Received: 16 January 2024 | Revised: 23 September 2024 | Accepted: 28 September 2024

DOI: 10.1002/hsr2.70134

SYSTEMATIC REVIEW

Health Science Reports Open Access WILEY

Can International Classification of Disease Perinatal Mortality (ICD-PM) be a solution to overcome neglected tragedy? A scoping reviews

Marziyhe Meraji | Masoumeh Jafari

Health Information Management, Department of Health Information Technology, School of Paramedical Sciences, Mashhad University of Medical Sciences, Mashhad, Iran

Correspondence
Masoumeh Jafari, Health Information Management, Department of Health Information Technology, School of Paramedical Sciences, Mashhad University of Medical Sciences, Mashhad, Iran.
Email: mzjafari1997@gmail.com

Abstract

Introduction: Over 5 million perinatal deaths occur annually worldwide, with a significant proportion of them being preventable. The International Classification of Disease Perinatal Mortality (ICD-PM) is the first globally developed classification system for categorizing the causes of perinatal deaths. The objective of this study is to identify and describe the experiences gained from the international utilization of ICD-PM.

Method: A scoping review based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-SCR) was conducted through a comprehensive search using relevant keywords in Web of Science, PubMed, and Scopus from January 2016 to April 20, 2022 to identify relevant studies. The selection of studies was based on predefined inclusion and exclusion criteria. After removing duplicate studies and reviewing titles, abstracts, and full texts, a total of 32 studies were included in the analysis.

Results: The primary search ended up with 229 studies, of which 32 articles were included in the final analysis. Based on the results of the content analysis conducted on the selected studies, six main themes and eight strategies were identified.

Conclusion: The findings suggest that the utilization of ICD-PM on a global scale has been limited. The forthcoming advancement of ICD presents a chance to assess and enhance ICD-PM to establish it as a universally recognized standard system for classifying perinatal mortalities.

KEYWORDS

classification of perinatal mortality, ICD-PM, International Classification of Diseases, perinatal deaths

1 | INTRODUCTION

In 2021, approximately 1.9 million stillborn babies were reported at or after 28 weeks of pregnancy, resulting in a global stillbirth rate of 13.9 per 1000 total births. Additionally, the global neonatal death rate for the same year was 18 per 1000 live births.[1,2] However, mortality rates are not evenly distributed globally, and it is unfortunate that a significant number of these deaths could be prevented.[3] In 2015, the International Public Health Agenda established a goal to end preventable deaths among children under the age of five by 2030.[4,5] Perinatal deaths account

for over 44% of deaths in this age group. Reducing the perinatal mortality rate in infants is considered a key strategy in achieving the Sustainable Development Goals.[4–7] According to the World Health Organization (WHO), a large percentage of stillbirths and 75% of neonatal deaths are preventable.[8] Unfortunately, in regions with high perinatal mortality rates, the recording and reporting processes for perinatal deaths are ineffective and unreliable, resulting in a significant number of these deaths going unreported. This is why perinatal death is sometimes referred to as a silent epidemic.[9] Therefore, it is crucial to have a comprehensive understanding of the true extent of mortality, its underlying causes, and the risk factors that contribute to perinatal mortality. This knowledge is essential in the development of an effective strategic program aimed at reducing preventable perinatal deaths.[10–14] The first step of this effort involves accurately documenting and classifying all causes of death in medical care facilities on a global scale.[15]

In a review conducted in 2016, it was found that between 2009 and 2014, 81 systems were implemented in 40 countries to classify perinatal mortality causes.[16] In the same year, experts from 21 countries conducted a Delphi study and reached a consensus on 17 essential characteristics for an ideal classification system for perinatal mortality causes.[17] However, it is important to note that none of the currently used systems incorporate all the necessary characteristics, with most lacking at least half of these important features.[18] The diversity of classification systems hampers the ability to compare, understand, and identify significant factors contributing to perinatal mortality globally and nationally, potentially impacting decision-making regarding the provision of appropriate medical interventions.[9] Recognizing the need for an internationally standardized classification system for perinatal mortality causes, including maternal conditions that contribute to perinatal death, the WHO developed the International Classification of Disease Perinatal Mortality (ICD-PM) in 2016, based on the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10).[19,20] This was the first globally developed system for classifying perinatal mortality causes.[15] Pilot studies conducted in the United Kingdom and South Africa have shown that ICD-PM is universally recognized as a standard for perinatal mortality classification.[21] With the use of ICD-10 codes, ICD-PM has three distinctive characteristics: the ability to record perinatal mortality timing, a multi-layered approach to classifying perinatal mortality causes, and the ability to link maternal conditions contributing to perinatal deaths with the assigned ICD codes. These features ensure comprehensive coverage of various data layers related to conditions and settings and establish a direct connection between the cause of mortality and the ICD codes used.[22]

2 | METHOD

This scoping review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-SCR)[23] and Arksey and O'Malley's framework.[24] The framework includes: (1) identifying the research questions, (2) identifying relevant studies, (3) study selection, (4) data charting, and (5) collating, summarizing, and reporting the results. According to this framework, comprehensive coverage of a subject should be provided. This study includes the following steps (Figure 1).

2.1 | Step 1: Identifying the research questions

The main research question was identified through consultation and collaboration with the research team. The research questions were designed to encompass the findings, benefits, challenges, and strategies of using ICD-PM for classifying perinatal mortalities globally. In other words, the questions were selected based on the research objectives. The research questions are as follows:

- What are the findings and benefits associated with using ICD-PM for classifying perinatal mortalities worldwide?
- What challenges arise when using ICD-PM for classifying perinatal mortalities worldwide?
- What strategies can be employed to overcome these challenges in using ICD-PM for classifying perinatal mortalities worldwide?

