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Mortality Reporting Modeling in Healthcare Facilities in Indonesia

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***Abstract*—**Healthcare facilities in Indonesia, such as hospitals and public health centers, play a crucial role in recording and reporting mortality data necessary for health policy development and quality assessment. Although various reporting methods are available, ranging from manual to electronic systems, the primary focus has often been on morbidity rather than mortality. External reporting processes typically involve basic coding for morbidity and mortality, and the application of the International Classification of Diseases (ICD) for cause-of-death determination in electronic medical records is still underdeveloped. This study employs a qualitative descriptive approach with a system modeling framework to design a comprehensive mortality reporting model that incorporates data mining techniques. By analyzing secondary data from integrated mortality reporting systems in Indonesian healthcare facilities, the study proposes a model that enhances data processing and presentation, offering a structured approach for utilizing mortality data for policy development and future forecasting. The results demonstrate that this model significantly improves data management processes and provides a valuable framework for advancing health policy. Future research should explore the implementation of this model and assess its impact on health policy outcomes in Indonesia.
Keywords— Mortality, Reporting, Healthcare Facilities, Data Mining, System Modeling

I.BACKGROUND

Healthcare facilities, such as hospitals and community health centers, play a crucial role in recording, reporting, and striving to reduce mortality rates. This data is necessary for the Ministry of Health to support future policies [1]. Additionally, it serves as a benchmark for the quality of record-keeping [2] and ensures the proper implementation of medical records in accordance with Ministry of Health Regulation No. 24 of 2022 on Medical Records [3].

The implementation of mortality data reporting in Indonesia varies across healthcare facilities, ranging from manual reporting [4] to electronic systems [5]. However, the focus of these reporting systems is still primarily on morbidity rather than mortality data as a main concern [6]. At the external reporting level, record coding is performed through basic processes for the characterization of morbidity and mortality [7]. Therefore, mortality data reporting should be understood through the rapid and accurate processing of data, with organized data presentation and structured relational patterns to facilitate understanding [8]. The rules for recording and determining the underlying causes of death have been established by the World Health Organization (WHO) in the International Classification of Diseases (ICD) [9]. Substantial variation in coding must be adhered to in order to determine the cause of death [10], supported by the cause-of-death tables available in the Mortality Medical Data System (MMDS). However, in practice, the implementation of these rules in electronic medical records has not been effectively realized, particularly in the computerized determination of the cause of death.

As a future step in mortality reporting for healthcare facilities, there is a need for modeling, designing, and implementing mortality data mining techniques. This approach represents a long historical evolution, with numerous models proposed since Gompertz published the law of mortality in 1825 [11]. Data mining models can be used to analyze data and uncover hidden patterns. However, the quality of the insights gained depends on proper data preparation [12].

Based on this, the management of mortality reporting in Indonesian healthcare facilities needs to be upgraded, including improvements in data recording methods, reporting practices, and the utilization of mortality data for data mining purposes. Therefore, the objective of this study is to develop a mortality reporting management model for healthcare facilities that can serve as a foundational basis for data mining at the health department level.

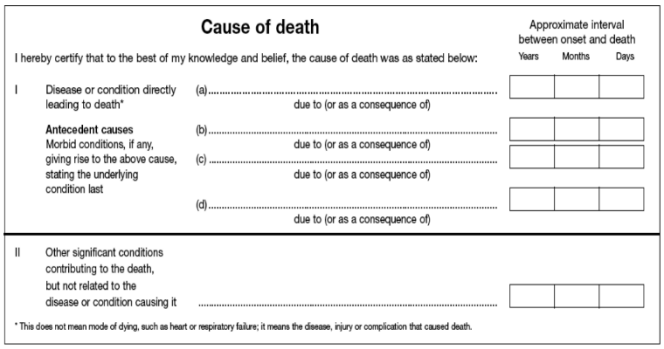
II.METHOD

The method used in this study is a descriptive qualitative research approach with a systems modeling framework. The data employed is secondary data on integrated mortality reporting management in healthcare facilities, which supports mortality data mining at the health department level in Indonesia. The data processing in this study involves systems modeling to design a suitable model for enhancing mortality reporting management in Indonesian healthcare facilities.

