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Speaker

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Analysis of COVID Death Data

March 5-September 16, 2020

Background

Understanding the death toll due to COVID 19 is a key part of understanding the pandemic. Analyzing the number, location, and circumstances of deaths caused by COVID reveals patterns in the spread of the disease and helps identify ways in which an outbreak should be managed. Focused prevention and treatment interventions depend on a foundation of credible data and sound analysis.

Death registries were created to track and measure the impact of infectious diseases. It was during the scourge of the bubonic plague that local officials throughout England first were directed to record vital statistics, including the reasons for each death, and analysts began to draw conclusions.

“In 1662 a London merchant, *John Graunt*, published a remarkable investigation: *Natural and Political Observations upon the Bills of Mortality*. He had no mathematical training, and his conclusions are not always correct, but still he is possessed of a remarkable originality and clearness of thought, and we cannot help admiring this first attempt to get a comprehensive view of these observations on births and deaths. It was the origin of ‘political arithmetic,’ as statistics in those days was named.”¹

Although greatly modernized since the 1600s, the foundation of vital statistics remains the same—it is the official source for counts and causes of death. The promise of valid data rests on an established set of rules for producing complete and consistent information about the cause(s) and conditions of each death.

Since the beginning of the COVID pandemic, public health officials have been trying to quickly publish numerous facts about the disease, including mortality data. The Florida Department of Health launched a dashboard in early March using several data sources, including notifications in “real-time” of cases and deaths from health practitioners and other providers. Such reports are investigated and confirmed by DOH staff. This process is guided by generally accepted practices, but it is not regulated to the same extent as vital records. This epidemiological process results in death counts that may vary compared with provisional vital statistics, but the difference is not material. The epidemiological data is also diffusely held and more difficult to access. Consequently, this analysis relies exclusively on death certificates. The data is provisional because the department does not finalize its information until after the end of the calendar year.

Death Certificates

The medical information on a death certificate is completed by a physician who attended or examined the patient or by another practitioner in an official capacity. Medical examiners (ME) may also complete the death certificate if an autopsy has been performed or if the ME has reviewed the case and has been delegated reporting responsibilities. By statute, MEs have such responsibilities in cases of certain

¹ Dr. Harald Westergaard, On the History and Prospects of Vital Statistics, a lecture in the University College of London, *Economica*, No. 14 (Jun., 1925), pp. 121-129 (9 pages); Wiley.

communicable diseases.² Specific procedures for certifying deaths and completing the form are specified in national guidance and state regulations. As a result, there is an expectation that information extracted from death certificates is consistent and comparable nationwide. Expectations for high-quality data are raised even further because there is an opportunity for medical examiners to offer an additional layer of review.

The medical information captured in a death certificate is organized in two parts. PART 1 is the place for identifying all conditions that directly caused the death, including the immediate and underlying causes. These are diseases and conditions with a direct causal relationship to the death. PART 2 is the place for identifying other contributing conditions, that is, conditions and diseases that made the death more likely but not the actual cause of death. The following example helps to illustrate this distinction.

Figure 1. Example of how the death certificate describes the chain of events.

41. CAUSE OF DEATH - PART I (See instructions on back)		Enter the chain of events - diseases, injuries, or complications - that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line.	Approximate Interval: Onset to Death
IMMEDIATE CAUSE (Final disease or condition resulting in death) Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE LAST (disease or injury that initiated the events resulting in death)	a. Aspiration pneumonia	Due to (or as a consequence of):	2 Days
	b. Complications of coma	Due to (or as a consequence of):	7 Weeks
	c. Blunt force injuries	Due to (or as a consequence of):	7 Weeks
	d. Motor vehicle accident	Due to (or as a consequence of):	7 Weeks
PART II. Enter other <u>significant conditions contributing to death</u> but not resulting in the underlying cause given in Part I.		42a. WAS AN AUTOPSY PERFORMED? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	42b. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

PART 1 consists of four lines labeled *a-d*. Certifiers are directed to complete these lines in a way that indicates the sequence or chain of events that ended in the death. Line *a*. in PART 1 should be the immediate and direct cause of death. If only *Line a*. is completed, the information should indicate a disease or condition sufficient in and of itself in causing a death. Only one cause should be listed on each line. If multiple morbid conditions are present, the certifier should construct a logical sequence of clinical events and identify other significant conditions in PART 2.