2.2 | Step 2: Identifying relevant studies

All studies underwent a rigorous review process, adhering to specified inclusion criteria: availability of full-text, relevance to the topic, and publication in English. Studies presented at conferences or seminars, review studies, and letters to the editor were excluded. The primary researcher, along with an expert in review studies, developed a comprehensive keyword search protocol. Both researchers independently conducted thorough searches in electronic databases such as Web of Science, PubMed, and Scopus, covering the period from January 2016 to April 20, 2022. The search aimed to identify relevant studies and used the following keyword combinations: "classification causes of death," "perinatal mortality," "neonatal death," "stillbirth," "ICD-PM," and "International Classification of Disease of Perinatal Mortality." Duplicate search results were eliminated using referral management software (EndNote X8.2). The search results were then carefully reviewed and validated by two team members, with detailed documentation of all search procedures and outcomes.

2.3 | Step 3: Study selection

After implementing the search strategy, the initial phase of the selection process began. Two researchers examined the titles and abstracts of all the studies and assessed them against predetermined inclusion and exclusion criteria. Any disagreements were resolved by consulting a third party. Regular discussions were held among the research team members to monitor the progress of the screening process. Irrelevant studies were eliminated, and the full text of the remaining studies was reviewed in detail. Two individuals independently scrutinized the full text to confirm its relevance.

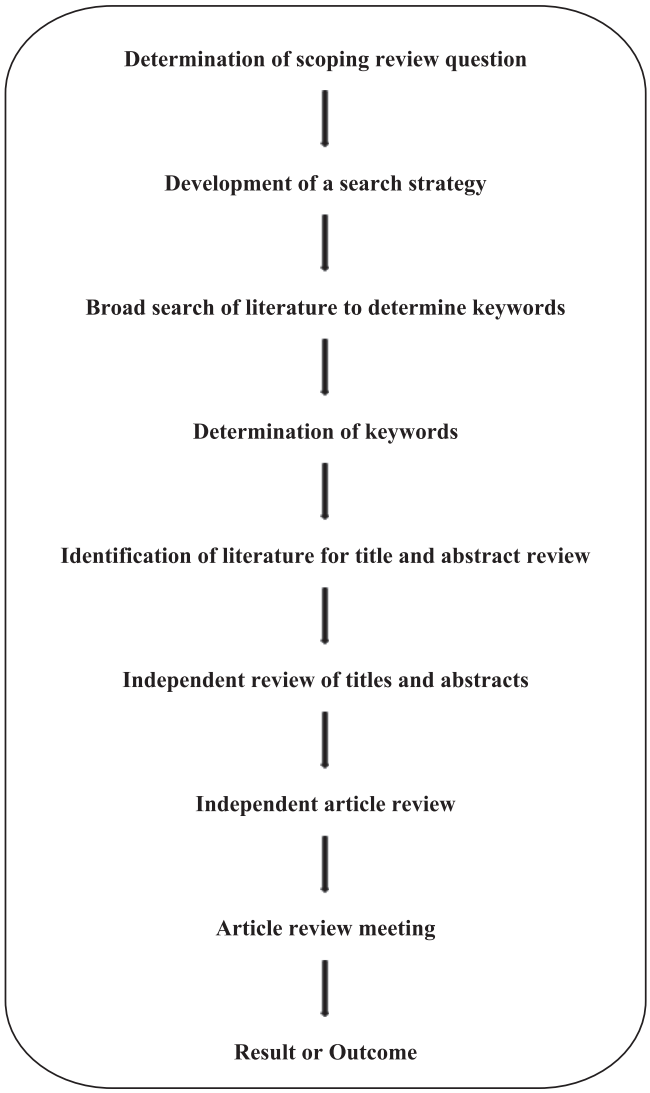

FIGURE 1 Steps in performing the scoping review on findings, advantages, challenges, and strategies of using ICD-PM for the classification of perinatal mortalities. After determining the research question and search strategy, the authors conducted literature search using specific keywords followed by a review of the selected literature to generate the results.

2.4 | Quality assessment tool

Two independent review authors (M.M. and M.J.) evaluated the study's methodological quality using the Cross-Sectional Studies Appraisal Tool.[25] This tool consists of 20 items, each assigned a value of either 0 or 1. If an item was not relevant to the article, it was marked as "Not Applicable" (N.A.) and not scored. To calculate the final score, the obtained score was divided by the total possible points after deducting the number of non-applicable items. The resulting score ranged from 0 to 1, and the methodological quality was categorized as weak (<0.5), moderate (0.51–0.65), moderate-strong (0.66–0.79), or strong (>0.80).[26]

2.5 | Step 4: Data charting

Author(s), publication year, country, study type, population, sample size, study period, and key findings.

2.6 | Step 5: Collating, summarizing, and reporting the results

This step involves collecting, summarizing, and reporting the findings. To establish a structured framework for synthesizing and consolidating data, researchers should prioritize specific aspects of the relevant literature. In this study, a thematic analysis approach was used to compile and summarize the results. Initially, one researcher (M.J.) thoroughly reviewed all the studies, annotated them, and identified thematic categories. The same researcher then reviewed and finalized all the studies within each thematic category. To ensure reliability, a second researcher (M.M.) verified the analysis of the listed studies.

3 | RESULTS

A total of 65 studies were obtained from Web of Science, 61 from PubMed, and 103 from Scopus. After eliminating 74 duplicate studies, there remained a pool of 155 unique studies. The titles and abstracts of these studies were assessed, resulting in the retrieval and evaluation of 57 full-text studies. Finally, through a comprehensive review process, 32 studies were selected for analysis (Figure 2).

3.1 | Study characteristics

The oldest study, published in 2016, and the most recent study, published in 2022, encompass a range of research studies. Among these, the majority comprise retrospective studies (10 studies, 31%). The remaining studies include prospective studies (7 studies, 22%), cross-sectional studies (6 studies, 19%), and other types of studies (9 studies, 28%). The sample sizes in these studies vary, ranging from 75 to 26,810 perinatal mortalities, which include stillbirth and neonatal death or both. Upon evaluating the studies using the quality assessment tool, 13 were rated as strong,[27–39] 16 as moderately strong,[3,40–54] 2 as moderate,[55,56] and 1 as weak[21] (Table 1). The data extracted for each study were then categorized by author, publication year, country, study type, population, sample size, study period, and key findings (Supporting Information S1: Table 1).

