Strategy to Improve Quality of Medical Certificate of Cause of Death: An Analysis of Mortality Surveillance Data DKI Jakarta Province, Indonesia 2016-2019

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Abstract

Medical certificate cause of death (MCCD) data is an important source of information for public health monitoring, priority setting, and planning. The completeness and accuracy of data on the cause of death affect the value of the policies adopted. Poor-quality data can lead to missed opportunities to improve the health of the population. This study aims to obtain a strategy to improve the quality of data on MCCD. We used DKI Jakarta province mortality surveillance data, which was collected from health facilities. The death cases from 2016 to 2019 and the deceased who lived in the DKI Jakarta area were selected. The Analysis of National Causes of Death for Action (ANACONDA) software 5.0 was used to determine the quality of the MCCD data
Results: The number of Health Facilities sending data from 2016 to 2019 has increased. Annual percentages Garbage Code (GC) tend not to change (more than 50%). GC in categories 3, 5, and 1 tend to be stable with an annual average of 34%, 26%, and 21%. Meanwhile, Category 4 tends to increase though it is small (from 5.7 to 14.4%). Based on the potential impact that GC causes in guiding or misguiding public policy to prevent, more than 60% is identified as being in the very high-level category.
Conclusion: Identifying the accuracy of cause of death data was needed to make the right strategy for improving the quality of data.

Keywords
Keywords: Quality data, Cause of Death, Garbage Code, DKI Jakarta, Indonesia

1. Introduction
Cause-specific mortality data is important to monitoring progress towards national and international health goals, including the Sustainable Development Goals (SDGs). 17 SDGs indicators, require cause-specific mortality data from a Civil Registration and Vital Statistics (CRVS) system for their measurement (Rao *et al.* 2005; AbouZahr 2011; Bauni *et al.* 2011; Murray *et al.* 2011; Sartorius 2013; Miki *et al.* 2018; Adair *et al.* 2021). All countries are committed to SDG, However, not all countries including Indonesia have a good CRVS system. The availability of mortality data at the national level is obtained through surveys (NIHRD 2015; Indriasih 2017). Meanwhile, since 1999 based on Indonesian law, Indonesia has begun to implement a decentralized system. Districts or provinces have the autonomy to manage and regulate the government, so data needs at the regional level are indispensable for planning, monitoring, and evaluating their programs. Until now, there has been no publication regarding the availability of routine data on causes of death at the provincial or district/city level in Indonesia. There is little information on mortality data, perhaps only DKI Jakarta Province has mortality surveillance.

DKI Jakarta Province has a population of about 10.5 million people, the Crude Death Rate (CDR) is 4.9 per 1000, so it is estimated that every year it will record around 52,100 deaths spread across 6 districts (BPS (Statistics Indonesia),

2018; DKI Jakarta Provincial Health Office 2020). The cause of death is reported by health facilities, both hospitals, and health centers through a mortality surveillance system. According to the health profile DKI Jakarta Province, the number of health facilities in 2019 had 170 hospitals and 334 Puskesmas. Determination of the cause of death is carried out by physicians, the hospital it is based on clinical records, while at the Puskesmas it is based on a verbal autopsy. Determination of the cause of death using coding rules of the International Classification of Diseases Revision in force (ICD-10), Not all physicians receive MCCD training, due to limited resources. Maybe only a small percentage of them have received training. It is hoped that these physicians will socialize the results of the training to other physicians in the health facilities where they work.

Data should guide governments as they plan, budget, and act for health. Good accuracy will be able to direct good policies. (Rao *et al.* 2005; AbouZahr 2011; Bauni *et al.* 2011; Murray *et al.* 2011; Miki *et al.* 2018; Suthar *et al.* 2019). several studies have shown that policies and practices in many countries are based on data that is far from accurate. Several countries have used the ANACONDA (Analysis of Causes of National Deaths for Action) tool to evaluate their data. a common problem is the poor quality of the MCCD data by discarding the garbage code (GC) (Kim *et al.* 2008). Good knowledge of the problem of the data ultimately aims to improve the quality of the MCCD data. Although the DKI Jakarta MCCD data is not nationally representative, it can be used to learn and obtain strategies to strengthen and improve the quality of MCCD data.