CDC guidelines regarding completion of a death certificate indicate COVID 19 will play a role in a person's death. However, it is expected to be found on a lower line because COVID 19 will lead to a more direct and immediate cause of death, such as respiratory failure, heart failure, pneumonia, or another condition.

While PART 2 is listing important diseases and conditions that were present at the time of death, these conditions did not constitute the immediate or underlying causes of death.

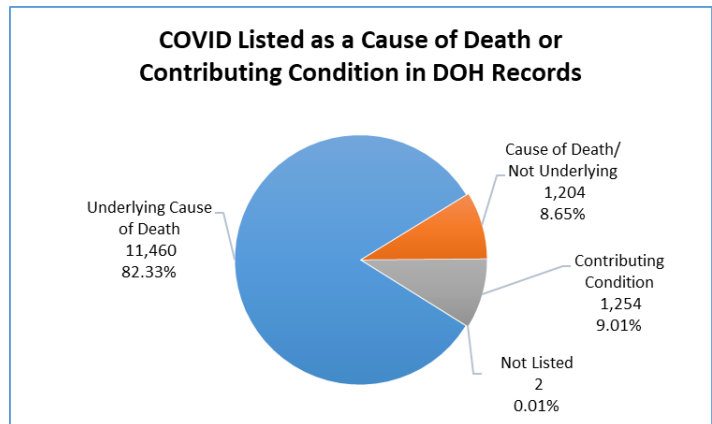
Limitations of the Data

An accurate count of the number of deaths due to COVID 19 depends on proper death certification. Certifying the cause of death is an expression of a medical opinion, and clinicians can disagree about a diagnosis or a cause of death. A physician's familiarity with the conditions of each patient is likely to impact the accuracy and completeness of the information on the death certificate. It is possible that pandemic conditions led to more death certificates being completed by physicians or medical examiners who had limited knowledge of the patients and by officials facing significant workload pressures. Among the 13,920 records reviewed in this analysis, 10,946 were based on death certificates completed by medical examiners, rather than physicians who treated the patient prior to death.

² FLA. STAT. S. 406.11 (2019).

Accuracy is also linked to the certifiers rigorously adhering to the national standards for completion of death certificates in general and guidelines for COVID 19 related deaths in particular. This dataset presents significant evidence of an absence of practitioner rigor and raises questions about the overall validity of the data or any conclusions drawn from it.

The death count will depend on several choices that are made about how to count. These methodology decision points are largely invisible but can have meaningful effects on the number of deaths reported. In Florida, two such choices present opposing effects. First, the decision to count all deaths when a positive COVID 19 test is known drives the count up because it includes people for whom COVID 19 was only a comorbidity—maybe even an asymptomatic one. In contrast, the decision to only count deaths when a positive COVID 19 test is known drives the count down because it eliminates probable and possible COVID 19 cases.³ The inflationary effect of the first choice is measurable if the death certificate is correctly filled out. This report quantifies that effect to some extent. The deflationary effect of the second choice is more inscrutable because we can't measure what we don't know.



Source Data

The Department of Health provided a data file to House staff on September 23, 2020. The file included a total of **13,920** individual records. Of these records:

- **11,460** records list COVID 19 as the immediate or underlying cause of death in PART 1.
- **1,204** records list COVID 19 as one of the causes in the final sequence of events, but not the underlying cause of death.
- **1,254** records list COVID 19 as a condition that contributed to death in PART 2, but COVID 19 is not listed as a cause of death in PART 1.
- **2** records do not list COVID 19 in either PART 1 or PART 2 (car accident; dementia).

This breakdown suggests that the reported COVID deaths are increased by as much as 10% when contributing conditions are mingled with underlying causes.

