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COVID-19 IN TENNESSEE: LESSONS LEARNED AND A TOOL FOR THE FUTURE

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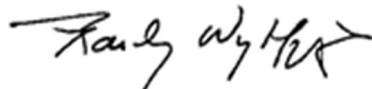
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ABSTRACT

Background: In late 2019, the SARS-CoV-2 virus was identified in Wuhan, China. Within a matter of weeks, the virus spread to the United States and many other countries around the world. By March 5, 2020, the first case of COVID-19 (the disease caused by the SARS-CoV-2 virus) was identified in the state of Tennessee, and the first known COVID-19 associated death in the state followed on March 20, 2020. In 2020 alone, there were 514,922 confirmed cases and 6,760 COVID-19 attributed deaths in the state of Tennessee. It is important to understand, however, that confirmed COVID-19 deaths do not accurately capture the overall impact of the COVID-19 pandemic. Many additional deaths resulted either directly from COVID-19 disease, or indirectly from the COVID-19 pandemic. This report seeks to briefly summarize the early stages of the COVID-19 pandemic and its immediate impact on the state of Tennessee and outline a novel tool for rapidly identifying excess mortality using publicly available data.

Methods: Calculating excess mortality is likely to accurately capture the total deaths that occurred because of the COVID-19 pandemic, including deaths that may not have been directly attributed to COVID-19 disease. To calculate excess mortality, four years (2017-2020) of data were collected from three sources, online funeral home listings, newspaper obituaries, and the state health department. Using simple linear regression, number of deaths by month for 2017, 2018 and 2019 were used to predict expected deaths, by data source, for each month of 2020 as the baseline for comparison. The percent difference of actual deaths from the expected deaths was then calculated and compared by data source.

Results: By quarter, 2020 actual funeral home listings differed from the expected by Q1: -9.29%, Q2: 11.50%, Q3: 7.36% and Q4: 55.90%. Newspaper obituaries differed from the expected by Q1: 8.05%, Q2: 20.00%, Q3: 9.93% and Q4: 44.55%. State reported Washington County data differed from the expected by Q1: 7.68%, Q2: 18.85%, Q3: 12.21%, Q4: 48.91%.

When comparing online funeral listings and newspaper obituaries to state reported data for Washington County, it is clear that either of the public data sources could have been used to identify spikes in excess mortality throughout 2020.

Conclusion: These findings reveal that publicly available online funeral home death listings and local newspaper obituaries can be used as a tool to help identify spikes in excess mortality in 'real-time'. The most notable impact being that the newspaper obituary and funeral home data was available in near real time, whereas the state reported Washington County data was not made available until October of 2021.

ACKNOWLEDGMENTS

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SECTION 1: THE COVID-19 PANDEMIC IN TENNESSEE

INTRODUCTION

In late 2019, the SARS-CoV-2 virus was identified in Wuhan, China.[1,2] Within a matter of weeks, the virus had spread to the United States and many other countries around the world.[3] By March 5, 2020, the first case of COVID-19 (the disease caused by the SARS-CoV-2 virus) was identified in the state of Tennessee (TN), and the first known COVID-19 associated death in the state followed on March 20, 2020.[4,5] In 2020 alone, there were 514,922 confirmed cases and 6,760 deaths from COVID-19 in the state of Tennessee, as reported by the Tennessee Department of Health.[6] It will take several years to fully understand the factors that enabled the rapid spread of the SARS-CoV-2 virus and its impact on the people of Tennessee. This section will examine the timeline and some of the characteristics that enabled COVID-19 to become a global pandemic. From there, the focus will narrow in on how the United States, and the state of Tennessee specifically, responded to the COVID-19 pandemic in 2020. Section 2 will focus on the potential to utilize unique data sources to identify early spikes in excess mortality that might have informed the COVID-19 response.

BACKGROUND

The name Coronavirus is derived from the appearance of this family of viruses as they are spherical in shape and composed of an outer lipid layer covered with a "crown" of club-shaped protein spikes.[7] The term corona is derived from the Latin word for crown.[7] Despite the novelty of the SARS-CoV-2 virus (the virus that causes COVID-19), coronaviruses are not new.[8] This family of viruses is responsible for multiple known diseases that primarily target the upper respiratory system and can range in severity from mild symptoms to acute respiratory failure and death.[9] Coronaviruses typically spread from person-to-person through airborne transmission, which can result in a high level of transmissibility.[10–13]

Two coronaviruses have been documented to cause severe illness. In November 2002, The Severe Acute Respiratory Syndrome (SARS) outbreak, caused by a coronavirus (SARS-CoV), began in South China and spread to 29 countries.[9] The SARS outbreak caused about 8,000 known infections and 774 deaths before it was contained in July 2003.[14] Similarly, the Middle East Respiratory Syndrome (MERS) outbreak was caused by another coronavirus called MERS-CoV, and was first reported in Saudi Arabia in September 2012.[9] MERS-CoV spread to 27 countries, caused about 2,500 known infections, and 866 deaths by January 2020.[9,15]

COVID-19 PANDEMIC TIMELINE

While caused by a similar coronavirus, the COVID-19 pandemic has far exceeded SARS and MERS in global spread, cases, and deaths.[9] In 2020 alone, the United States surpassed 20 million known infections from SARS-CoV-2, and more than 346,000 deaths.[16] Globally, infections topped 83,000,000 and there were 1,824,590 deaths reported in 2020.[16] Some of the

milestones during the early stages of the COVID-19 pandemic beginning with its initial discovery in Wuhan, China and concluding with more granular events in the state of Tennessee, as summarized in Figure 1.