3.2 | Findings, benefits, and challenges

Based on the results of the content analysis conducted on the selected studies, six main themes and eight strategies were identified. These will be outlined below.

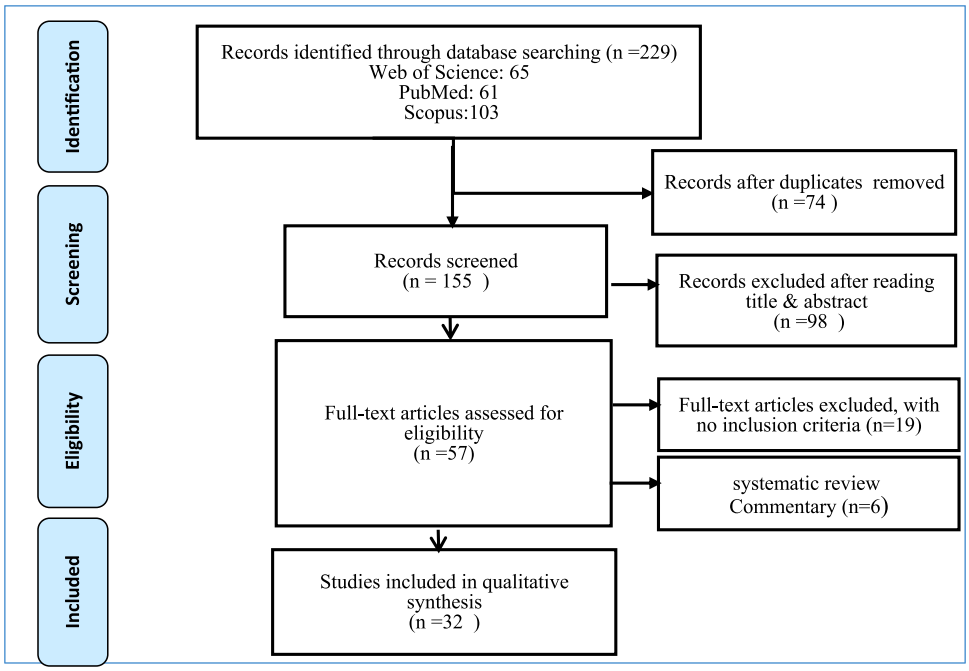

FIGURE 2 PRISMA diagram showing the selection of studies for scoping review.

3.3 | Identifying the causes of death

A total of 59% of the studies included in the current review have confirmed a reduction in unknown causes of perinatal mortality as a result of utilizing ICD-PM.[3,21,27–31,36,37,39–42,47–50,54,55] However, 34% of the reviewed studies have reported persistently high percentages of unknown causes of perinatal mortality, especially in cases of stillbirth, despite the utilization of this system. These studies mainly attribute this issue to the poor quality of the data.[28,29,31,39,41,44–47,50,55]

3.4 | Identifying the exact time of death

Forty-one percent of the reviewed studies found that ICD-PM accurately categorizes the timing of perinatal death.[4,23,27,28,31,32,41,42,44,45,47,50,55] Conversely, 25% of the studies identified the inability to determine the exact time of perinatal death as the main obstacle due to poor data quality and missing information.[21,27,29,31,41,42,47,55]

3.5 | Recording maternal conditions

Thirty-one percent of the studies indicated that ICD-PM can enhance the categorization of perinatal death causes by attributing the maternal conditions that impact perinatal death.[4,21,27,28,32,39,40,42,47,51] Nevertheless, 19% of the studies observed a significant rise in the influence of maternal conditions on the cause of perinatal death following the implementation of ICD-PM.[28,29,39,44,47,48]

3.6 | Based on ICD-10

Although ICD-PM is based on the ICD-10 framework and enables its extensive usage,[21,47] a significant portion of the studies analyzed (28%) identified the inherent difficulty of ICD10 as the main barrier to accurately categorizing perinatal mortality causes.[28,30,31,42,44–47,55]

3.7 | Focusing on identifying causes of neonatal deaths and stillbirths

The results obtained in the present scoping review indicated that ICD-PM has been used for 50%,[27–31,36,38,40–42,44,45,50,52,53,56] 9%,[32,35,37] and 41%[3,21,33,34,39,43,46–49,51,54,55] of stillbirths, neonatal mortalities, and perinatal mortalities, respectively.

3.8 | International applicability

Twenty-eight percent of the studies have endorsed ICD-PM as a classification system with universal applicability.[32–35,37,47,48,51,56] However, 34% of the studies have acknowledged that a conclusive opinion on this matter depends on long-term and large-scale implementation.[29,30,32–35,37,40,41,44,47]

3.9 | Strategies for overcoming the challenge of using ICD-PM

Based on the findings of the present study, we recommend eight important strategies for addressing the challenges encountered when

TABLE 1 AXIS quality assessment of the included studies.