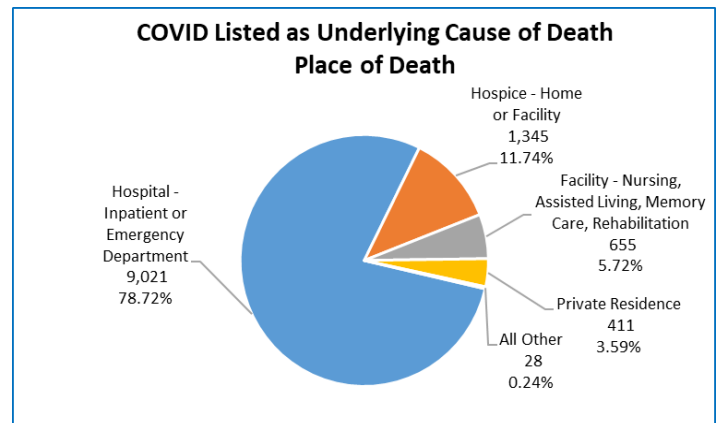
Findings

- **11,460** records list COVID 19 as the cause of death.
 - **8,058** of these records list COVID 19 in Line a. – and list no other causes in any other line of PART 1.

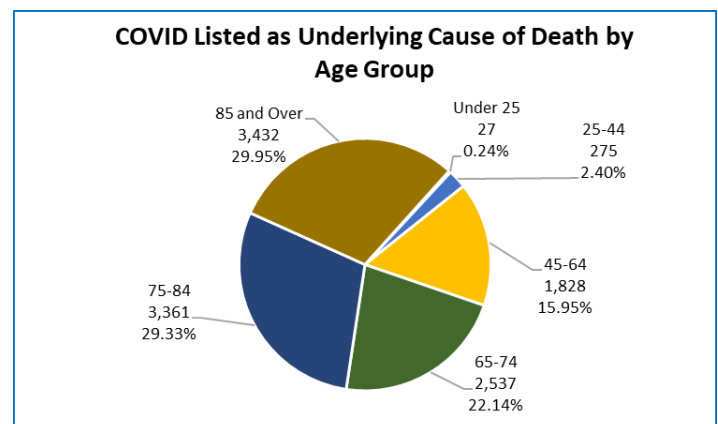
³ CDC guidelines require reporting of possible and probable cases, in addition to those with positive lab tests. “Coronavirus Disease 2019 (COVID-19) 2020 Interim Case Definition”, U.S. Department of Health and Human Services, Centers for Disease Control, April 5, 2020.

- Of **these** records, **3,697** records specify COVID 19 and only COVID 19 as the immediate *and* underlying cause of death (Line a.), even though most of those (all but **246**) had other contributing conditions.
- The other **4,361** records reported multiple immediate and underlying causes, including COVID 19, in a single line (Line a.) including:
 - **3,756** listed pneumonia
 - **265** listed respiratory failure
 - **218** listed pulmonary complications
 - **175** listed an assortment of immediate and underlying causes unrelated to COVID 19 (dementia, cancer, stroke, diabetes, etc.)
- **1,494** records identify COVID 19 as the underlying cause, or starting point, for the chain of events leading to death resulting from one immediate cause.
- **1,669** records list COVID 19 as the starting point for the chain of events leading to death resulting from two other causes.
- **239** records list COVID 19 as the starting point for the chain of events leading to death resulting from three other causes.
- Most patients (nearly **80%** of the **11,460**) died in a hospital. **1,345** of the **11,460** deaths (almost 12%) occurred in hospice care, suggesting an advanced disease state unrelated to but possibly aggravated by COVID.
- Over **81%** of the **11,460** deaths occurred in patients who were 65 years of age or older.

Place of Death	Number	Percent
Hospital (Inpatient or Emergency)	9,021	78.72%
Hospice (Home or Facility)	1,345	11.74%
Long-Term Care Facility (Nursing, Rehabilitation, Memory Care, Assisted Living)	655	5.72%
Private Residence	411	3.59%
All Other	28	0.24%
TOTAL	11,460	



Age Group	Number	Percent
Under 25	27	0.24%
25-44	275	2.40%
45-64	1,828	15.95%
65-74	2,537	22.14%
75-84	3,361	29.34%
85 and Over	3,432	29.95%
TOTAL	11,460	



Discussion

Florida's vital statistics system is more coordinated than many other states. Nevertheless, this report reveals shortcomings in the process that predate the pandemic but also are exacerbated by pandemic conditions. Valid and accurate information about COVID 19 is essential to enable an effective public health response for a variety of problems. Action is needed to improve the quality of the death records.

