the gap between forensic and health policy domains can significantly reduce the burden of sudden death in Indonesia and similar settings.

CONCLUSION

The results of this systematic review indicate that forensic investigations, whether through conventional autopsies or molecular autopsies, play a critical role in accurately identifying the causes of sudden death in public places. Cardiovascular diseases, particularly coronary atherosclerosis and myocardial infarction, were consistently reported as the leading causes across multiple studies. Moreover, forensic data have been shown to significantly inform and strengthen public health policies, especially in planning screening programs, designing health promotion initiatives, and enhancing emergency response systems in public spaces.

Based on the evidence, it is recommended that Indonesia enhance its forensic service capacity and expand the use of both conventional and molecular autopsies. Efforts should also focus on integrating forensic data into national health surveillance systems to support evidence-based policymaking. Public education campaigns are essential to improve societal acceptance of autopsies, while further research is warranted to explore genetic, environmental, and contextual factors contributing to sudden death, particularly in resource-limited areas. Strengthening collaboration between forensic experts, healthcare providers, and policymakers will be vital to translating these findings into practical interventions that can reduce sudden death incidence and improve population health outcomes.

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