Implementation of Indonesia's Civil Registration and Vital Statistics (CRVS) Systems in Malang District: Results from the 2020 CRVS in Public Health

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Abstract. To improve the availability of public health registration, each nation must implement a comprehensive Civil Registration and Vital Statistics (CRVS) systems framework that works seamlessly across local, national, and global levels. This study aimed to describe the implementation of the CRVS system in Malang District to get mortality statistics for health indicators and strengthen health policy implementation. This study was implemented using a participatory action research approach. The study was conducted throughout 2020 at 39 Public Health Centers across Malang District. Sampling involves stakeholders, health professionals, and communities. Data access, dissemination, and utility were highly satisfied (92.0%). Death cases by death scene were at Home (74.59%). Death cases by the VA method, hospitals, and MCCD were dominated by non-communicable diseases, namely cardiovascular diseases and chronic metabolic disorders. Causes of death for neonates were dominated by complications of intrapartum events (39.0%). Developing the CRVS systems implies that the health service systems will be improved effectively and efficiently.

Keywords: CRVS, Verbal Autopsy, Implementation Research, Public Health

1. Introduction

Globally, a key target within the Sustainable Development Goals (SDGs) is to ensure all individuals retain a lawful identity via birth registration by 2030 (SDG target 16.9). Birth data collection is essential for assessing and attaining universal health coverage (SDG target 3.8), enabling policymakers and planners to identify individuals needing healthcare, education, and other services[1].

The data shows that over 110 low-and middle-income countries have inadequate CRVS systems. This inadequacy is particularly pronounced in rural regions and among these countries' most economically disadvantaged populations [2]. Enhancing CRVS systems is crucial to successfully implementing health and social development initiatives [3].

In Indonesia, the CRVS systems constitute a vital asset for collecting this data. Civil registration is defined by the organized, ongoing, and obligatory documentation of all vital occurrences, including stillbirths, live births, deaths, their causes, and other civil occurrences, as mandated by the relevant legal frameworks.

Accurate and reliable information regarding births, deaths, and the underlying causes of mortality within a Population is crucial for the effective functioning of national health information systems. Specifically, mortality statistics are crucial for determining different mortality rates, and mortality ratios, and calculating life expectancy at birth. Additionally, data concerning death causes are crucial for assessing population health, informing health policy,

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and evaluating health programs.

Indonesia's CRVS system Framework is determined by National Law Nos. 23, 2006 [4] and 24, 2013 [5]. The Directorate General of Population Administration and Civil Registration, operating under the Ministry of Home Affairs, is responsible for implementing this system. These laws encompass a range of issues linked to population administration, including registering vital events and utilizing registration data for public sector goals. The Population Information and Administration System (SIAK) manages vital event records. It is essential to recognize that Indonesia's CRVS systems are still developing. Currently, the SIAK database does not deliver all the data linked to mortality rates and ratios, specifically on causes of death, which are critical for assessing vital statistics indicators.

In Malang District, the Implementation of Indonesia's Civil Registration and Vital Statistics (CRVS) systems has not fully blended into the health sector, so the recording of births and deaths continues to function partially.

The Jokowi-Ma'ruf Administration renewed Indonesia's Civil Registration and Vital Statistics Systems by enacting Presidential Regulation No. 62, 2019. This regulation constructed the National Strategy to accelerate the Population Administration System, thereby facilitating the advancement of Vital Statistics. [6]. The Ministry of Home Affairs is designated as the central authority overseeing all activities of CRVS. Ministry of Health has been designated as the primary authority responsible for documenting births, deaths, and their causes. In this role, the Ministry enacted Regulation No. 31, 2019 [7], which delineates the duties of the Public Health Centre Information System regarding Civil Registration and Vital Statistics (CRVS) activities. Article 19 of this regulation orders that all births and deaths occurring within the jurisdiction of each Public Health Centre be systematically recorded in their designated Birth and Death Registers. This directive requires the periodic submission of summarized data to the District Health Office. Concerning death records, the regulation specifies that the collected information must include the individual's identity, address, age at the time of death, sex, place of death, and the causes of death, which must be classified according to the WHO International Classification of Diseases.