Author, year	Introduction (1 point)	Methods (10 points)	Results (5 points)	Discussion (2 points)	Other (2 points)	Total points	Score	Quality
Sharma et al., 2021[27]	1	7	3	2	2	15/17	0.88	Strong
Kunjachen et al., 2017[40]	1	5	3	1	2	12/18	0.66	Moderate-strong
Dagdevire et al., 2021[41]	1	7	3	2	1	14/18	0.77	Moderate-strong
Miyoshi et al., 2019[55]	1	4	2	1	2	10/17	0.59	Moderate
Mok et al., 2021[28]	1	7	3	2	2	15/18	0.83	Strong
Prüst et al., 2020[29]	1	8	3	2	1	15/17	0.88	Strong
Benedetto et al., 2020[30]	1	8	3	2	1	15/17	0.88	Strong
Aminu et al., 2019[42]	1	9	3	1	1	15/19	0.79	Moderate-strong
Allanson et al., 2016[43]	1	6	3	2	1	13/18	0.72	Moderate-strong
Dase et al., 2020[31]	1	6	3	2	2	14/17	0.82	Strong
Reinebrant et al., 2017[44]	1	7	3	1	1	13/17	0.76	Moderate-strong
Aguinaga et al., 2021[45]	1	7	3	1	2	14/18	0.77	Moderate-strong
Allanson et al., 2016[21]	1	2	2	1	1	7/17	0.41	weak
D'Aloja et al., 2021[46]	1	6	3	2	1	13/19	068	Moderate-strong
Allanson et al., 2016[32]	1	6	3	2	2	14/17	082	Strong
Housseine et al., 2021[47]	1	6	2	2	2	13/17	0.76	Moderate-strong
Luk et al., 2020[3]	1	6	3	2	2	14/17	0.82	Moderate-strong
Lavin, et al., 2018[48]	1	6	2	1	2	12/17	0.71	Moderate- strong
Barrientos et al., 2019[33]	1	7	3	2	1	14/17	0.82	strong
Bhat et al., 2021[56]	1	6	3	1	0	11/17	0.64	Moderate
Zulfeen et al., 2020[49]	1	6	3	2	1	13/17	0.76	Moderate-strong
Monmany et al., 2021[34]	1	7	4	1	2	15/18	0.83	Strong
Kortekaas et al., 2018[35]	1	8	3	2	2	16/18	0.88	Strong
Bhagat et al., 2020[50]	1	6	3	2	1	13/18	0.72	Moderate-strong
Wasim et al., 2020[36]	1	8	3	1	1	14/17	0.82	strong
Taylor et al., 2020[51]	1	6	3	1	1	12/18	0.66	Moderate-strong
Al-Sheyab et al., 2020[37]	1	6	4	2	1	14/17	0.82	Strong

(Continues)

TABLE 1 (Continued)

Author, year	Introduction (1 point)	Methods (10 points)	Results (5 points)	Discussion (2 points)	Other (2 points)	Total points	Score	Quality
Kumar et al., 2021[38]	1	7	2	3	2	15/18	0.83	Strong
Dianna, et al., 2019[52]	0	8	3	1	0	12/18	0.66	Moderate-strong
Subedi et al., 2022[39]	1	7	3	2	2	15/18	0.83	Strong
Taweevisit et al., 2022[53]	1	6	2	1	2	12/17	0.71	Moderate-strong
Cherian et al., 2022[54]	1	7	3	1	1	13/18	0.72	Moderate-strong

using ICD-PM. The following are detailed descriptions of these strategies:

- Establish a standardized definition for maternal conditions and fetal causes, and provide clear instructions and guidelines for their application.[28,32,43,47]
- Introduce additional specific subcategories to reduce the number of unexplained cases.[29,30,47,48,53]
- Focus on all contributing conditions and factors that lead to mortality, rather than solely concentrating on a single cause.[29,47]
- Ensure consistent and permanent usage of ICD-PM, and provide explicit instructions for its implementation.[3,29,32,33,35,36,40,41,44,56]
- Incorporate certainty percentages for each selected cause when multiple factors contribute to mortality in a given scenario.[32]
- Include categories for recording the precise time of mortality.[29,47]
- Develop new versions of ICD-PM based on ICD11.[21,32,40,42–44]
- Enhance the quality of documentation and improve accuracy in recording the exact time of mortality.[21,29]

4 | DISCUSSION

The ICD-PM serves as a vital tool in comprehending and tackling perinatal mortality on a global scale. Its standardized methodology aids in the identification of causes and contributing factors, thereby facilitating the development of effective prevention strategies and enhancing outcomes in maternal and perinatal health.

ICD-PM has the potential to significantly reduce the number of cases of perinatal mortality with unknown causes.[3,27,28,30,36,37,40,47–49,54,57,58] This reduction is crucial as researchers rely on the percentage of stillbirths with unknown causes to assess the effectiveness of the classification system.[59] An ideal classification system with global applicability should categorize less than 20% of deaths as unknown.[18] However, 34% of the reviewed studies reported unknown causes when utilizing ICD-PM.[28,29,31,39,41,44–47,50,55] As a result, it can be inferred that the use of ICD-PM does not consistently provide a satisfactory solution for identifying the underlying reasons behind perinatal mortality. Studies have shown that even after its implementation in Nepal, over one-third of stillbirths were still classified as unknown causes.[39] Similarly, a study conducted in Tanzania produced similar results following the implementation of ICD-PM.[47] Additionally, a systematic review of the application of ICD-PM highlighted a common challenge of a significant proportion of antepartum stillbirths with no specified cause.[60] Numerous cases that could not be categorized under the ICD-PM were attributed to factors such as inadequate data quality, absence of documented evidence, conflicting evidence, or insufficient access to essential facilities and equipment required for investigating postnatal mortalities, including autopsies and placenta examinations.[21,27–29,31,39,41,42,44,47,55,57,61] Therefore, the key to effectively applying ICD-PM to reduce perinatal mortality with unknown causes is having high-quality data.[28,29,31,39,41,44–47,50,55] Additionally, a pilot study conducted in the United Kingdom and South Africa showed that consistent implementation of ICD-PM can overcome the problem of poor data over time.[21]

Accurate classification of perinatal mortality timing is crucial for comparing and planning preventive interventions, especially in developing countries.[32,62] Reliable data on the timing of death are essential.[44,62,63] The ICD-PM provides a way to identify perinatal mortality timing.[3,27,28] However, the lack of dependable data and insufficient facilities in overcrowded hospitals make it difficult to accurately determine the timing of mortality.[21,27,29,31,41,42,47,55] To address this challenge, a new category of "unknown time" has been introduced for stillbirths, in addition to the antepartum and intrapartum categories.[47] Nevertheless, consistent utilization of the ICD-PM can improve the accuracy of determining mortality timing, especially for stillbirths, as shown by the findings of the current scoping review.

