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Opinion

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International comparisons of COVID-19 deaths in the presence of comorbidities require uniform mortality coding guidelines

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Background

The World Health Organization's (WHO's) International Form of Medical Certificate of Cause of Death (CoD)—henceforth, death certificate—records a causal chain of pathological events to identify the pre-existing disease conditions that ultimately led to death.[1] The death certificate consists of two parts—Part I and Part II that record the diseases leading directly to death and the diseases contributing to death, respectively. Part I carries only one Underlying Cause of Death (UCoD); further, the UCoD is distinguished from the 'Immediate Cause of Death' (ICoD), also known as the 'condition directly leading to death'. The ICoD and UCoD are mentioned on the first and last lines of Part I, respectively. Death certificates have the same structure in all of WHO's participating countries, despite the use of different languages; see examples in the supplementary material, available as Supplementary data at *IJE* online. In 1948, the Sixth Decennial Revision Conference for the International Classification of Diseases (ICD) agreed to use the UCoD for computing mortality statistics.[1]

On 25 March 2020 the WHO mandated two ICD-10 codes worldwide to classify deaths related to COVID-19:

i. U07.1 for those confirmed with a positive laboratory test of COVID-19, and
ii. U07.2 for those when COVID-19 was diagnosed clinically or epidemiologically, but not via a laboratory test.[2]

On 20 April 2020 the WHO updated these guidelines and, in an effort to collect more data for COVID-19, requested countries to emphasize a 'public health interest' rather than a 'purely medical interest'.[3] To this end, the WHO recommended the use of a provisional U07.1—even when COVID-19 testing was not confirmed in a laboratory—in countries where laboratory confirmation is not mentioned on death certificates.[3]

Two examples

Pre-existing conditions and comorbidities—such as hypertension, diabetes mellitus, chronic obstructive pulmonary disease (COPD) and obesity—are significantly correlated with COVID-19.[3,4] The WHO requires reporting of such chronic comorbidities—that contributed to death but were not directly responsible for it—in Part II. The following two examples demonstrate how the choice of the ICD-10 code employed on the death certificate—COVID-19 or the associated comorbidity—has a major impact on the official national statistics of COVID-19.

Guidelines released by the US National Center for Health Statistics (NCHS) in April 2020 contain three examples—all classified with a UCoD of COVID-19.[5] Analogous guidelines released by the Russian Ministry of Health on 27 May 2020 contain ten examples—five of

which are classified with a UCoD of COVID-19.[6] Examples 1 and 2 of the Russian and US reports, respectively, are strikingly similar (see supplementary material, available as Supplementary data at *IJE* online). Both have a UCoD of COVID-19 and both mention acute respiratory distress as the ICoD; the deceased here is a patient with (i) respiratory distress, (ii) pneumonia, and (iii) COVID-19. Examples 6–10 of the Russian report do not have a direct analogy in the US report; COVID-19 is reported in Part II of the death certificate for four of these. In Example 10 of the Russian report (see supplementary material, available as Supplementary data at *IJE* online), the deceased is classified with a UCoD of gastric cancer (C16.2)—despite a laboratory confirmed positive test for COVID-19—since the patient showed 'no pathomorphological conditions for COVID-19' and 'medical care was imparted for gastric cancer'.[6] However, within the guidelines of the US report, this deceased would likely be classified with a UCoD of COVID-19 (see supplementary material, available as Supplementary data at *IJE* online for details).

In July 2020, the US and Russia ranked first and fourth, respectively, for the maximum number of COVID-19 infections; however, the US had the world's largest reported death toll whereas Russia's reported death toll was significantly lower. With the above background, these varying statistics are not surprising, even though both Russia and the US are participating countries of the WHO.

Long-standing concerns

Broadly, there are three steps between the notification of a death and the generation of a mortality statistic.[7,8] Below, I discuss concerns with each of these three steps, and suggest methods to improve the process.

Physician completes the death certificate

The first step in this chain is the completion of a death certificate by a physician or a coroner. However, death certificates are completed only for deaths that are formally notified to authorities; cumbersome or inefficient death notification systems contribute to over one-third of global deaths being unregistered.[9] Other than medicolegal reasons, autopsies are rarely requested—both for deaths within and outside the hospital.[10] Although autopsies further our understanding of the pathogenesis of COVID-19[11], there is reluctance to perform them for suspected COVID-19 deceased patients,[12] and patients are increasingly resorting to private autopsies to determine the true CoD.[13]

Swiftly declining autopsy rates worldwide[14] further the importance of correctly identifying the CoD on deaths that do get registered. First, efficient training programmes for physicians and coroners in certifying deaths, and second, improved formal notification systems for community deaths would assist in improving the quality of death certificates. The Bloomberg Philanthropies Data for Health Initiative at Melbourne provides an example of how effective training strategies significantly reduced errors in death certification in five countries.[7] Similar programmes implemented via interactive workshops also showed success in New York[15] and Spain.[16] The Latin American and Caribbean Network to Strengthen Health Information Systems (RELACSIS) is an initiative by the Pan American Health Organization and WHO that provides technical advice in >25 Spanish-speaking countries for better ICD-10 coding via training programmes.[17] In low- and middle-income countries (LMICs), the use of information and communication technologies offers a way to increase death notifications by integrating the death notification and death registration processes.[18]