This study is part of CRVS strengthening activities in two districts. It focuses on getting an idea of how to implement the CRVS system to find mortality statistics for health indicators in the district of Malang. This study aimed to describe the implementation of CRVS Systems in Malang District to obtain mortality statistics for health indicators.

2. Literature Review

Civil registration refers to the systematic, ongoing, and obligatory documentation of significant life events within a nation's populace, conducted by the legal stipulations of that nation. The United Nations identifies ten key events that should be recorded: live birth, death, fetal death, marriage, divorce, annulment of marriage, judicial separation, adoption, legitimation, and recognition. Vital statistics encompass the aggregation of data about these crucial occurrences, along with pertinent details about the events and the individuals involved, and are derived from the civil registration framework. Additionally, vital statistics can be sourced from population surveys and census data [8].

Terms of Civil Registration are defined as among the best sources of life expectancy and infant, child, and maternal mortality data. Some indicators of childhood mortality, such as the infant mortality rate (IMR), the under-five mortality rate (U5MR), and the maternal mortality ratio (MMR), become the primary health development indicators for monitoring, evaluating, and planning health programs [9,10]. The mortality indicator is one measure used to assess the

achievement of targets such as the Sustainable Development Goals (SDGs).

In pursuit of the goals established in Indonesia's five-year development framework, the government utilizes death indicators as a critical component of the Ministry of Health Strategic Plan. Mortality measurement is regarded as a fundamental indicator for evaluating the health conditions of a nation or region owing to its reliability, representativeness, consistency, and affordability [11].

Indonesia's CRVS systems are inadequate. As a result, mortality data is sourced from surveys and censuses that incur substantial costs, necessitating that they be conducted at five-year intervals [11].

CRVS systems function as the principal repository of data concerning births, deaths, and the factors contributing to mortality. This information's applicability is paramount for creating health policies, assessing program outcomes, and pursuing academic inquiry. In Indonesia, it is essential to monitor critical indicators, including life expectancy at birth, maternal mortality ratios, and child mortality rates associated with particular causes, to guide the national health policy framework effectively [12]. CRVS systems extend beyond mere data collection; they serve as essential conduits to vital services that individuals require, including identity verification, legal rights, access to various services, and social protection mechanisms [13].

Verbal autopsy (VA) is a technique employed to ascertain the cause of death by conducting interviews with the relatives or caregivers of the deceased. These interviews utilize a standardized questionnaire to collect information regarding symptoms, medical history, and the events surrounding the death. Subsequently, healthcare professionals or algorithms evaluate this data to determine the probable cause of death [14]. The main objective of a verbal autopsy is to elucidate the causes of death within communities or populations in regions lacking formal medical certification of death or where such certification is not yet firmly established. Verbal autopsy is an essential instrument for nations to gather necessary information regarding non-medically certified deaths in communities, thereby enhancing CRVS systems. This process provides critical health data that informs evidence-based health policies and planning [14].

VA methodology involves the systematic collection of anamnestic data through interviews with a close relative or caregiver of a deceased individual, typically conducted shortly after the death. This data encompasses various symptoms, signs, and contextual factors preceding the death. The gathered information is then subjected to analysis via computer models and reviewed by healthcare experts to ascertain the most probable cause of death. The primary questions for this methodology are contained within the "Verbal Autopsy Instrument," which was created by the WHO in 2012 and has been updated as of March 2022 [15].

Community-based verbal autopsy is a strategy that enables health cadres and health facilitators or workers to undertake verbal autopsies to ascertain the suspected causes of death in the community. Health cadres were chosen by program managers at public health centers, focusing on their proactive involvement in health program execution in their villages. At the same time, researchers took the initiative to recruit health facilitators and workers [16].

A mobile application for verbal autopsy was developed using the Kobo Toolbox platform. The questions incorporated in the application were based on the WHO 2016 verbal autopsy instrument version 1.5.3, which was later translated into Indonesian. All data gathered through this application were securely stored on a cloud server linked to the Kobo Toolbox platform [16]. The Death Certificate, officially called the Medical Certificate of Cause of Death (MCCD), is predominantly issued by medical professionals in governmental roles and private practitioners [17]. This certificate is structured into two sections: Part 1 addresses the diseases or conditions that directly led to the death, while Part 2 encompasses additional pertinent conditions. The initial line of Part 1 specifies the immediate cause of death, which is a mandatory entry, whereas

the concluding line indicates the underlying cause. Additionally, both sections include a column designed to estimate the duration from the onset of a condition to the time of death [18].