1.1 Objectives

This study aims to identify the garbage code pattern to obtain a strategy to improve the quality of medical certificate of cause of death data in Indonesia

2. Literature Review

Mortality statistics are one of the most important sources of health information and the most reliable type of health data in many countries. This data is used to monitor public health developments, plan premature death prevention programs and determine program priorities (AbouZahr 2011; Bauni *et al.* 2011; Murray *et al.* 2011; Miki *et al.* 2018). Ideally, the data can be obtained from the population registration system (Adair *et al.* 2021). However, in many countries, the population registration system is still poor, so data needs are sought through other methods. Indonesia does not yet have a good population registration system, especially in recording deaths. (NIHRD 2015; Indriasih 2017). Determination of the cause of death is carried out by doctors using a standard form, namely: the Medical Certificate of Cause of Death (MCCD). When two or more causes of death are recorded, the medical certificate shown below is intended to aid in the selection of the underlying cause of death (UCOD). MCCD form has 2 parts. Part I of the form is for diseases that are directly related to death, and Part II is for unrelated but. Despite the very clear rules of ICD-10, however, many studies show that errors (misclassification garbage code) in death certification are common.(França *et al.* 2020; Naghavi *et al.* 2020; Adair *et al.* 2021).contributing conditions. In completing the medical certificate of cause of death, the medical practitioner or other qualified certifiers should use clinical judgment(WHO 2005).

The poor quality of global MCCD data is not solely due, as is commonly assumed, to the high proportion of deaths occurring in the community, away from hospitals and physicians. A systematic review of studies on the quality of hospital death certificates concluded that physicians in hospitals routinely misdiagnosed UCOD(Mikkelsen *et al.* 2020). In general, a major problem with UCOD data is the poor cause of death certification practices that result in 'garbage codes', i.e. codes that provide little or no information about the true underlying cause of death (Naghavi *et al.* 2010). The major consequence of garbage codes is that they obscure the true mortality pattern in a population. For example, when septicemia is defined as UCOD without any information on the cause of the septicemia such as from a wound infected after an accident, from a postoperative amputation due to diabetes, or meningitis. or pneumonia, it will be difficult to formulate policies to prevent these deaths, potentially leading to inefficient allocation of resources to prevent them. (Iburg *et al.* 2020)

Providing quality mortality data (representative and accurate) is a big challenge for all of us. To improve the quality of mortality data, the first thing to do is evaluate existing data to identify problems. Many countries have used the ANACONDA (Analysis of Causes of National Deaths for Action) tool to assess data. ANACONDA tool has been developed by the Bloomberg Data for Health (D4H) Initiative at the University of Melbourn. The main function of ANACONDA is to allow countries to comprehensively assess the accuracy and completeness of their mortality and COD data, it can be used for many other purposes.

ANACONDA divides this GC into five categories(Naghavi *et al.* 2020):. which are;

Category 1: "Symptoms, signs and ill-defined conditions as the cause of death" mostly drawn from the ICD-10 Chapter XVIII codes or R codes.
Category 2: "Impossible as underlying causes of death" including conditions such as essential hypertension and atherosclerosis as well as causes which are the long-term sequelae of various diseases.
Category 3: "Intermediate causes of death" being diseases or injuries that have been precipitated by an underlying cause (e.g. heart failure).
Category 4: "Immediate causes of death" such as cardiac arrest or respiratory failure.
Category 5: "Insufficiently specified causes of death within ICD Chapters" partially informative causes such as causes within a larger cause of death category, e.g. malignant neoplasm without specification of site, or unspecified vehicle accidents.

ANACONDA also categorizes the GC into four levels of severity according to their potential impact on misguiding public policy and planning. ANACONDA show how causes with Severity Levels. These severity levels are defined as follows (Naghavi *et al.* 2020):
Level 1 (very high) – codes with serious policy implications. These are causes (e.g. septicemia) for which the true UCOD might belong to any one of three broad cause groups: communicable or non-communicable diseases, or injuries. We simply don't know. Such errors potentially grossly misinform understanding of the extent of an epidemiological transition in a population.
Level 2 (high) – codes with substantial policy implications. These are causes for which the true UCOD is likely to belong to one, or at most two, of the three broad groups, (e.g., essential primary hypertension). While not greatly altering the understanding of the broad composition of mortality in a population, these codes might considerably affect the comparative importance of leading causes within broad disease categories.
Level 3 (medium) – codes with important policy implications. These are causes for which the true underlying UCOD is likely to be within the same ICD chapter. For instance, 'unspecified cancer' still identifies the death as being attributed to cancer, and thus has some policy value, although greater type (site) specificity is required because different strategies are applied for different sites of cancer (e.g. breast versus lung).
Level 4 (low) – codes with limited policy implications. These are diagnoses for which the true UCOD is likely to be confined to a single disease or injury category (e.g. unspecified stroke would still be assigned as a stroke death). The implications of unusable causes classified at this level will, therefore, generally, be much less important for public policy.