III.RESULTS AND DISCUSSION

Mortality Reporting Management in Healthcare Facilities

Currently, the implementation of mortality reporting in Indonesia is still limited to the preparation of case statistics reports. The data collected includes the number of death cases and their causes, which are then reported in the form of simple statistics. Although this information is important, the approach used remains very basic and does not fully harness the potential of the available data.Mortality statistical data in Indonesia has not yet been utilized for data mining to provide deeper insights. Data mining is the process of analyzing data from various perspectives and summarizing it into useful information. In several developed countries, mortality statistical data is



Cause of death

Approximate interval between onset and death — Years / Months / Days

I hereby certify that to the best of my knowledge and belief, the cause of death was as stated below:

I — Disease or condition directly leading to death* — (a) ..... — due to (or as a consequence of)

Antecedent causes — Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last — (b) ..... — due to (or as a consequence of) — (c) ..... — due to (or as a consequence of) — (d) ..... — due to (or as a consequence of)

II — Other significant conditions contributing to the death, but not related to the disease or condition causing it .....

* This does not mean mode of dying, such as heart or respiratory failure; it means the disease, injury or complication that caused death.

Fig.1.Death Certificate Template

TABLE D
CAUSAL RELATIONSHIP: GENERAL PRINCIPLE AND RULES 1 AND 2

--- A000 ---	--- A012 ---	--- A031 ---
	CONTINUED	CONTINUED
A000	C000 -C97	Y842
A009	R75	
B200 -B24	Y431 -Y434	--- A032 ---
C000 -C97	Y632	
R75	Y842	A032
Y431 -Y434		A039
Y632	--- A013 ---	B200 -B24
Y842		C000 -C97
	A013 -A014	R75
--- A001 ---	B200 -B24	Y431 -Y434
	C000 -C97	Y632
A001 -A009	R75	Y842
B200 -B24	Y431 -Y434	
C000 -C97	Y632	--- A033 ---
R75	Y842	

fig.2.MMDS Table

Procedures

The procedures that can be implemented in the reporting of this research involve combining system modeling methods with Natural Language Processing (NLP), as well as integrating the re-selection rules for determining the underlying causes of death in the MMDS (Fig. 3). The details of these procedures are as follows:Mortality reporting modeling in healthcare facilities begins with the creation of a death certificate written in free-text format. In this certificate, medical professionals record details of the death, including patient identity such as name, age, and gender, as well as the time and place of death. The cause of death and other details are also recorded, often in natural language, including medical history and conditions leading up to the death in accordance with the MMDS's sequence of causes of death as illustrated in Fig. 2, which shows Table (D) from the MMDS explaining possible diagnoses and the sequence of causes of death.Employed for this purpose, leading to significant benefits such as mortality prediction or forecasting, pattern and trend identification, and data-driven decision-making.The implementation of mortality reporting management in healthcare facilities is based on the MMDS procedural guidelines established by the WHO, although in practice many healthcare facilities do not accurately document the sequence of causes of death on death certificates as shown in Fig. 1.