The domain of Civil Registration and Vital Statistics (CRVS) within Public Health encompasses data related to live births, deaths, and fetal deaths. Live births are defined as the complete expulsion or extraction of a product of conception from the mother, regardless of the length of the pregnancy, provided that the newborn exhibits signs of life, such as breathing. Deaths refer to the irreversible cessation of all signs of life occurring at any point following a live birth. Fetal death is characterized by the loss of life before to the complete expulsion or extraction of the product of conception from the mother, again irrespective of the pregnancy duration [19].

The International Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10), is an internationally acknowledged framework for the coding and classifying of diseases, health conditions, and associated health issues. This system is predominantly overseen by the World Health Organization (WHO) and fulfills various roles within the healthcare sector, encompassing epidemiological research, health administration, and clinical applications. The ICD-10 comprises three distinct volumes: Volume 1 contains a tabular list of diseases and injuries; Volume 2 serves as a coding instruction manual; and Volume 3 provides an alphabetical index of diseases [20].

The International Classification of Diseases (ICD) fulfills multiple roles within healthcare systems. It facilitates statistical analysis, offering essential data that informs public health research and policy formulation. It also plays a significant role in healthcare administration and is integral to billing and reimbursement procedures in medical environments. Furthermore, the ICD contributes to Clinical Decision Support, aiding healthcare professionals in accurately diagnosing and managing patient care [20].

The function of Verbal Autopsy within Civil Registration and Vital Statistics (CRVS) systems is essential, especially in contexts where a significant number of deaths transpire outside healthcare institutions and lack medical certification. Verbal Autopsy entails conducting systematic interviews with relatives or caregivers of the deceased to collect data regarding the symptoms, medical background, and conditions leading to the death. Subsequently, this data is evaluated through computational algorithms or by medical professionals to determine a likely cause of death.

Verbal autopsy data can be incorporated into Civil Registration and Vital Statistics (CRVS) systems to enhance the comprehensiveness and accuracy of mortality statistics, offer insights into the causes of death for individuals who pass away outside of healthcare institutions, track patterns in mortality causes, and guide health policy formulation and intervention strategies.

3. Methodology

This research was conducted as implementation research employing a participatory action research (PAR) methodology. PAR is characterized by a collaborative approach in which the researchers and the participants engage jointly throughout the entire research process [21–24]. The implementation of this study is expected to yield outcomes that align with sustainability objectives [22]. The study was conducted throughout the year 2020 at 39 Public Health Centers across Malang District, with a target of 16.857 deaths related to VA. The data utilized to support the CRVS systems initiative are derived from the Hospital Information System (SIMRS), the Health Information System Office (SIK Dinkes), and the CRVS Population Information System Office (SI Dukcapil). The participants in this study comprise decision-makers, particularly those

related to population and civil registration as well as health, policy actors, and pertinent stakeholders: subjects of the research at the district/city level include the Regent/Mayor, Regional Secretary, Development Planning Agency (Bappeda), Civil Registration and Population Office (Dukcapil), District Health Office, National Population and Family Planning Board (BKKBN), Health Social Security Agency (BPJS Kesehatan), Police, Communication and Information Office, Central Bureau of Statistics (BPS), Regional People's Representative Council (DPRD), hospitals, health professional organizations, among others. At the sub-district level, the research subjects consist of the Sub-district Head (Camat) and the Head of the Public Health Center (Puskesmas). At the village level, the subjects include the Village Head (Kepala Desa) and the Village Midwife (Bidan di Desa).

The collected data consists of quantitative information encompassing pregnancy, birth, mortality, and causes of death. Data from hospitals is obtained through the Hospital Information System (SIMRS). In contrast, community data is sourced from the Health Information System Office (SIK Dinkes), the Civil Registration Information System Office (SI Dukcapil), and verbal autopsy methods. The qualitative data, which includes in-depth interviews and focus group discussions (FGD), was collected from informants according to the sample framework developed collaboratively with the team and colleagues. The gathered data was analyzed using ODK Collect and SMART VA software for the VA data, while the MCCD data was manually entered into an Excel program. Subsequently, the data was cleaned and merged to create graphical representations.