Research on the ICD-PM has shown that including maternal conditions in the classification process can enhance the analysis and interpretation of perinatal mortality.[3,21,27,28,32,39,40,42,44,47] Maternal conditions often play a role in these deaths or contribute directly to them.[18,19,62,64,65] International initiatives prioritize the inclusion of maternal conditions in documenting the causes of these deaths.[9,64] However, using the ICD-PM can lead to an overestimation of the contribution of maternal conditions to perinatal mortality. A 2018 study using an alternative tool for classifying factors contributing to stillbirths found that maternal conditions accounted for 37% of global stillbirths, compared to 71% in Suriname and 59% in South Africa when using the ICD-PM.[44] These variations can be attributed to differences in the classification systems used to categorize stillbirths.[48] The discrepancy arises from different definitions of maternal conditions, leading to potential incompatibilities between systems.[29,44] There is currently a lack of international consensus on the definition of maternal complications.[66] Establishing a consensus on the definition of this condition will support consistent reporting of perinatal deaths caused by maternal conditions, improve comparability, and encourage data collection efforts on the causes of perinatal mortality associated with maternal conditions.

The widespread utilization of ICD-10 by 117 for the classification of causes of death, coupled with the fact that ICD-PM is also based on ICD-10, presents a valuable opportunity to adapt ICD-PM for the global classification of perinatal deaths. However, this endeavor is not without inherent challenges.[17,67] This is primarily due to the complexity of ICD-10, which includes irrelevant categories for both the mother and fetus.[67] ICD-10 does not establish a clear link between maternal conditions and perinatal deaths[19] and fails to recognize the fetus as an independent entity, resulting in the presence of unclassified data.[15,46,64] Addressing these issues, ICD-PM aims to eliminate irrelevant categories,[68] prioritize overlooked deaths, and accurately classify complications that are erroneously categorized as perinatal mortality within ICD-10 as maternal conditions contributing to perinatal mortality.[47] Through this scoping review, we have identified challenges associated with the utilization of ICD-PM that are directly linked to ICD-10.

The subcategories within ICD-PM lack comprehensiveness and do not cover all cases. Research has indicated that ICD-PM provides less detailed information compared to INCODE.[45] A study conducted in Thailand suggests the inclusion of a distinct category within ICD-PM for fetal placenta examination results, to reduce misclassification of death cases.[53] Similarly, a study conducted in South Africa has emphasized the necessity of including a separate category for autopsies in future reviews of ICD-PM.[37] Additionally, the implementation of ICD-PM highlights challenges in categorizing intricate and uncommon instances of perinatal mortality, as demonstrated by a research study carried out in Italy. Furthermore, inconsistencies can arise in the interpretation and classification of identical scenarios. It is important to note that these challenges are not exclusive to ICD-PM but are prevalent in all classification systems.[28]

Another challenge is that not all causes of mortality can be captured due to the nature of ICD-10, especially when there are competing conditions. Differentiating causes and related conditions that are inadequately defined in ICD-PM is also important.[30,44,47] There is a need for more guidelines and standards for identifying causes of perinatal mortality. The ICD codes for capturing maternal conditions in perinatal death situations differ from those used for the mother in situations where the baby has died. Requiring different codes for essentially the same underlying pathology poses a potential risk to the data's quality. Research has shown that utilizing similar codes for both the mother's disease and death yields more valuable and informative data.[30,69] It is highly recommended to include the WHO's Application of ICD-10 to deaths during pregnancy, childbirth, and the puerperium, known as ICD-Maternal Mortality (ICD-MM), for the classification of maternal conditions in ICD-PM. This is due to the fact that ICD-MM encompasses 702 codes for maternal conditions, whereas ICD-PM only comprises 53 codes.[19]

Therefore, the deficiencies in ICD-10 explain why ICD compatibility has not been considered one of the 17 important features of an ideal classification system. A study indicates that the compatibility of other classification systems with ICD, the international standard for identifying mortality causes, is somewhat limited, with only 21% of previous classification systems based on ICD.[19] In contrast, ICD10-based reports tend to classify a higher rate of stillbirths as unexplainable on average.[70] However, ICD is considered the most important international standard for reporting mortality statistics, so compatibility with ICD is a requirement for international reports. This scoping review suggests that, although efforts have been made in the development of ICD-PM to address the challenges associated with ICD-10, there are still some challenges that can be attributed to the nature of ICD-10.[42] Consequently, potential future revisions of ICD-11 will offer an opportunity to modify and enhance ICD-PM.

An international classification system should include categories for identifying factors that cause neonatal mortality and stillbirths, as well as the capability to distinguish between the two. This differentiation is one of the 17 essential features of an optimal perinatal mortality classification system and is crucial for accurately capturing and reporting perinatal deaths.[17,19] We found that ICD-PM has mainly been used for stillbirths. This is likely because the ICD-PM has a superior capacity for classifying the causes of stillbirths compared to neonatal deaths. A study conducted in Hong Kong supports this observation, as it showed that the ICD-PM had a significantly greater

impact on the classification of stillbirths compared to neonatal deaths.[3] These findings contradict a pilot study that highlighted the effectiveness of the ICD-PM in classifying neonatal mortalities.[21] The discrepancies observed across different studies may be due to the subjectivity of the classification methods used, as well as the varying quality of the data used. Therefore, it is highly recommended that users receive comprehensive instructions on the proper use of the ICD-PM to mitigate such errors in future applications.

ICD-PM has the potential to be used internationally as a classification system. This has been confirmed by 28% of the reviewed studies.[32–35,37,47,48,51,56] However, in order for it to have international applicability, it is crucial that it aligns with all 17 key features of an ideal perinatal mortality classification system.[18] Currently, the ICD-PM meets five of these characteristics.[3] Based on the findings of this scoping review, further research is needed to establish the validity of the ICD-PM in different research settings. A definitive assessment of its validity can only be made after it has been implemented in various situations over a period of time.[29,30,32–35,37,40,41,44,47]

In this scoping review, we have identified several limitations. First, the reliability and accuracy of the findings are significantly influenced by the quality of the selected studies. Upon assessing the quality of the articles, it was found that only one study had poor quality. Secondly, the use of retrospective research methods may affect the validity of the data obtained through ICD-PM. Thirdly, the limited global implementation of ICD-PM made it difficult to pinpoint the actual challenges associated with its use. Finally, the exclusion of non-English studies in this study may have a substantial impact on the results.