3. Methods

The purpose of this research is to develop strategies for improving the accuracy and utility of DKI Jakarta Province MCCD data. The strategy is developed by identifying the garbage code issue that must be addressed. We assessed the quality of data on age, gender, and underlying cause of death using the computer application Analysis of National Causes of Death for Action (ANACONDA) version 5.0.
ANACONDA is used in four steps.

Step 1, Data Preparation To clean and prepare data for further analysis, data preprocessing is required. The analysis is limited to deaths that occurred in the DKI Jakarta area between 2016 and 2019. The deceased's information, such as missing age and gender, should be supplemented or excluded from the dataset.
Step 2, Tabulate data using the ANACONDA data input template. The data input template consists of two data input sheets: the **Mortality Data** worksheet and the **Population Data** worksheet. For population data, we use Indonesia Population Projection 2015-2045.
Step 3, Import data into ANACONDA 5.0
Step 4, to find out the completeness of the data.
Step 5, According to ICD rules, ANACONDA identifies garbage codes that are invalid as underlying causes of death (UCOD).

4. Data Collection

This study uses mortality surveillance data belonging to the DKI Jakarta Province and population data obtained from the projections carried out by Statistics Indonesia (BPS). Data was used with the permission of the Provincial Health Office. Data is collected by the provincial health office from health facilities, namely health centers, and hospitals online through the provincial service web. For deaths that occur outside the health facility, the assignment of the cause of death is carried out by the Puskesmas using a verbal autopsy. all causes of death are carried out by physicians. This study uses data on the deaths of residents living in DKI Jakarta and deaths that occurred from 2016 to 2019.

5. Results and Discussion

Completeness

Based on the mortality surveillance data of DKI Jakarta Province, there is a significant increase in the response rate of health facilities. For hospitals, from 58% in 2016 to 79% in 2019, while for Puskesmas from 25% to 52%. Indeed, in the beginning, only a few puskesmas did verbal autopsies, due to certain project activities. However, gradually other puskesmas followed suit to perform a verbal autopsy on orders from the provincial health office. So there is an increase in the response rate of health facilities is significant with an increase in the number of death data and also completeness. The number of deaths that have a cause of death increased from 27,180 cases to 41,577 cases. Furthermore, with the estimated Crude Death Rate (CDR) in 2015 of 4.2 per 1000 and 2020 of 4.9 per 1000 (BPS (Statistics Indonesia), 2018), the completeness in 2015 was 65.4% and in 2019 was 81.5%. (see table 1). Progress in the completeness of data is quite encouraging, this condition is slightly above global conditions, which is only about two out of three deaths recorded worldwide (Adair *et al.* 2021).

In many countries, the only COD data available is from hospitals, this is not the case in Indonesia. Based on the Hospital Information System template managed by the Ministry of Health, hospitals are not yet required to report cases of death with the cause of death. Death data reported are deaths above or below 48 hours, and in the morbidity report, it is reported the number of patients based on the diagnosis of illness (not the cause of death) who were discharged from the hospital in a state of death, not differentiated by age and sex (Kementerian Kesehatan 2011). Procurement of this data is a big challenge for the Indonesian government. Policies and coordination between the central and local governments are needed so that each hospital must make MCCD for every case of death.

Efforts to improve the completeness of data from hospitals must be carried out in parallel with death data outside hospitals, more than 50% of deaths in Indonesia occur outside hospitals (NIHRD 2015; Indriasih *et al.* 2020). The collection of out-of-hospital mortality data is a major challenge for local governments. Decentralized systems and different cultures, will lead to variations in the collection of mortality data. Data collection in urban areas is different from rural areas, for example, limited land for burials in urban areas will have an impact on the number of recorded deaths because a letter is required as an administrative requirement in burying bodies. Furthermore, the Puskesmas or other parties can perform a verbal autopsy to determine the cause of death. The cooperation of the village government, community leaders, religion and customs as well as the puskesmas is needed to obtain death data. For DKI Jakarta Province, the Provincial Health Office can provide periodic notifications to hospitals or health centers to enter death data through the existing surveillance system.