All of the information in the death certificate is important and should be accurate, but accuracy in PART 1 of the medical information is particularly critical. This is where the story of each death is told. The structure of PART 1 calls for the certifying physician to lay out the chain of events that culminated in death. When that chain is known and understood, it is possible to begin looking for ways to interrupt the chain and perhaps reduce mortality for certain causes.

PART 1 is also important as a part of clinical care. CDC guidelines state this point as follows:

In fulfilling the role of the certifier (i.e., person completing the medical part of the death certificate), the physician performs the final act of care to a patient by providing closure with a well-thought-out and complete death certificate that will allow the family to close the person's affairs. At the same time, the physician performs a service for the larger community.⁴

For an example of a CDC-compliant death certificate, see Figure 2. Non-compliant samples are displayed in Figures 3 and 4.

The key criticisms of Florida's COVID 19 death records arise from the following findings:

- Nearly 60% of the records classified by the Department of Health have errors or are recorded in a manner inconsistent with state and national guidance. The problematic records (8,058 of them) only provide underlying cause of death information in Line a. of PART 1. Of these, 7,629 were completed by medical examiners.
- Some of these records (4,361) jumble COVID 19 with other conditions all on Line a. of PART 1, in direct contradiction to the death certificate guidelines (see Fig. 3). This is not just a simple paperwork problem; the certifier has subverted the goal of understanding the chain of events. While many of these jumbled causes may be sorted out in the CDC coding process, that step relies on imposing expected patterns rather than correcting based on certain knowledge.
- Some of these records (3,697) list COVID 19 in Line a. of PART 1 with no other causes listed in lines a., b., c. or d. (see Fig. 4). The certifier, who is the medical examiner in 3,556 of these records, certifies that the presence of the virus is the sole precipitating cause of the death. That can't be true. What really happens is that the virus triggers other conditions and those conditions cause death in some cases. A lack of precision not only subverts the goal of understanding the chain of events, it "certifies" that no clinical events occurred at all — other than a positive COVID 19 lab test. Here, the certifier has failed to properly certify the death.
- 246 of these records only list COVID 19 in Part 1 also list no other contributing conditions in Part 2 —no other causes *and* no co-morbid conditions.

⁴ Physicians' Handbook on Certification of Death, 2003 edition, U.S. Department of Health and Human Services, Centers for Disease Control, National Center for Health Statistics.

The size and seriousness of these PART 1 shortcomings undermine the credibility of the death records for COVID 19. Additional problems are more limited in scope, but worth noting in order to be more precise about mortality related to COVID 19. For example,

- Any “current” count of COVID 19 deaths is more accurately described as the number of people with COVID 19 who died, rather than those who died from COVID 19. As of September 16 this inflation factor accounted for a 10% increase in the count — moving it from 12,664 to 13,920. CDC guidelines require states to include these deaths in their death counts,⁵ and Florida is complying with this direction. However, the CDC choice to count deaths in this manner results in a misleading count of COVID 19 deaths. Contributing conditions are not the same as underlying causes. Treating them as the same distorts the assessment of the pandemic.
- The distortion of combining PART 1 with PART 2 is made worse because it is nearly impossible to untangle later. PART 2 lacks specificity; mentioning COVID in this section may mean COVID 19 played a significant role, or it may mean the certifying physician merely recorded a positive lab test there — we cannot tell.
- 1,345 people (approximately 12% of the 11,460 with COVID 19 as an underlying cause of death) were identified as hospice patients; for these patients, other causes are likely to be significant in the chain of events leading to their deaths, but the sloppiness in the death certificates prevents any more complete understanding of these deaths.

It is worth noting that precise adherence to CDC guidelines leads to higher death counts. This is not the only example of U.S. health statistics instituting procedures that count “more” rather than fewer events. Infant mortality is another area where U.S. data methods produce higher counts.⁶ There is nothing inherently wrong in adopting a more expansive definition and consequently counting a greater number of observed events. The real difficulty comes from comparing such numbers across jurisdictions when they are apples and oranges.

Even with the shortcomings in the dataset, the overarching pattern of deaths related to COVID 19 is its tendency to strike those with pre-existing vulnerabilities such as advanced age or other health conditions. Although this pattern might be expected of almost any communicable disease, it is particularly worth noting because it is sharply different than the 1918 pandemic that targeted healthy people between ages 20 and 40. Because this virus has a more devastating effect on older and sicker patients, there is good reason to focus and prioritize public health interventions to protect these populations.