5 | CONCLUSION

ICD-PM is the first-ever global classification system for perinatal causes of death. It can convert local perinatal classifications into an international framework, allowing for international comparisons. It can serve as a benchmark for categorizing perinatal mortality causes worldwide. However, it is important to recognize the need for widespread and prolonged use to understand the challenges of implementing this system.

CONFLICT OF INTERESTS STATEMENT

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Marziyhe Meraji: Conceptualization; investigation; writing—review and editing; supervision; methodology; project administration. **Masoumeh Jafari**: Conceptualization; investigation; methodology; writing—review and editing; writing—original draft; project administration; supervision.

ACKNOWLEDGMENTS

This article is a component of MJ's master's thesis, which evaluates the impact of the International Perinatal Mortality Classification system on coding quality for perinatal mortality. This thesis has received approval from Mashhad University of Medical Sciences under research design code 991818. However, there was no financial support from the university for this portion of the thesis, which has been developed into the current article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request. All generated and analyzed data are available for review.

TRANSPARENCY STATEMENT

The lead author Masoumeh Jafari affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

ORCID

Masoumeh Jafari http://orcid.org/0000-0002-6361-6617

REFERENCES

1. UNICEF Data: Monitoring the situation of children and women January 2023 [cited October 5, 2023]. Available from: https://data.unicef.org/topic/child-survival/stillbirths
2. UNICEF Data: Monitoring the situation of children and women 2023 [cited October 5, 2023]. Available from: https://data.unicef.org/topic/child-survival/neonatal-mortality/
3. Luk HM, Allanson E, Ming WK, Leung WC. Improving diagnostic classification of stillbirths and neonatal deaths using ICD-PM (International Classification of Diseases for Perinatal Mortality) codes: validation study. *JMIR Med Inform*. 2020;8(8):e20071.
4. Lehtonen L, Gimeno, A, Prada Llorca A, Bento, M. Early neonatal death: a challenge world wide. *Seminars Fetal Neonatal*. 2017;2(22):153-160.
5. Kardum D, Filipović-Grčić B, Müller A, et al. Survival until discharge of very-low-birth-weight infants in two croatian perinatal care regions: a retrospective cohort study of time and cause of death. *Acta Clinica Croatica*. 2019;58:446-454.C
6. Liu L, Johnson HL, Cousens S, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379(9832):2151-2161. doi:10.1016/S0140-6736(12)60560-1
7. Mathews TJ, MacDorman MF. Infant mortality statistics from the 2009 period linked birth/infant death data set. *Natl Vital Stat Rep*. 2013;61(8):1-27.
8. Alyahya M, Khader Y. Health care professionals knowledge and awareness of the ICD10 coding system for assigning the cause of perinatal death in Jordanian hospitals. *J Multi Discip Health Care*. 2019;12:49-57.
9. World Health Organization. Every newborn: an action plan to end preventable deaths. Geneva: World Health Organization. 2014. Accessed November 12, 2019. https://www.who.int/docs/default-source/mcadocuments/advisory-groups/quality-of-care/everynewborn-action-plan-(enap).pdf?sfvrsn=4d7b389_2
10. Lawn JE, Blencowe H, Pattinson R, et al. Stillbirths: where? When? Why? How to make the data count? *Lancet*. 2011;377(9775):1448-1463.
11. Flenady V. Epidemiology of fetal and neonatal pathology. In: Khong TY, Malcomson RDG, eds. *Keeling's Fetal and Neonatal Pathology*. Springer International Publishing; 2015.

