



Forensic Evaluation of Suicide

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Abstract: Suicide is one of the causes of unnatural death that has complex medical, psychological, and legal implications. Forensic evaluation of suicide cases often faces challenges due to overlapping pathological findings with accident and homicide cases, especially in cases of hanging and complex suicide. This study aims to systematically analyze forensic evaluation approaches in suicide cases through the integration of conventional autopsy, Post-Mortem Computed Tomography (PMCT), psychological autopsy, toxicology examination, and other contextual analyses. This study uses the Systematic Literature Review (SLR) method with reference to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A total of 25 articles published between 1992 and 2025 that met the inclusion criteria were analyzed qualitatively. Data were extracted and synthesized to identify research methods, key findings, and the contributions of each approach to forensic suicide evaluation. The results of the study show that conventional autopsy is still the primary method for determining the cause of death, but it has limitations when used alone. The integration of PMCT has been shown to improve the objective detection of neck injuries and internal findings. Psychological autopsy plays an important role in uncovering the psychological and social factors of the victim, especially in ambiguous deaths. Toxicological examination provides crucial information regarding the influence of psychoactive substances on the victim's behavior, while forensic linguistic analysis helps authenticate wills and understand the motives for suicide. In complex suicide cases, a multidisciplinary approach is an absolute necessity.

Keywords: Suicide, Psychological Autopsy, PMCT, Literature Review.

INTRODUCTION

Suicide is a public health and social problem with serious implications in medical, psychological, legal, and ethical aspects. The World Health Organization (WHO) consistently reports that suicide is a leading cause of unnatural death in various age groups, with highly variable characteristics and mechanisms. In the medicolegal context, death by suicide is not only viewed as a clinical event but also as a legal event that requires objective and scientifically accountable evidence.

Forensic evaluation of suicide cases is highly complex because it often involves ambiguous conditions of death, overlapping with violence, accidents, or murder. Some

methods of suicide, particularly hanging, can present pathological findings that resemble homicidal hanging, thereby increasing the risk of misclassification if the evaluation relies solely on one approach (Putra et al., 2023; Wijaya et al., 2023). Errors in determining the cause and mechanism of death not only have an impact on legal justice, but also on the rights of the victim's family and the accuracy of suicide epidemiology data. Traditionally, conventional autopsies have been the primary method for determining the cause of death in suicide cases. Autopsies provide important information about external and internal injuries, the mechanism of death, and the possible presence of signs of violence. However, several studies have shown that physical autopsies have limitations in detecting certain injuries, particularly in soft tissues and neck structures, as well as in distinguishing ante-mortem and post-mortem injuries with precision (Ampanozi et al., 2022; Patil et al., 2024).

This condition has encouraged the development of a more comprehensive forensic approach utilizing postmortem imaging technology. Post-Mortem Computed Tomography (PMCT) has developed as an additional diagnostic tool in modern forensic practice. PMCT enables non-invasive, objective, and reconstructable visualization of internal injuries, thereby providing added value in the evaluation of suicide cases, particularly in hanging and complex suicide methods (Ampanozi et al., 2022; Patil et al., 2024). The integration of PMCT with conventional autopsy has been shown to improve the accuracy of forensic findings interpretation and reduce the potential for subjective bias by examiners.

In addition to physical aspects, suicide evaluation cannot be separated from the psychological and social dimensions of the victim. Psychological autopsy is a method developed to reconstruct the mental condition, psychopathological history, interpersonal relationships, and life stressors of the victim before death. Classic studies by Isometsä (1992) and Hawton et al. (2003) show that psychological autopsy can reveal suicide risk factors that cannot be identified through physical examination alone. Recent research also confirms that psychological autopsy plays a crucial role in cases of ambiguous death and atypical suicide (Catanesi et al., 2022; Yilmaz et al., 2022; De Leo & Sveticic, 2025).

Postmortem toxicology examinations are also an important component of forensic suicide evaluations. The presence of alcohol, psychoactive drugs, or hazardous chemicals can affect the cognitive and behavioral condition of the victim before death. Bugelli et al. (2022) showed that psychoactive substances have a significant relationship with suicidal behavior, while Tambunan and Yudhianto (2020) emphasized that the identification of certain chemicals plays an important role in confirming the mechanism of suicide and ruling out other suspected criminal acts. In addition to medical and psychological approaches, forensic linguistic analysis has also begun to gain attention in suicide investigations, particularly through the study of wills. Stylistic and linguistic structure analysis has been proven to reflect the emotional state, interpersonal conflicts, and motives of the victim (Hidayat & Nuraini, 2022; Ramadhan & Sari, 2023; Siregar et al., 2023). This approach has medicolegal value as it can assist in document authentication and support the interpretation that the death was a result of suicide.