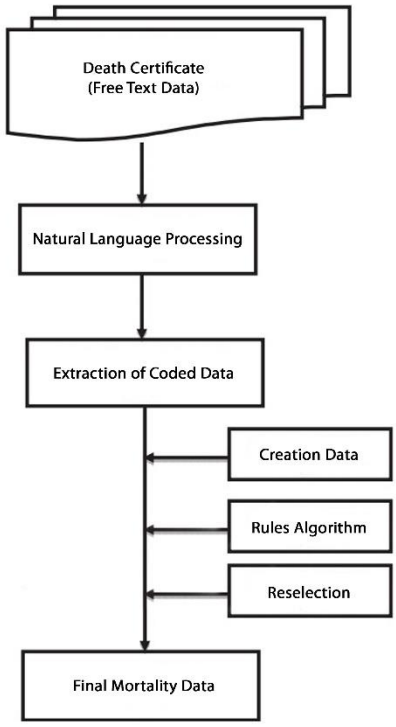


Fig. 3 Flow Diagram of UCOD Reselecton

The next stage involves the use of Natural Language Processing (NLP) to parse and interpret the free-text data from the death certificate. NLP processes this text by breaking it down into smaller units such as words or phrases and extracting key information such as disease names and dates. This technology also helps to simplify natural language into a more structured and consistent format, and resolves ambiguities in the text to ensure clear interpretation of medical terms that may have multiple meanings.After the free-text data is processed by NLP, the resulting data is then encoded. This process involves using the ICD (International Classification of Diseases) codes for causes of death, ensuring that the data is consistent and standardized. The encoded data is then organized into a structured format, making it easier to analyze and compare. This stage Also includes an initial validation to ensure that the encoded data is both consistent and accurate.

The encoded data then undergoes several additional processes before becoming the final mortality data. First, the extracted data is organized into a structured data record. This involves creating a more standardized and ready-to-use data record, as well as refining the data by adding relevant additional information.Next, rule-based algorithms are applied to ensure that the encoded data meets certain criteria and is consistent. These algorithms include validation rules that check data compliance with established standards, as well as automated corrections for any non-compliant data. Additionally, the system provides alerts for data that may require manual review to ensure its accuracy.Following the algorithmic validation, any data that is identified as problematic or non-compliant is re-evaluated through a re-selection process. This involves manual review of data flagged by the algorithms and re-extraction of problematic data if necessary. The aim of this process is to ensure that the re-selected data meets quality standards before it is included in the final mortality dataset.

Finally, the mortality data that has undergone various stages of validation and refinement becomes the final data set ready for use. This final data set is stored in a database that can be accessed for further analysis and reporting. Through this comprehensive and structured process, mortality data becomes not only a statistical report but also a powerful tool for decision-making and more effective health policy planning.

Discussion

Mortality reporting in Indonesia is currently limited to the preparation of statistical case reports that include the number of deaths and their causes. This approach is still very basic and does not fully utilize the potential of the data. In contrast, in developed countries, mortality statistics are used for data mining to perform mortality forecasting and data-driven decision-making [13], providing significant benefits for health policy planning [14, 15].To enhance the effectiveness of mortality

reporting in Indonesia, a more advanced reporting model should be implemented. This model integrates various technologies such as Natural Language Processing (NLP) [16] and ICD coding to transform free-text data from death certificates into structured data that can be analyzed and then standardized based on MMDS guidelines. This process involves several stages, including free-text data extraction, coding, validation, and the creation of a final data record ready for use.

By using NLP, information from death certificates is transformed into a more structured and consistent format [16]. The data, once coded with ICD, is then validated and further processed to ensure its quality and accuracy. The final outcome of this process is more detailed mortality data that is ready for in-depth analysis, prediction, and decision-making [17, 18]. This approach not only enhances the accuracy and consistency of mortality data but also opens up opportunities for broader applications [19, 20, 21]. The processed mortality data can be used to identify patterns and trends in mortality, assist in better health policy planning [22], and provide deeper insights for more effective public health interventions [23, 24].

Adopting this more advanced mortality reporting model can provide significant benefits to the health system in Indonesia. Mortality data serves not only as a statistical report but also as an effective tool for formulating better and more predictive health policies [25, 26]. This approach aligns with practices in advanced countries that have successfully utilized mortality data for more accurate and sustainable health planning.

IV.CONCLUSIONS AND SUGGESTIONS

Current mortality reporting in Indonesia is still limited to compiling statistical death reports without fully leveraging the data for effective health policy planning. In contrast, advanced countries have adopted sophisticated mortality reporting models using Natural Language Processing (NLP) and ICD coding to produce structured data that can be analyzed for prediction and decision-making. Implementing a more advanced mortality reporting model in Indonesia, by integrating the latest technologies, could improve data accuracy, identify patterns and trends in mortality, and provide more valuable information for more effective and predictive health policy planning. Therefore, it is recommended that Indonesian authorities consider adopting advanced data mining and analysis technologies to enhance the mortality reporting system and support data-driven and sustainable health policies in the future.

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