12. Heazell AEP, Siassakos D, Blencowe H, et al. Stillbirths: economic and psychosocial consequences. *Lancet*. 2016;387(10018):604-616.
13. Bang AT, Bang RA, Baitule SB, Reddy MH, Deshmukh MD. Effect of home-based neonatal care and management of sepsis on neonatal mortality: field trial in rural India. *Lancet*. 1999;354:1955-1961.
14. Manandhar DS, Osrin D, Shrestha BP, et al. Effect of a participatory intervention with women's groups on birth outcomes in Nepal: cluster-randomised controlled trial. *Lancet*. 2004;364:970-979.
15. Allanson E, Tunçalp Ö, Gardosi J, et al. Classifying the causes of perinatal death. *Bull World Health Organ*. 2016;94(2):79-79A.
16. Leisher SH, Teoh Z, Reinebrant H, et al. Seeking order amidst chaos: a systematic review of classification systems for causes of stillbirth and neonatal death, 2009-2014. *BMC Pregnancy and Childb*. 2016;16:1-7.
17. Wojcieszek AM, Reinebrant HE, Leisher SH, et al. Characteristics of a global classification system for perinatal deaths: a Delphi consensus study. *BMC Pregnancy Childbirth*. 2016;16(1):223.
18. Leisher SH, Teoh Z, Reinebrant H, et al. Classification systems for causes of stillbirth and neonatal death, 2009–2014: an assessment of alignment with characteristics for an effective global system. *BMC Pregnancy Childbirth*. 2016;16(1):1-6.
19. Allanson ER, Tunçalp ö, Gardosi J, et al. Giving a voice to millions: developing the WHO application of ICD-10 to deaths during the perinatal period: ICD-PM. *BJOG: Int J Obstet Gynaecol*. 2016;123(12):1896-1899.
20. Gardosi J, Pattinson RC. Classification of Stillbirth: a global approach. In: Facchinetti FDG, Barnciani D, Saade G, eds. *Stillbirth: Understanding and Management*. Information Healthcare; 2010. http://perinatal.org.uk/pdfs/classification_of_stillbirth.pdf.
21. Allanson ER, Tunçalp Ö, Gardosi J, et al. The WHO application of ICD-10 to deaths during the perinatal period (ICD-PM): results from pilot database testing in South Africa and United Kingdom. *BJOG: Int J Obstet Gynaecol*. 2016;123(12):2019-2028.
22. World Health Organization.*The WHO Application of ICD10 to Perinatal Deaths: ICD10-Peribatak Mortality (ICD-PM)*. WHO; 2015.
23. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. 2018;169(7):467-473.
24. Arksey H, O'Malley L. Scoping studies: towards a methodological frame-work. *Int J Soc Res Methodol*. 2005;8(1):19-32.
25. Downes MJ, Brennan ML, Williams HC, Dean RS. Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). *BMJ Open*. 2016;6:e011458.
26. Tura AK, Trang TL, van den Akker T, et al. Applicability of the WHO maternal near misstool in sub-Saharan Africa: a systematic review. *BMC Pregnancy Childbirth*. 2019;19:79.
27. Sharma B, Siwatch S, Kakkar N, Suri V, Raina A, Aggarwal N. Classifying stillbirths in a tertiary care hospital of India: International Classification of Disease-Perinatal Mortality (ICD-PM) versus cause of death-associated condition (CODAC) system. *J Obstet Gynaecol*. 2021;41(2):229-233.
28. Mok YK, Seto MTY, Lai THT, Wang W, Cheung KW. Pitfalls of International Classification of Diseases-Perinatal Mortality in analysing stillbirths. *Public Health*. 2021;201:12-18.
29. Prüst ZD, Verschueren KJC, Bhikha-Kori GAA, et al. Investigation of stillbirth causes in Suriname: application of the WHO ICD-PM tool to national-level hospital data. *Glob Health Action*. 2020;13(1):1794105.
30. DiBenedetto F, Fabio F, Francesca M, Gaia P. A comparison of three classification systems for stillbirth.
31. Dase E, Wariri O, Onuwabuchi E, et al. Applying the WHO ICD-PM classification system to stillbirths in a major referral centre in Northeast Nigeria: a retrospective analysis from 2010–2018. *BMC Pregnancy Childbirth*. 2020;20:383. doi:10.1186/s12884-020-03059-8
32. Allanson ER, Vogel JP, Tunçalp Ö, et al. Application of ICD-PM to preterm-related neonatal deaths in South Africa and United Kingdom. *BJOG: Int J Obstet Gynaecol*. 2016;123(12):2029-2036.
33. Zuleta-Tobón JJ, Salazar-Barrientos M. Aplicación del Sistema de Clasificación Internacional de Enfermedades para la Mortalidad Perinatal CIE-MP a partir de registros vitales para clasificar las muertes perinatales en Antioquia, Colombia. *Rev Colomb Obstet Ginecol*. 2019;70(4):228-242.
34. Monmany NT, Astete JA, Ramaiah D, et al. Extended perinatal mortality audit in a rural hospital in India. *Am J Perinatol*. 2021;40:375-386.
35. Kortekaas JC, Scheuer AC, De Miranda E, et al. Perinatal death beyond 41 weeks pregnancy: an evaluation of causes and substandard care factors as identified in perinatal audit in the Netherlands. *BMC Pregnancy Childbirth*. 2018;18(1):380.
36. Wasim T, Bushra N, Iqbal HI, Mumtaz A, Khan KS. Maternal condition as an underlying cause of perinatal mortality: prospective cohort study. *J Obstet Gynaecol Res*. 2021;47(2):544-550.
37. Al-Sheyab NA, Khader YS, Shattnawi KK, Alyahya MS, Batieha A. Rate, risk factors, and causes of neonatal deaths in Jordan: analysis of data from Jordan stillbirth and neonatal surveillance system (JSANDS). *Front Public Health*. 2020;8:595379.
38. Kumar M, Puri M, Yadav R, et al. Stillbirths and the COVID-19 pandemic: looking beyond SARS-CoV-2 infection. *Int J Gynaecol Obstet: Off Organ Int Federation Gynaecol Obstet*. 2021;153(1):76-82.
39. Subedi N, Kandel D, Ghale T, Gurung B, Shrestha B, Paudel S. Causes of perinatal mortality and associated maternal factors in a tertiary referral hospital of Gandaki province of Nepal: a cross-sectional study from a hospital-based surveillance. *BMC Pregnancy Childbirth*. 2022;22(1):245.
40. Kunjachen Maducolil M, Abid H, Lobo RM, et al. Risk factors and classification of stillbirth in a Middle Eastern population: a retrospective study. *J Perinat Med*. 2018;46(9):1022-1027.
41. Dagdeviren G, Uysal NS, Dilbaz K, Celen S, Caglar AT. Application of the international classification of diseases-perinatal mortality (ICD-PM) system to stillbirths: a single center experience in a middle income country. *J Gynecol Obstet Human Reprod*. 2022;51(2):102285.
42. Aminu M, Mathai M, van den Broek N. Application of the ICD-PM classification system to stillbirth in four sub-Saharan African countries. *PLoS One*. 2019;14(5):e0215864.
43. Allanson ER, Tunçalp Ö, Gardosi J, et al. Optimising the International Classification Of Diseases to identify the maternal condition in the case of perinatal death. *BJOG: Int J Obstet Gynaecol*. 2016;123(12):2037-2046.
44. Reinebrant HE, Leisher SH, Coory M, et al. Making stillbirths visible: a systematic review of globally reported causes of stillbirth. *BJOG: Int J Obstet Gynaecol*. 2018;125(2):212-224.
45. Aguinaga M, Valdespino Y, Medina D, et al. Causal analysis of fetal death in high-risk pregnancies. *J Perinat Med*. 2021;49(6):740-747.
46. D'Aloja P, Salvatore MA, Sampaolo L, Privitera MG, Donati S. A nationwide surveillance system to reduce perinatal death cases in Italy: implementing a population-based pilot project. *Epidemiol Prev*. 2021;45(5):343-352.
47. Housseine N, Snieder A, Binsillim M, Meguid T, Browne JL, Rijken MJ. The application of WHO ICD-PM: feasibility for the classification of timing and causes of perinatal deaths in a busy birth centre in a low-income country. *PLoS One*. 2021;16(1):e0245196.
48. Lavin T, Allanson ER, Nedkoff L, Preen DB, Pattinson RC. Applying the international classification of diseases to perinatal mortality data, South Africa. *Bull World Health Organ*. 2018;96(12):806-816.
49. Zulfeen M, Upadhyay R, Amin SV, Pai MV, Lewis L. What do the numbers say? - Introduction of the WHO ICD-PM classification and fetuses - at risk approach in perinatal audit, South India. *Clin Exp Obstet Gynecol*. 2021;48(1):144-150.
50. Bhagat B, Venkataseshan S, Sharma B, et al. A root cause analysis of stillbirths delivered in a tertiary care hospital of India–Understanding the gaps in care provided. *Int J Health Syst Implement Res*. 2020;4(3):29-39.
51. Taylor AW, Blau DM, Bassat Q, et al. Initial findings from a novel population-based child mortality surveillance approach: a descriptive study. *Lancet Glob Health*. 2020;8(7):e909-e919.