4 Results

Table 1. CRVS Implementation Assessment in Malang District

No.	Dimension	Score
I	Usage compliance of the International Statistical Classification of Diseases and Related Health Problems tenth revision (ICD-10), and Medical Certificates Cause of Death (MCCD) occurring inside and outside hospitals	0.00
II	Completeness of registration of birth and death	17.0
III	Organization and function of CRVS System	33.0
IV	Data storage and distribution	33.0
V	Practices that influence data quality for cause of death	33.0
VI	Qualification and coder training, and quality of coding	50.0
VII	The Legal Framework for CRVS	67.0
VIII	Implementation of coding ICD-10	67.0
IX	Quality and data fairness check	67.0
X	Infrastructure, population, and civil registration resources	78.0
XI	Data access, dissemination, and data utility	92.0

Source: secondary data of CRVS, 2020

The CRVS reveals that Dimension I to V have a percentage score of less than 34, categorizing them as dysfunctional. Dimension VI scores between 34 and 64, placing it in the

weak category. Dimension VII, through X, scores between 65 and 84, categorizing them as functional but inadequate, while Dimension XI scores between 85 and 100, categorizing them as satisfactory (Table 1).

Table 2. Mortality Rate/Ratio and Life Expectancy in Malang District

Mortality Rate	Male and Female	Male	Female
CDR per 1,000 population	6.18		
Life expectancy at birth (years)	75.7 (95% CI: 75.6 – 75.9)	74.9	76.5
Infant mortality rate per 1,000 live births	11.4 (95% CI: 10.3 – 12.6)		
Under-5 mortality rate per 1,000 live births	13.9 (95% CI: 12.6 – 15.2)		
Maternal Mortality Ratio per 100,000 live births			136

Source: secondary data of CRVS, 2020

In Table 2, the Civil Registration and Vital Statistics (CRVS) indicates that the crude death rate for the population of Malang District in 2020 was 6.18 per 1.000. The life expectancy for residents of Malang District in the same year was 75.7 years, with females exhibiting a higher life expectancy (76.5 years) compared to males (74.9 years). The Infant Mortality Rate (IMR) was 11.4 per 1,000 live births, with a 95% confidence interval ranging from 10.3 to 12.6. The Under-Five Mortality Rate (U5MR) was 13.9 per 1,000 live births, with a 95% confidence interval of 12.6 to 15.2. Maternal Mortality Ratio (MMRa) in Malang District was 136 per 100,000 live births, which is lower than the national average of 189 per 100,000 live births.

According to data from the Civil Registration and Vital Statistics (CRVS), it has been reported that three-quarters of death cases, or over half, occur at home, accounting for 74.59%. In contrast, only 2% of deaths occur in community health centers or clinics (see Table 3).

Table 3. Cases by Death Scene in Malang District (n=18,130)

Death Scene	Number	Percent (%)
Public Health Centers/Clinics	4	0.02
Death on Arrival (DOA)/roads	167	0.92
Home	13,524	74.59
Hospitals	4,435	24.46
Total	18,130	100.00

Source: secondary data of CRVS, 2020

Table 4. Ten highest Causes of Death by Diagnose of Disease based on Verbal Autopsy Method in Malang District (n=13,530)

No.	Diagnose of disease	Number	%Total case
1	Ischemic heart diseases	2,985	22.1
2	Cerebrovascular diseases	2,484	18.4
3	Diabetes mellitus	1,294	9.6
4	Chronic lower respiratory diseases	693	5.1
5	Falls	344	2.5
6	Other acute lower respiratory infection	218	1.6
7	Other non-communicable diseases	210	1.6
8	Respiratory tuberculosis	181	1.3
9	Diseases of the liver	148	1.1
10	Transportation accidents	139	1.0

Source: secondary data of CRVS, 2020

Table 4 identifies not only the primary cause of death, as determined by verbal autopsy results, is Ischaemic Heart Disease, accounting for 22.1%, following Cerebrovascular diseases at 18.4%, Diabetes Mellitus at 9.6%, and Chronic lower respiratory diseases at 5.1% but also reported that Non- Communicable Diseases contribute to more than half of the mortality cases, with a contribution of 50.1% as tracked by the verbal autopsy method.