The phenomenon of complex suicide, which involves the use of more than one method of suicide or an unusual mechanism of death, further highlights the challenges in forensic evaluation. Studies by Singh et al. (2025) and De Matteis et al. (2024) show that complex suicide cases often raise doubts in determining the cause of death and require an integrated multidisciplinary approach. Although various approaches and methods of forensic evaluation have been developed, to date there has been no systematic synthesis of the literature that integrates these findings into a comprehensive framework for forensic evaluation of suicide. Most studies are still partial, focusing on a single method or specific aspect, which has the potential to produce fragmented interpretations.

Based on these conditions, a systematic study is needed that can integrate various approaches to forensic suicide evaluation, including conventional autopsy, PMCT,

psychological autopsy, toxicology, and other contextual analyses. Therefore, this study was conducted using a Systematic Literature Review (SLR) approach with reference to the PRISMA guidelines to present a comprehensive overview of the practices, challenges, and developments in forensic suicide evaluation. The results of this study are expected to serve as a conceptual basis for improving the accuracy of determining causes of death, strengthening forensic medicine practices, and supporting the judicial system and suicide prevention efforts in a scientific and sustainable manner.

METHOD

This study used a Systematic Literature Review (SLR) approach with reference to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This approach was chosen because SLR allows for the systematic, transparent, and standardized collection, assessment, and synthesis of scientific evidence, so that the results of the study can be methodologically accountable and replicated by other researchers.

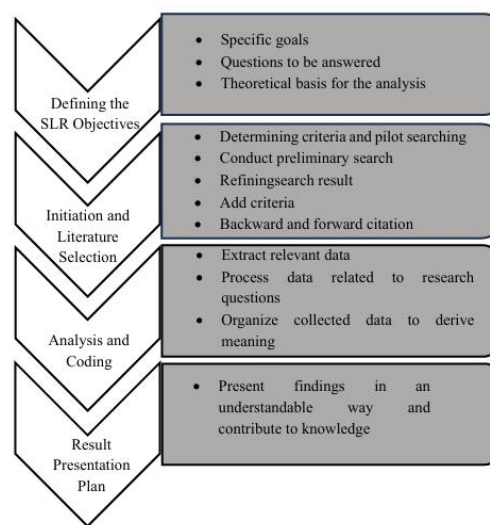


Figure 1. Stages of Systematic Literature Review

Stages of Systematic Literature Review

The implementation of Systematic Literature Review (SLR) in this study followed the main stages of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which included determining the objectives and research questions, identifying literature, screening and selecting studies, analyzing data, and reporting results systematically and transparently.

1. Determination of Research Objectives and Questions

The initial stage of the research began with the formulation of research objectives and questions that specifically focused on the forensic evaluation of suicide cases. The main objective of this research, " , " was to systematically review various forensic methods used in the identification of suicide, including approaches to crime scene investigation, autopsy findings, psychological autopsy, and medico-legal implications in determining the cause and mechanism of death. The research questions are designed to identify:

- a. the most frequently used forensic methods in suicide evaluation,
- b. the characteristics and forensic indicators that support the determination of suicide, and
- c. the challenges and limitations in distinguishing suicide from other forms of unnatural death.

2. Identification and Literature Search

The literature search was conducted systematically through several reputable scientific databases, namely PubMed, PubMed Central (PMC), Scopus/ScienceDirect, and Google Scholar. The search strategy used a combination of relevant keywords and Boolean operators, including forensic suicide, suicide investigation, forensic evaluation, cause of death, mechanism of death, psychological autopsy, and medico-legal suicide. From the initial search results in all of these databases, 2,590 articles were found that were potentially relevant to the research topic.

3. Duplicate Removal

All identified articles were then examined to eliminate duplicates that appeared due to cross-database searches. At this stage, 730 duplicate articles were removed. Thus, 1,860 unique articles were obtained, which then entered the screening stage.

4. Screening Based on Title and Abstract

The remaining 1,860 articles were then screened based on the suitability of their titles and abstracts to the research focus. The exclusion criteria at this stage included articles that:

- a. were not related to forensic suicide evaluation,
- b. focused on psychological or social aspects without a forensic context,
- c. were not empirical research or scientific reviews, and
- d. did not clearly discuss the causes or mechanisms of death.