The earliest use of death registry data was aptly referred to as “political arithmetic”. Four hundred years later, the data is still a political football. A better option would be using the information to understand the complexities and nuances of this disease — not as a scoresheet. And the first step in pursuit of this ideal is assuring complete and reliable data. Complete and reliable does not mean perfect or pure or absolute. It means that the deaths are reported fully; that the reports are prepared in a manner consistent with nationally accepted guidelines and standards; and that the certifiers are using sound medical judgement in drawing their conclusions about the final events in each decedent’s life.

⁵ Coronavirus Disease 2019 (COVID-19) 2020 Interim Case Definition, U.S. Department of Health and Human Services, Centers for Disease Control, April 5, 2020.

⁶ Texas A&M University. “Why American infant mortality rates are so high.” ScienceDaily. ScienceDaily, 13 October 2016.

Summary

Mortality data offers an important tool for policymakers to improve public health. This report identifies several important factors that garble the data and undermine a complete understanding of the scope and impact of the COVID-19 pandemic in Florida. Specifically, the weaknesses in the death certification process should be addressed. Potential improvements include:

- Institution of automated systems that limit the frequency of human error.
- Increased resources for Vital Statistics to allow for more immediate quality monitoring and improvement.
- Expanded accountability procedures for medical examiners, especially in a pandemic.
- Clarification of the role and authority of the Department of Health to institute quality improvement procedures.
- Development of ongoing death review initiatives targeted to address significant public health events, similar to those used in trauma deaths and infant mortality. These reviews should adopt an assessment model that focuses on system changes rather than any determination of individual fault.

Figure 2. Sample, CDC-Compliant Death Certificate for a COVID 19 Death.⁷

CAUSE OF DEATH (See instructions and examples)	
32. PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death) →	a. Acute respiratory distress syndrome Due to (or as a consequence of):
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. Pneumonia Due to (or as a consequence of):
	c. COVID-19 Due to (or as a consequence of):
	d.
PART II. Enter other <u>significant conditions contributing to death</u> but not resulting in the underlying cause given in PART I	

Figure 3. Non-Compliant Florida Death Certificate for a COVID 19 Death: All Causes Listed in Line a. of PART I.

41. CAUSE OF DEATH - PART I. (See instructions on back)		Enter the chain of events - diseases, injuries, or complications - that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line.		Approximate Interval: Onset to Death
IMMEDIATE CAUSE (Final disease or condition resulting in death) →	a.	COVID-19 VIRAL RESPIRATORY INFECTION	Due to (or as a consequence of):	
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE LAST (disease or injury that initiated the events resulting in death)	b.		Due to (or as a consequence of):	
	c.		Due to (or as a consequence of):	
	d.		Due to (or as a consequence of):	
PART II. Enter other <u>significant conditions contributing to death</u> but not resulting in the underlying cause given in PART I.		42a. WAS AN AUTOPSY PERFORMED? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	42b. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
CHRONIC OBSTRUCTIVE PULMONARY DISEASE; CHRONIC RENAL FAILURE				

Figure 4. Non-Compliant Florida Death Certificate for a COVID 19 Death: COVID 19 Cause Listed in Line a. of PART 1; No Other Underlying Causes Listed in Lines a, b, c. or d.

41. CAUSE OF DEATH - PART I. (See instructions on back)		Enter the chain of events - diseases, injuries, or complications - that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line.		Approximate Interval: Onset to Death
IMMEDIATE CAUSE (Final disease or condition resulting in death) →	a.	COVID-19	Due to (or as a consequence of):	
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE LAST (disease or injury that initiated the events resulting in death)	b.		Due to (or as a consequence of):	
	c.		Due to (or as a consequence of):	
	d.		Due to (or as a consequence of):	
PART II. Enter other <u>significant conditions contributing to death</u> but not resulting in the underlying cause given in PART I.		42a. WAS AN AUTOPSY PERFORMED? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	42b. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	

⁷ Guidance for Certifying Deaths Due to Coronavirus Disease 2019 (COVID-19), U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, Vital Statistics Reporting Guidance, Report No. 3, April 2020.