Garbage Code (GC)

In MCCD, there may be several causes of death. However, an international agreement is that the main tabulation for the cause of death is the underlying cause of death. So the final result of MCCD is to have an underlying cause of death. The underlying cause of death is needed for the needs of early death prevention policies. In this article, the quality of the MCCD data is demonstrated by looking at the garbage code (GC) pattern. Table 1 shows that more than 50% of the mortality surveillance data is garbage coded. This condition tends to have no significant changes from 2016 to 2019. This proportion of GC is greater than the Indonesian Sample Registration System (SRS) data in 2014 (31%) (Indriasih *et al.* 2020). Although larger, the proportion of GC is similar to the results of studies conducted on mortality data from 20 countries, GC being in the range of 7-66%. Finland had the lowest proportion of GC (7%), while Egypt had the highest proportion of GC(66%). (Iburg *et al.* 2020). The distribution of GC from surveillance data for the DKI Jakarta province tends to be the same every year, the most identified GCs are in category 3 (Intermediate causes of death) followed by category 5 (Insufficiently specified causes within ICD Chapters) and category 1 (symptoms, signs and ill-defined conditions). In category 3, it is not the underlying cause determined by the physicians but the intermediate cause. Intermediate causes are conditions that occur due to underlying diseases such as heart failure, septicemia, peritonitis, osteomyelitis, and pulmonary embolism. This composition is different from the 2014 SRS data condition where the largest proportion of GC is in category 5, namely the cause of death made by physicians is not specific, such as cancer cases where the location of the cancer is not written, stroke is not specific and injury cases do not mention the cause of the injury.

Table 2 shows that there is no significant change in the distribution of garbage codes according to their potential impact on misguiding public health policy by severity. Every year, more than 30% of DKI Jakarta's MCCD data is identified as garbage code which has the potential to cause serious policy impacts (level 1: very high). In this category,

we find many less informative causes, such as septicemia, ill-defined, shock & cardiac arrest. In the case of septicemia, when septicemia is defined as UCOD without any information on the cause of the septicemia such as from a wound infected after an accident, from a postoperative amputation due to diabetes, or from meningitis, or pneumonia, it will be difficult to formulate policies to prevent these deaths, potentially leading to inefficient allocation of resources to prevent them(Iburg *et al.* 2020).

In the case of DKI Jakarta MCCD, to improve data quality, it is better to prioritize by reducing GC which causes serious policy impacts. Table 3 lists the top 5 included in the GC that have serious policy impacts. The highest GC category is the impossible cause for death group, the codes included in this group are mostly R codes, and the most are R99.- (other ill-defined and unspecified cause of mortality), R98.-(unattended dead); R96.- (other sudden death, cause unknown). Other codes outside the R code are mostly E16.- (Other disorders of pancreatic internal secretion) and K30 (Dyspepsia).

Further analysis identified GC by age group, sex, and severity of its effects (see table 4). In general, most of the GC is at a very high level. GC mostly occurs in the age group above 5 years. The Garbage Code of men is much higher than that of women (with a difference of almost 15%). the 5-65 year age group was identified as having the largest proportion every year (> 20%), even in men in 2019 GC reached 31%. In the ANACONDA guidelines, it is stated that, if there are more than 15-20% of the total GC occurs in the age group under the age of 65 years, this indicates that there is a serious problem due to data input, physicians have difficulty in confirming the cause due to comorbidities. Another condition is death at home, the information obtained is very minimal so it leads to an unclear diagnosis and ill-defined diagnoses of the underlying cause of death.

The GC in this surveillance data tends to be the same every year, an indication that there is no evaluation or feedback to physicians regarding the results of determining the cause of death they made. evaluation of the quality of mortality data should ideally be at the facility level (Nyondo *et al.* 2021). Routine national and sub-national (eg district/provincial) audits can be carried out with tools such as ANACONDA to comprehensively assess data quality. The most reason that causes poor quality mortality data is that physicians do not understand how to fill in death certificates correctly (Mikkelsen *et al.* 2020).

Evaluation and improvement of the training system by looking at training conditions, such as duration of training (how many contact hours), the target group for training (physicians), number of participants (in the classroom), trainer qualification, and material of training (Gross *et al.* 2019). The qualifications of the trainers should be reviewed, regarding literacy and communication skills to deliver the material. Lack of literacy and communication skills will potentially make teaching less informative so that trainees do not understand the material presented. The understanding of the basic causes of death according to the ICD-10 needs to be strengthened again, by increasing the hours of lessons, practice case studies, and discussions. The discussion will be optimal with a class that is not too large, with 5-15 participants(Gross *et al.* 2019). GC is one indicator of data quality. Submission of GC, including codes and their effects, is expected to add to a better understanding of the accuracy of the underlying cause of death and the effect of decreasing GC. A good understanding will give positive effects on improving the quality of MCCDs and, accordingly, on the quality of country mortality statistics(Nyondo *et al.* 2021). On the other hand, the quality of the MCCD data is also highly dependent on the physician's concern for the quality of the data. Senior physicians' guidance or instruction in determining the cause of death based on the ICD may be very beneficial in improving completeness and decreasing GC.