After this screening process, 1,720 articles were excluded, leaving 140 articles that were deemed eligible for full-text assessment.

5. Full Text Eligibility Assessment

The 140 articles that passed the screening stage were then thoroughly evaluated through full text reading. Articles were excluded if they did not describe the forensic evaluation methods in detail, did not present relevant findings related to suicide, or did not have adequate methodological quality. At this stage, 115 articles were eliminated because they did not meet the inclusion criteria, leaving 25 articles that met all the research requirements.

6. Inclusion of Studies in the Final Synthesis

A total of 25 articles that met all inclusion criteria were then included in the final synthesis of the study. These articles were analyzed qualitatively to compare:

- a. suicide forensic evaluation methods,
- b. autopsy findings and crime scene investigations,
- c. the use of psychological autopsies, and
- d. medico-legal implications in determining the cause and mechanism of death.

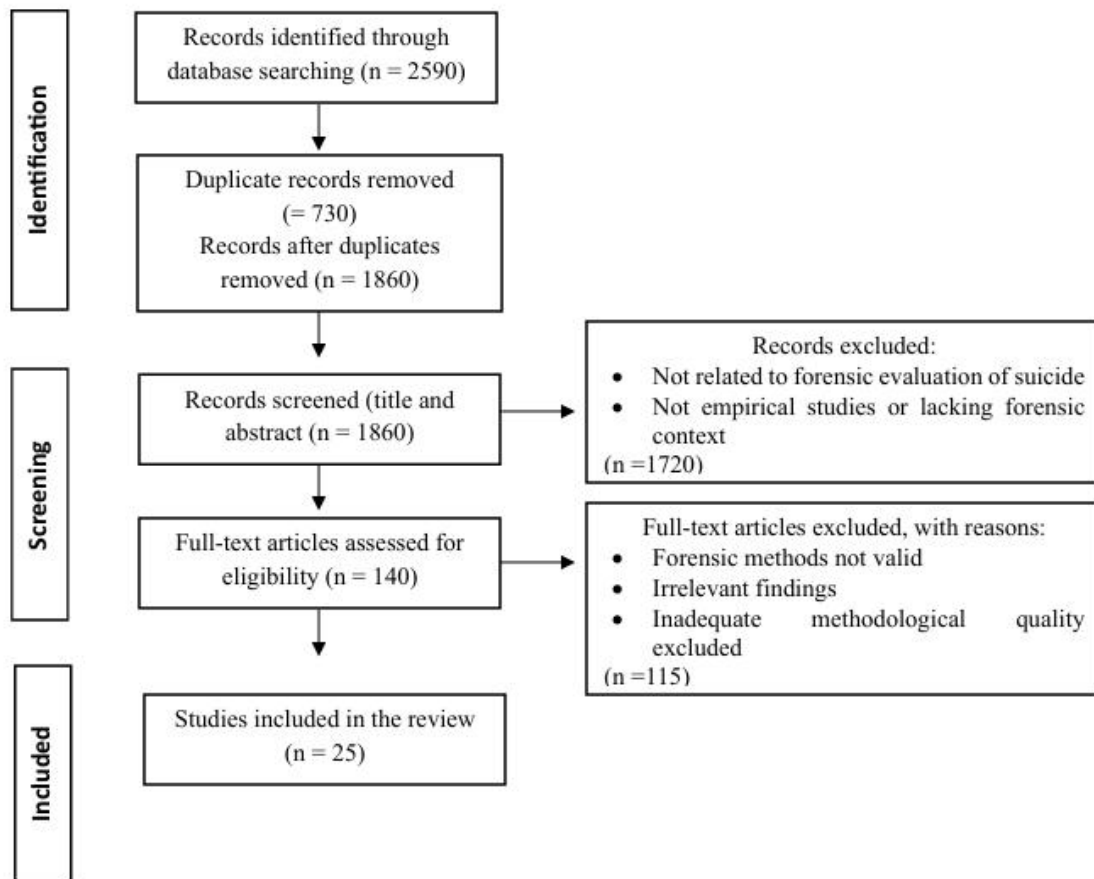


Figure 2. Article Selection Flow Based on PRISMA

RESULT AND DISCUSSION

Table 1. Extracted Dataset

No	Author and Year	Title	Research Method	Research Results
1	Ampanozi et al., 2022	Comparison of autopsy and PMCT findings in suicidal hangings	Comparative study (autopsy vs. PMCT)	PMCT complements conventional autopsy in identifying findings of suicidal hangings
2	Arsenault-Lapierre et al., 2004	Psychiatric diagnoses in 3275 suicides	Meta-analysis	Psychiatric disorders were found in the majority of suicide cases
3	Bugelli et al., 2022	Suicidal behavior and postmortem toxicology	Retrospective toxicology study	Psychoactive substances play a significant role in suicidal behavior
4	Catanesi et al., 2022	Psychological autopsy in schizophrenia suicide	Case study + psychological autopsy	Psychological autopsy effectively reveals atypical suicide risk factors
5	Cummins et al., 2025	Acoustic and ML methods for suicide risk assessment	Systematic review	AI-based methods have the potential to support suicide risk detection
6	De Leo & Sveticic, 2025	Psychological autopsy overview	Narrative review	Psychological autopsy is important in ambiguous deaths
7	De Matteis et al., 2024	Suicidal decapitation by hanging	Systematic review	Complex suicides require a multidisciplinary

8	Hasanuddin et al., 2021	Forensic analysis of hanging	Descriptive forensic study	forensic approach Injury parameters help distinguish suicide from homicide
9	Hawton et al., 2003	Psychological autopsy studies of suicide	Systematic review	Consistent methods for evaluating psychosocial factors in suicide Language patterns reflecting the psychological condition of the victim
10	Hidayat & Nuraini, 2022	Profiling suicide notes	Forensic linguistic analysis	Main challenges: informant bias and data limitations