Table 5. Ten Highest Diagnose Causes of Death by Using VA and MCCD in Malang District (n=18.130)

No	Cause of Death	Number	%Total case
1	Cerebrovascular diseases	3,142	17.3
2	Ischemic heart diseases	3,141	17.3
3	Diabetes mellitus	1,593	8.8
4	Chronic lower respiratory diseases	800	4.4
5	Remainder of disease of the genitourinary system	488	2.7
6	Falls	348	1.9
7	Other heart diseases	319	1.8
8	Pneumonia	309	1.7
9	Respiratory tuberculosis	285	1.6
10	Other acute lower respiratory infections	230	1.3

Source: secondary data of CRVS, 2020

The results of the CRVS tracking utilizing the VA and MCCD methods indicate that approximately 43.4% of the top three leading causes of death are attributed to non-communicable diseases, specifically cerebrovascular diseases, ischemic heart diseases, and diabetes mellitus. In contrast, less than 10% of deaths are due to communicable diseases. The proportion of deaths from communicable diseases is less than one-fifth of the mortality observed (See Table 5).

Table 6. Nine Highest Cause of Death for Neonatal in Malang District (n=164)

No	Cause of Death	AV		Hospitals		Total	
		n	**%**	**n**	**%**	**n**	**%**

1.	Complications of Intrapartum events (P20-P21)	10	35.7	54	39.7	64	39.0
2.	Infection (P23)	5	17.9	18	13.2	23	14.0
3.	Respiratory and cardiovascular disorder (P22, P24)	-	0.0	22	16.2	22	13.4
4.	Low birth weight and prematurity	10	35.7	6	4.4	16	9.8
5.	Miscellaneous	-	0.0	16	11.8	16	9.8
6.	Congenital malformations, deformations, and chromosomal abnormalities	3	10.7	9	6.6	12	7.3
7.	Other neonatal conditions	-	0.0	8	5.9	8	4.9
8.	Neonatal death of unspecified cause	-	0.0	2	1.5	2	1.2
9.	Convulsions and disorders of cerebral status	-	0.0	1	0.7	1	0.6
	Total	28	100.0	136	100.0	164	100.0

The results of the Civil Registration and Vital Statistics (CRVS) indicate that 39.7% of neonatal mortality (0-28 days) is attributed to complications arising from intrapartum events. This is followed by infections at 14.0%, respiratory and cardiovascular disorders at 13.4%, low birth weight and prematurity at 9.8%, and other miscellaneous causes at 9.8% (See Table 6).

5 Discussion

This section discusses five crucial perspectives: the assessment of CRVS implementation, mortality rate, life expectancy profiles, scene of death, and cause of death (by AV and MCCD methods, and by neonatal death).

Initial findings indicated that the Civil Registration and Population Agency (Dukcapil) continues to utilize paper forms for Death Reporting (F2.28) and Death Certificates (F2.29). Consequently, many deaths among the Population are not accurately recorded. Additional issues include the absence of clear documentation regarding the causes of death on these forms, as well as the lack of adherence to the international standard disease and cause of death coding system (ICD-10). It is essential to employ specialized coders who can collaborate with the Malang District Health Office to address these deficiencies.

Compliance with the utilization of ICD-10 needs to be improved. Healthcare professionals, specifically coders, frequently encounter challenges in accurately and comprehensively determining disease classifications within the ICD-10 framework, predominantly in English. This situation underscores the necessity for structured and continuous training in ICD-10 for coders. Additionally, the compliance rate among physicians and clinicians in using the Medical Cause of Death Certificate (MCCD) is also low. Implementing training programs for MCCD

completion for doctors in community health centers and hospitals is essential to enhance their skills and competencies in filling out MCCD forms. This training will facilitate the electronic entry of data (eMCCD) and ensure a systematic reporting process from villages to districts within the integrated Smart Health UB system.

Nevertheless, the level of compliance among healthcare professionals in utilizing ICD-10 and MCCD is closely linked to the providers' ability to deliver healthcare services and the complexity and types of diagnoses present in the MCCD forms. This finding aligns with research indicating that compliance with ICD-10 usage is significantly related to determining patient care costs and classifying diagnoses within healthcare provider services [30]. Several studies have reported that the completion rates for MCCD categories need to be improved (45.28%) and inaccurate (55.17%) [25,26]. In contrast, other research has indicated no significant relationship between the completeness of medical record documentation and the accuracy of ICD-10 and ICD-9 coding [27], despite the practical correlation between coding accuracy and the thoroughness of medical records.