Table 1. Distribution of garbage code by categories and by years

Description	**2016**	**2017**	**2018**	**2019**
no of death	27,180	33,883	38,783	41,577
no of garbage	14,268	17,491	19,875	22,286
Category 1: "Symptoms, signs and ill-defined conditions"	11.8	10.3	10.2	10.7
Category 2: "Impossible as underlying causes of death"	4.6	4.8	4.1	3.6
Category 3: "Intermediate causes of death"	18.2	17.0	17.3	16.3
Category 4: "Immediate causes of death"	2.9	5.4	6.1	7.5

Category 5: "Insufficiently specified causes within ICD Chapters"	15.1	14.2	13.6	15.5
Total garbage codes	52.5	51.6	51.2	53.6

Table 2. Percentage garbage code by severity impact level

level	2016	2017	2018	2019
Very High	30.6	31.0	31.1	32.0
High	8.3	7.8	7.8	7.4
Medium	2.0	1.6	1.7	4.0
Low	11.6	11.3	10.7	10.3
Total garbage codes	52.5	51.6	51.2	53.6

Table 3. Top 5 leading packages cause of death in very high severity impact

Rank	2016	2017	2018	2019
1	impossible cause for death	impossible cause for death	impossible cause for death	impossible cause for death
2	septicemia	Cardiac Arrest & Shock	Cardiac Arrest & Shock	Cardiac Arrest & Shock
3	Cardiac Arrest & Shock	septicemia	septicemia	septicemia
4	Left Heart failure	Left Heart failure	Left Heart failure	Left Heart failure
5	Acute Respiratory Failure	Senility	Acute Respiratory Failure	electrolyte & acid-base disorder

Table 4. age and sex distribution of total garbage codes in each severity impact level

	< 5 years				***5-64 years***				***65 +***				***all age***			
	2016	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**
males																
very high	2,5	2,0	2,0	1,7	19,4	20,3	19,7	19,2	11,7	12,9	13,5	13,7	33,6	35,2	35,2	34,6
high	0,4	0,3	0,2	0,1	4,9	5,1	4,4	4,1	3,5	3,6	3,9	3,7	8,8	9,0	8,5	7,9
medium	0,2	0,2	0,1	0,2	1,2	1,0	1,1	2,5	0,9	0,6	0,7	1,6	2,3	1,8	1,9	4,3
low	1,0	1,0	0,8	0,7	6,2	0,1	5,6	5,0	5,1	5,2	5,5	4,7	12,3	6,3	11,9	10,4
	4,1	3,5	3,1	2,7	31,7	26,5	30,8	30,8	21,2	22,3	23,6	23,7	57,0	52,3	57,5	57,2
female																
very high	1,7	1,3	1,5	1,2	12,1	12,6	12,3	12,5	11,0	10,8	11,7	11,0	24,8	24,7	25,5	24,7
high	0,3	0,2	0,1	0,1	3,2	2,7	2,9	2,6	3,5	3,3	3,5	3,1	7,0	6,2	6,5	5,8
medium	0,2	0,1	0,1	0,1	0,9	0,7	0,6	1,8	0,6	0,5	0,5	1,2	1,7	1,3	1,2	3,1
low	0,8	0,6	0,6	0,5	4,9	4,4	4,0	3,9	4,6	4,5	4,4	4,3	10,3	9,5	9,0	8,7
	3,0	2,2	2,3	1,9	21,1	20,4	19,8	20,8	19,7	19,1	20,1	19,6	43,8	41,7	42,2	42,3

6. Conclusion

DKI Jakarta MCCD data has poor quality and there is no significant change for 4 years. More than half of the MCCD data were identified as garbage codes and most of them were categorized as having serious impacts on public policy. The GC by age group also describes a serious problem. To avoid prolonged problems, in the future must have a better strategy. Evaluation of data quality needs to be done regularly, coordination is very important to improve data completeness. reduce GC and will ultimately improve MCCD data quality. Reducing GC can be done by improving the training system. The magnitude of the problem requires an evaluation of the training system as well as the implementation of cause of death certification. Re-evaluate the competence of the trainer, methods, materials, duration of the training, and also the trainees. The addition of GC material during training needs to be done to provide a better understanding of the accuracy of MCCD data.

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Biography

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