11	Isometsä, 1992	Problems in psychological autopsy	Methodological review	Psychological autopsy enriches medicolegal investigations
12	Khan, 2025	The psychological autopsy	Narrative review	Psychological autopsy improves the accuracy of determining the cause of death
13	Palermo & Gudjonsson, 2021	Systematic review on psychological autopsy	Systematic review	PMCT is effective in detecting neck injuries
14	Patil et al., 2024	Neck findings in hanging	Comparative study of autopsy & PMCT	Hanging is not always suicide; a comprehensive evaluation is necessary
15	Putra et al., 2023	Homicide by hanging	Literature review	Dominant psychological factors in the prison population
16	Rahmawati, 2022	Suicide risk among prison inmates	Literature review	The majority of victims were adult males with blunt trauma
17	Rahmawati et al., 2024	Description of suspected suicide victims	Observational descriptive study	Stylistic features help authenticate wills
18	Ramadhan & Sari, 2023	Stylistic analysis of suicide note	Forensic linguistics	Psychological autopsy is crucial in cases of questionable death
19	Sharma, 2022	Psychological autopsy in equivocal death	Article review	Complex suicide requires a multidimensional approach
20	Singh et al., 2025	Rare case of complex suicide	Case report	Language reflects family relationships and conflicts
21	Siregar et al., 2023	Suicide note stylistic analysis	Qualitative linguistic study	Toxicology examination is important in confirming the cause of death
22	Tambunan & Yudhianto, 2020	Toxicology of suicide by hydrochloric acid	Case studies & medicolegal reviews	An effective method as an investigative tool
23	Tishler & Reiss, 2023	Psychological autopsy in forensics	Narrative review	Significant differences in injuries between suicide and homicide
24	Wijaya et al., 2023	Autopsy of suicidal vs homicidal hanging	Comparative pathological study	Psychological autopsy clarifies the motives for suicide
25	Yilmaz et al., 2022	Psychological autopsy in completed suicide	Case study	

Based on the results of literature selection conducted through a Systematic Literature Review (SLR) approach with strict adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, 25 articles were found to meet all inclusion criteria and were subsequently analyzed qualitatively. This selection process involved the stages of identification, screening, eligibility assessment, and final inclusion, which were carried out systematically to ensure that only articles that were relevant, of adequate methodological quality, and had a significant contribution to the topic of forensic suicide evaluation were included in the final synthesis. Thus, the results of this study represent a collection of literature that has undergone a rigorous selection process and is scientifically accountable.