To date, the implementation of the Medical Certificate of Cause of Death (MCCD) forms, both in paper (MCCD form) and electronic (eMCCD) formats, has not been adopted for every case of death and its causes. This has resulted in numerous unreported causes of death. Additionally, it is essential to translate these forms into Indonesian to facilitate comprehension of the form's content. Training sessions on MCCD should be conducted for healthcare professionals, covering the use of eMCCD, disease coding, cause of death coding, and reinforcing compliance among personnel in coding diseases and causes of death. Furthermore, the integration of MCCD forms into applications such as HIMS, HIS Malang District, IS Dukcapil, and Smart HealthUB is crucial for enhancing the CRVS system, particularly concerning the completeness of birth and death registrations, as well as the necessary infrastructure and resources for civil registration.

Access to data, dissemination, and utilization of data have been effectively implemented. Subsequently, the health department has published annual birth data categorized by gender, age, and sub-district on the website dinkes.malangkab.go.id. In contrast, the civil registration office has yet to present data across the three categories of gender, age, and geographic location. Additionally, data is available on the dashboard of malangkab.go.id; however, the publication of statistics regarding the causes of death is updated annually. According to the agreement, the dashboard will be updated to reflect monthly data on births and deaths.

In addition, the calculation of mortality rates and Life Expectancy (LE) conducted in Malang Regency utilized life tables and the Analysis of Cause of Death (ANACOD) application, following guidelines established by the International Health Metric Evaluation (IHME). The results, which integrated various tools for assessing Maternal Mortality Rates in Malang Regency based on the 2020 CRVS, indicated 136 per 100,000 live births. This figure is lower than the national average of 189 per 100,000, as reported in the 2020 SUPAS [28]. Nationally, Malang District remains among the regions with the highest maternal mortality ratio in East Java.

The findings from the 2020 CRVS indicate that 75% of deaths occurred at home, with only a tiny fraction taking place in community health centers or clinics [29]. This observation aligns with the results of a Sample Registration System (SRS) study conducted in Kulonprogo District, which reported that deaths occurred at home (68.42%), in hospitals (29.24%), and other locations (2.34%) [30]. Several key factors contributing to the high incidence of home deaths can serve as guidelines for health service delivery: 1) elderly individuals often face mobility limitations(disabilities); 2) they frequently suffer from chronic illnesses such as heart disease, stroke, diabetes, and tuberculosis, which receive inadequate attention due to a lack of awareness

regarding their severity and adverse effects on the health of older adults; 3) limited access to healthcare providers, often influenced by geographical, social, and economic factors; 4) family decision-making is frequently linked to insufficient literacy regarding non-communicable diseases and warning signs of serious illnesses; and 5) suboptimal death recording practices by healthcare professionals, compounded by low literacy regarding the use of verbal autopsies, disease coding, and causes of death, as well as the application of the MCCD.

It is essential to emphasize that an important factor that should not be overlooked concerning the high mortality rates at home is the enhancement of the husband's role, the involvement of close family members, and the active participation of healthcare professionals through home visits and early detection of catastrophic diseases, particularly non-communicable diseases, at the primary healthcare facility level.

According to a verbal autopsy study conducted in Malang District in 2020, the primary cause of death identified was ischemic heart disease, followed by cerebrovascular diseases, diabetes mellitus in third place, and chronic lower respiratory diseases in fifth place [29]. A Previous study of data from 2014 to 2017 indicated that the completeness of mortality data ranged from 55% to 72%, with cardiovascular diseases, diabetes, chronic obstructive pulmonary diseases, tuberculosis, and transport accidents recognized as the leading causes of death [31]. This trend highlights a significant prevalence of non-communicable diseases, particularly cardiovascular and chronic metabolic disorders, which have shown a marked increase in the community over the past decade. The 2018 RKD study revealed a rise in the prevalence of non-communicable diseases compared to the 2013 Riskesdas, with notable increases in cancer, stroke, chronic kidney disease, diabetes mellitus, and hypertension. Specifically, the prevalence of cancer increased from 1.4% to 1.8%, stroke from 7% to 10.9%, and chronic kidney disease from 2% to 3.8% [32]. The 2023 Indonesian Health Survey (SKI) reported a national prevalence of heart disease at 0.85% and diabetes mellitus at 1.7%. A study indicates that the prevalence of cardiovascular risk factors is associated with social determinants of health [33–36]. Therefore, it is crucial to prioritize promotional and preventive efforts in health literacy regarding healthy lifestyle choices, including dietary habits, physical activity, and regular health check-ups, starting within the home environment.