Mortality coder logs the death certificate into a registration system

In the next step, a mortality coder enters the data on the death certificate into a civil registration and vital statistics (CRVS) system. This requires (i) efficient CRVS systems, and (ii) well-trained mortality coders. Although significant progress is being made, LMICs still lack reliable CRVS systems;[19] countries also under-appreciate the value of notifying so-called 'community deaths' —deaths not attended by a physician.[18] Further, the US NCHS estimates there are few mortality coders—also known as nosologists—worldwide, although morbidity coders are abundant;[20] thus, poor ICD-10 choices result from ignorance in dealing with causal comorbidities and nosological classifications.[20,21] In June 2020, as part of an initiative to measure indirect mortality impacts of COVID-19, the WHO asked participating countries to include mortality statistics using a standard template on existing CRVS systems.[22] Questions on this template distinguish deaths where COVID-19 is mentioned anywhere on the death certificate vs those where COVID-19 is listed as the UCoD;[22] when available, these data are a significant step towards achieving comparable COVID-19 statistics, and reducing errors from both misjudgment and manipulation.[23]

Again, the problem is not new. In Iran, reassignment of misclassified deaths could increase the proportion of deaths due to lower respiratory diseases by 73%.[24] In Denmark, patients—especially males—with very severe COPD might not even have COPD listed on the death certificate.[25] The WHO estimates ~30% under-reporting of deaths due to ischaemic heart disease in France.[26] In the

USA, a study finds hospitals with high inpatient death rates over-report heart disease and renal disease as the UCoD and under-report cancer.[27]

Statistician consolidates the available data into mortality statistics

As the final step, a statistician uses the generated data to develop mortality statistics. This step, relying on a combination of epidemiology and statistics, is arguably the most well-studied of the three; see, e.g. mortality statistics for cancer,[28] ischaemic heart disease[29] and influenza.[30] However, unreliable data on death certificates risks the statistics suffering from garbage-in garbage-out. The WHO estimated 4–6% of so-called 'garbage codes' in Russia's coding of HIV deaths as lower respiratory infections.[31,32]

COVID-19 mortality statistics worldwide are frequently being revised. Officially reported Russian statistics for the month of April 2020 split COVID- 19 deaths into four categories. For Moscow, the numbers were: (i) 636 with COVID-19 identified, (ii) 169 possibly with COVID-19, (iii) 360 with COVID- 19 significant but not the UCoD, and (iv) 396 with COVID-19 not significant and not the UCoD. Likely (iii) and (iv) were reported in Part II of the death certificate. After revising the April death toll, the new toll was the sum (i.e. 1561)—more than double of the previously reported 636. On 17 July 2020 Kyrgyzstan and Kazakhstan changed their counting mechanism to include pneumonia-related deaths with clinical consistencies with COVID-19—in line with WHO's plea—in their national COVID-19 toll;[33] both are among the countries with the fastest growing infections worldwide. On 27 July 2020 Texas changed its reporting mechanism as well, and 600 new fatalities were added. Concerns of under-reporting of deaths, by counting only a subset of COVID-19 deaths, within Germany and the UK have also been raised. The New York Times estimates at least 207 000 under-reported deaths worldwide. On the other hand, Sweden claimed its high per capita death toll is because it reports 'true' death counts,[34] whereas Belgium reports almost no discrepancy between reported and excess mortality.[35]

Discussion

To reduce the impact of the COVID-19 pandemic, researchers worldwide are addressing a series of important challenges—from effective testing strategies to the development of vaccines. Cause-specific mortality estimates are the foundations of epidemiology and evidence-based population health policy.[36] Reliable estimates are essential for the control of COVID-19 by informing solutions to the above-mentioned challenges,[36] helping estimate the true impact of COVID- 19,[37] and comparing subsequent public health responses across different countries and political systems.[38] All of this requires collection of clear, uniform and comparable national death counts by the WHO, as well as implementation of new strategies to improve death notifications and the quality of data on death certificates.

i. First, there is a need for both mortality counts—with COVID-19 reported as the UCoD and as the ICoD. Different countries follow widely varying definitions by including or excluding suspected counts, and the extent of testing; see, e.g.[37] for conflicting definitions even within the European Union. Only with accurate data on both of these death classifications can we hope to make sense of the basic epidemiological formulae.
ii. Second, detailed excess mortality data for COVID-19 should be mandated from all participating countries. Until reliable death certification records for COVID-19 that distinguish UCoD and ICoD are available, excess mortality data can help estimate direct and indirect COVID-19 deaths; see, e.g.[39] Within Europe, systems for timely reporting of mortality statistics for seasonal influenza and pandemics already exist in 26 countries via the European Monitoring of Excess Mortality (EuroMOMO) network.[40] However, such systems need to be pervasive, uniform worldwide and cater to COVID-19.
iii. Third, unified nosological guidelines for UCoD reporting—across all countries—that leave little leeway for errors from ignorance or manipulation are required. An autopsy should be performed when doubts exist. Feinstein—arguably the founder of clinical epidemiology—expressed the concern that a patient with comorbidities of coronary artery disease, pulmonary emphysema, ulcerative colitis and diabetes mellitus is 'not allowed' to die from all of them.[41] All these conditions mentioned by Feinstein, 50 years ago, are known comorbidities of COVID-19.
iv. Finally, educational training programmes that provide effective guidance on notifying and registering deaths need to be ramped up. COVID-19 has resurfaced long-standing concerns of poor-quality death certificates. Training programmes such as those mentioned above show how simple strategies when implemented effectively can significantly reduce errors in certification.[7] Similar programmes focused on COVID-19, conducted both by the WHO and regional authorities, could assist in comparability of mortality data.

A victory against COVID-19 cannot be declared with progress in clinical medicine alone; improvement in public health measures needs to go hand-in-hand. In the absence of these changes, the dead simply end up as a statistical

data point on a public health death certificate with a bias informed by politics and nosology.

Ethics approval

I confirm all relevant ethical guidelines have been followed, and no human subjects were involved in this study.

Supplementary data

Supplementary data are available at *IJE* online.

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Data availability

The data underlying this article are available in the article and in its online supplementary material.

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Conflict of interest

None declared.

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