The publication period of the included studies covers a fairly long period, from 1992 to 2025. This time frame shows that the issue of forensic suicide evaluation has been a subject of academic and practical interest for more than three decades. The early period was marked by contributions from classic studies that focused on developing conceptual frameworks and basic methodologies in suicide investigation, particularly through the psychological autopsy approach. Over time, developments in forensic medicine technology, the increasing complexity of cases, and the need for greater medicolegal accuracy have led to the emergence of contemporary studies that integrate multidisciplinary approaches, including postmortem imaging, advanced toxicology analysis, and forensic linguistic studies. Thus, the temporal distribution of the included articles reflects the conceptual and methodological evolution in the field of forensic suicide.

In terms of research design, the majority of the articles analyzed used systematic review, narrative review, comparative study, case study, and retrospective analysis approaches. This variation in research design shows that the phenomenon of suicide in a forensic context cannot be understood partially or through a single methodological approach. Systematic review and narrative review studies play an important role in summarizing and synthesizing existing knowledge, while comparative studies and retrospective analyses provide empirical insights into the differences in forensic findings between suicide and other forms of death. Case studies, on the other hand, offer a deep understanding of the complexity and uniqueness of individual cases, which often cannot be represented in large-scale quantitative research designs. The diversity of research designs indicates that the evaluation of suicide in forensic practice requires a flexible, adaptive, and contextual approach.

From a geographical perspective, the included studies came from various regions of the world, including Indonesia, European countries, and the United States. This diversity of geographical backgrounds provides a global perspective that enriches our understanding of suicide as a universal phenomenon influenced by different cultural, social, legal, and health system factors. Studies from Indonesia, for example, provide an overview of forensic practices and medico-legal challenges in the context of a developing country with distinctive socio-cultural characteristics. Meanwhile, studies from Europe and America generally highlight the use of advanced forensic technology and multidisciplinary approaches that have been systematically integrated into death investigation systems. Thus, this literature synthesis not only reflects a single regional context but also presents a comprehensive understanding across cultures and legal systems.

The results of the literature synthesis show that conventional autopsies are still the primary method for determining the cause and mechanism of death in suicide cases, especially in cases involving hanging. Conventional autopsies allow for direct examination of organs, identification of external and internal injuries, and assessment of signs characteristic of mechanical asphyxia. In many cases, autopsy findings such as ligature marks, bleeding of the soft tissues of the neck, and changes in internal organs are the main basis for concluding that death was due to suicide. However, the literature also shows that conventional autopsies

have limitations, particularly in detecting subtle injuries or certain internal structures that are difficult to visualize directly.

Several studies emphasize the importance of integrating conventional autopsy with Post-Mortem Computed Tomography (PMCT) as a complementary method in forensic suicide evaluation. Ampanozi et al. (2022) and Patil et al. (2024) show that PMCT has advantages in detecting bone injuries, subtle fractures, and soft tissue distribution that may be missed in traditional autopsy examinations. PMCT enables three-dimensional visualization of anatomical structures without damaging tissue, making it highly useful in objectively documenting forensic findings that can be reviewed later. In the context of suicide by hanging, PMCT can provide additional information about the condition of the hyoid bone, laryngeal cartilage, and cervical vertebrae, which has important implications in distinguishing between suicide and homicide.

The findings regarding the importance of this integrative approach are reinforced by Wijaya et al. (2023) and Putra et al. (2023), who emphasize that the pathological picture between suicidal hanging and homicidal hanging often shows significant overlap. Classic signs that have been considered specific to suicide, such as the position of the ligature marks or certain bleeding patterns, are not always consistent and can also be found in cases of murder staged to resemble suicide. Therefore, forensic evaluation cannot rely solely on a single anatomical parameter or examination method. A comparative approach that considers various findings and the context of the incident is crucial in modern forensic practice.

Most of the articles analyzed in this study highlight psychological autopsy as a very important component in suicide investigations, especially in cases with ambiguous or unclear mechanisms of death. Psychological autopsy is an investigative approach that aims to reconstruct the psychological, emotional, social, and environmental conditions of the victim prior to death by gathering information from various sources, including family, friends, medical records, and the victim's personal documents. This approach allows for a more holistic assessment of the factors that may have contributed to the decision to commit suicide.

Classic studies by Isometsä (1992) and Hawton et al. (2003) form the methodological basis for the development of psychological autopsy as an investigative tool in a forensic context. Both studies show that many suicide cases cannot be adequately understood through physical examination alone, as psychological and social factors play a very significant role. Psychological autopsy allows for the identification of behavioral patterns, mood changes, and life events that may have triggered the suicide, thus providing a broader context for forensic findings.