The incidence of deaths categorized as ill-defined diseases is less prevalent in the data obtained from hospital records. This suggests that the process of filling out the MCCD is performed adequately. Nevertheless, with an absolute count of 340 cases from a total of 4,600 deaths, there is still a necessity to improve the training and capacity for MCCD completion among healthcare professionals in hospitals.

In the context of the JKN program, BPJS Kesehatan has identified eight diseases that incur the highest catastrophic claims. These diseases are heart disease, cancer, stroke, renal failure, hemophilia, thalassemia, leukemia, and liver cirrhosis. The financial burden of these illnesses on health insurance reached IDR 34.7 trillion in 2023 [37].

Furthermore, according to the 2020 CRVS data for Malang District, it has been reported that nearly 40% of neonatal deaths (0-28 days) are attributed to complications arising from intrapartum events, followed by infectious diseases, cardiovascular conditions, and premature births [29]. Empirical evidence from several prior studies in Nepal, which employed the VA tracking methodology, indicates that sepsis is the leading contributor to neonatal deaths, representing 47.0% of the total. Subsequent causes include birth asphyxia at 16.6%, preterm birth at 13.3%, and low birth weight at 5.0% [38]. Globally, the leading direct causes of neonatal death are estimated to be preterm birth (28%), severe infections (26%), and asphyxia (23%).The neonatal stage accounts for around 77% of all mortality cases [39]. Another study indicates that the underlying causes of death include complications arising from intrapartum events (31%),

complications related to prematurity (28%), infections (17%), respiratory disorders (11%), and congenital malformations (8%) [40]. According to the data, Indonesia's neonatal mortality rate (NMR) decreased from 11 per 1,000 live births in 2020 to 8 per 1,000 live births by 2030 [41]. Given the prevalence of mortality cases during the neonatal phase, it is essential to develop a Newborn Early Warning System (NEWS) to predict emergencies in newborns and thereby reduce neonatal mortality rates.

Finally, the critical role of implementing a robust healthcare service system is evident through integrating the VA in the Maternal and Child Health (KIA) regional regulation. This involves improving midwives' skills in maternal health services, increasing the application of USG in 39 community health centers through targeted training for general practitioners, midwives, and nurses, and elevating the budget for the Health Operational Assistant (BOK) sub-program KIA, with a particular focus on VA activities in primary healthcare facilities and community contexts.

6 Conclusion

Coding personnel must adhere more closely to utilizing digital ICD-10 and MCCD to determine the codes for disease and mortality causes and manually enter data into the MCCD forms. Birth and death registration are underutilized in the integrated application system involving civil registration, population, and district health offices. The leading cause of death associated with the use of VA was predominantly attributed to non-communicable diseases.

The majority of deaths occur at home, with only a small number of fatalities reported in healthcare settings. Close to 40% of deaths among neonates are caused by complications that occur during intrapartum events. More proactive stakeholder engagement is needed regarding their commitment and coordination in implementing Civil Registration and Vital Statistics (CRVS). More financial resources are needed to integrate VA into the community. More human resource support is needed to apply VA technologies and mobile community care delivery (MCCD) in hospitals, primary healthcare facilities, and community organizations.

7 Limitations of the study

Referring to NHI's catastrophic perspective, no data collected from the study explains the association among death cases with verbal autopsy methods in communities and health insurance memberships by segment. Therefore, further research aims to integrate the Social Health Insurance Administration Body (BPJS Kesehatan) and VA data to conduct a National Health Insurance (JKN) catastrophic analysis linked to them.

Ethics Approval

The Health Research Ethics Committee, National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia, issued a recommendation for study ethics approval with the number LB.02.01/2/KE.279/2020, dated 14 April 2020.

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