52. Blau DM, Caneer JP, Philipsborn RP, et al. Overview and development of the child health and mortality prevention surveillance determination of cause of death (DeCoDe) process and DeCoDe diagnosis standards. *Clin Infect Dis*. 2019;69(suppl_4):S333-S341.
53. Taweevisit M, Nimitpanya P, Thorner PS. Classification of stillbirth by the International Classification of Diseases for Perinatal Mortality using a sequential approach: a 20-year retrospective study from Thailand. *J Obstet Gynaecol Res*. 2022;48:1175-1182.
54. Cherian AG, Tryphena C, George K, Abraham VJ, Mohan VR, Prasad JH. Perinatal mortality and its causes in a rural block in Tamil Nadu, Southern India: a community-based nonconcurrent cohort study. *Indian J Community Med: Off Publ Indian Assoc Preventive Soc Med*. 2022;47(1):12-17.
55. Miyoshi Y, Matsubara K, Takata N, Oka Y. Baby survival in Zambia: stillbirth and neonatal death in a local hospital setting. *BMC Pregnancy Childbirth*. 2019;19(1):90.
56. Bhat S, Birdus N, Bhat SM. Ethnic variation in causes of stillbirth in high income countries: a systematic review and meta-analysis. *Int J Gynecol Obstet*. 2021;158:270-277.
57. Priyani AAH, Thuvarakan P, De Silva MVC. Classification of perinatal deaths according to ICD-PM: an audit on perinatal post-mortems in a tertiary care centre in Sri Lanka. *Sri Lanka J Obstet Gynaecol*. 2017;39(2):31.
58. Shrestha J, Basnet S, Pandey C, Thapa S. Perinatal mortality trend and classification of causes at a tertiary care centre of western Nepal. *J Kathmandu Med Coll*. 2021;10:109-119.
59. Flenady V, Wojcieszek AM, Ellwood D, et al. Classification of causes and associated conditions for stillbirths and neonatal deaths. *Semin Fetal Neonatal Med*. 2017;22(3):176-185.
60. Prüst ZD, Kodan LR, van den Akker T, Bloemenkamp KW, Rijken MJ, Verschueren KJ. The global use of the International Classification of Diseases to Perinatal Mortality (ICD-PM): a systematic review. *J Glob Health*. 2022;12:04069.
61. Mitra B, Acharya BP. Retrospective analysis of risk factors for intrauterine fetal death in a busy zonal hospital.
62. Aminu M, Unkels R, Mdegela M, Utz B, Adaji S, van den Broek N. Causes of and factors associated with stillbirth in low- and middle-income countries: a systematic literature review. *BJOG: Int J Obstet Gynaecol*. 2014;121(suppl 4):141-153. doi:10.1111/1471-0528.12995
63. Sharma B, Aggarwal N. Classifying stillbirths in India: do we need a separate classification system? *Int J Health Syst Implement Res*. 2019;3(2):4-8.
64. De Bernis L, Kinney MV, Stones W, et al. Stillbirths: ending preventable deaths by 2030. *Lancet*. 2016;387(10019):703-716.
65. Frøen JF, Gordijn SJ, Abdel-Aleem H, et al. Making stillbirths count, making numbers talk - issues in data collection for stillbirths. *BMC Pregnancy Childbirth*. 2009;9(1):58.
66. Lavin T, Preen DB, Allanson E, Pattinson RC. Why correctly identifying maternal condition in perinatal death classification systems is crucial: a commentary. *BJOG: Int J Obstet Gynaecol*. 2020;127(6):668-670.
67. Barabadi M, SheikhTaheri A, Mearaji M, Maidani Z, Shahmoradi L, Ahmadi M. Comprehensive guide to ICD-10 disease coding. 2017.
68. Stillbirth Collaborative Research Network Writing Group. Causes of death among stillbirths. *JAMA*. 2011;306(22):2459-2468. doi:10.1001/jama.2011.1823
69. Flenady V, Frøen JF, Pinar H, et al. An evaluation of classification systems for stillbirth. *BMC Pregnancy Childbirth*. 2009;9(1):24.
70. Flenady V, Reinebrant H, Leisher SH, et al. *Identifying Causes of Stillbirth and Neonatal Death Globally; The Challenges Posed By Disparate Classification Systems*. International Stillbirth Alliance; 2013.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Meraji M, Jafari M. Can International Classification of Disease Perinatal Mortality (ICD-PM) be a solution to overcome neglected tragedy? A scoping reviews. *Health Sci Rep*. 2024;7:e70134. doi:10.1002/hsr2.70134