Recent research by Catanesi et al. (2022), Yilmaz et al. (2022), and De Leo and Svetcic (2025) confirms the relevance and effectiveness of psychological autopsy in modern forensic practice. These studies show that the psychological autopsy approach is very useful in identifying risk factors such as mental disorders, social stressors, interpersonal conflicts, and a history of suicidal behavior, which often cannot be revealed through physical autopsy alone. This information is particularly important in cases where anatomical findings do not provide a definitive answer as to the cause of death.

Palermo and Gudjonsson (2021) even conclude that integrating psychological autopsy into forensic investigations can significantly improve the accuracy of determining the cause of death. By combining psychological and social data with medical findings, forensic investigators can obtain a more comprehensive picture and reduce the risk of misclassifying deaths. This has very important medicolegal implications, given that conclusions about the cause of death can have an impact on legal proceedings, insurance claims, and public perception of a case.

Postmortem toxicology examinations also emerge as an important element in the forensic evaluation of suicide based on the results of a literature synthesis. These examinations aim to identify the presence and levels of chemicals in the victim's body that

may have affected behavior, consciousness, and physiological functions prior to death. Bugelli et al. (2022) found that the presence of alcohol, psychoactive drugs, and illegal substances is closely associated with suicidal behavior. These substances can lower inhibitions, increase impulsivity, and worsen psychological conditions, thereby potentially triggering suicidal actions.

These findings are in line with the research by Tambunan and Yudhianto (2020), which shows that the identification of certain chemicals, such as hydrochloric acid, plays an important role in confirming the mechanism of suicide and ruling out other possible criminal acts. In a forensic context, toxicological examination not only serves as a means of confirming the cause of death, but also as a means of understanding the physiological and psychological condition of the victim prior to death. Thus, toxicology results can provide additional clues as to whether the death was consistent with suicide or requires further investigation.

In addition to medical and psychological approaches, several studies analyzed highlight the role of forensic linguistics in suicide evaluation, particularly through the analysis of wills. Wills are often a key piece of evidence in suicide investigations, but their authenticity and interpretation require caution. Ramadhan and Sari (2023), Hidayat and Nuraini (2022), and Siregar et al. (2023) show that stylistic analysis, language structure, and lexical choices in wills can reveal the emotional state, interpersonal conflicts, and motives of the victim prior to death. The forensic linguistic approach allows investigators to assess whether the will was written spontaneously by the victim or was fabricated by another party. In a medicolegal context, findings from linguistic analysis can support or challenge conclusions about the cause of death, thereby contributing to a more accurate and objective decision-making process.

Several articles in this study raise the phenomenon of complex suicide, which are cases of suicide involving more than one method or mechanism of death that is not common. Singh et al. (2025) and De Matteis et al. (2024) report that complex suicide cases often raise doubts in determining the cause of death, as the resulting forensic findings may resemble acts of violence or accidents. This phenomenon emphasizes that forensic evaluation of suicide must be conducted very carefully and comprehensively. These findings collectively confirm that forensic evaluation of suicide cannot be conducted partially or separately. An approach that combines conventional autopsy data, PMCT, toxicology examinations, psychological autopsy, forensic linguistic analysis, and other contextual information is key to reaching conclusions that are accurate and scientifically and legally accountable.

CONCLUSION

This Systematic Literature Review study confirms that forensic evaluation of suicide cases is a multidimensional process that cannot rely solely on anatomical or medical approaches. Conventional autopsies remain the mainstay in determining the mechanism of death, but they have limitations in explaining the overall context of death, especially in ambiguous cases. Developments in modern forensics demonstrate the importance of an integrative approach. PMCT strengthens the objective and non-invasive analysis of internal injuries, psychological autopsy helps reconstruct the mental condition and psychosocial factors of the victim, while toxicological examination plays a role in understanding the influence of substances on cognitive and behavioral conditions. Non-medical approaches such as forensic linguistics also enrich contextual interpretation, particularly through analysis of the victim's written communication. The greatest challenge arises in complex suicide cases that are at high risk of misclassification, requiring caution, integration of data across methods, and multidisciplinary collaboration. Overall, forensic suicide evaluations must be conducted holistically, systematically, and based on scientific evidence in order to produce accurate, objective, and accountable medicolegal conclusions. The findings of this study can serve as a

basis for developing forensic evaluation standards, improving the quality of forensic medicine practices, and strengthening the role of forensic science in the judicial system and suicide prevention.

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