Pandemic Milestone Timeline
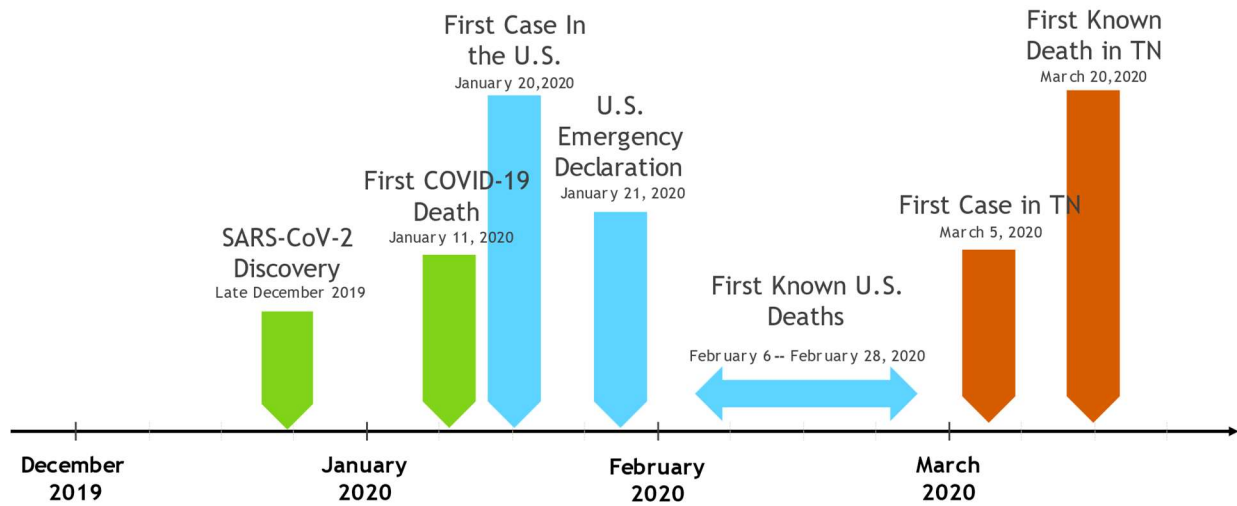
FIGURE 1 – COVID-19 PANDEMIC MILESTONE TIMELINE (2019-2020)

DISCOVERY

As previously mentioned, the SARS-CoV-2 virus was originally identified in Wuhan, China in late December 2019 and traced to a large seafood and animal market.[2] This pattern of disease transmission initially from animals to humans is in line with many common diseases known as zoonotic diseases.[17,18] There is still some debate about the exact origin of the SARS-CoV-2 virus, but it is widely believed that it originated in bats, traveled through an intermediate host, then mutated to infect humans.[1]

FIRST COVID-19 DEATH

On January 11, 2020, Chinese authorities announced the first known death caused by the SARS-CoV-2 virus.[3,19] The 61-year-old man was known to be a regular customer at the market in Wuhan where the novel virus was discovered.[19]

FIRST CASE IDENTIFIED IN THE U.S.

On January 20, 2020, the Centers for Disease Control and Prevention (CDC) confirmed the first case of COVID-19 in the U.S. in Washington state.[20] The infected man, who was in his 30s and a resident of Snohomish County, Washington, developed symptoms after returning from a trip to the region around Wuhan.[21]

EMERGENCY DECLARATION

On January 31, 2020, the U.S. Department of Health and Human Services declared a public health emergency for the United States.[22]

FIRST U.S. DEATH

There are conflicting reports regarding the first COVID-19 attributable death in the United States. Early in the pandemic it was believed that the first death was in Washington state on February 28, 2020.[23] Subsequently, a death that had occurred on February 6, 2020, in the San Francisco Bay area was identified as a COVID-19 death.[23,24]

FIRST CASE IDENTIFIED IN TENNESSEE

On March 5, 2020, the Tennessee Department of Health announced that the first case of COVID-19 in the state was identified in an adult male from Williamson County who had recently traveled out-of-state.[5]

FIRST TENNESSEE DEATH

On March 20, 2020, a 73-year-old man in Davidson County, Tennessee died due to complications from COVID-19.[4] He was the first known person to die from COVID-19 in the state of Tennessee.

QUANTIFYING THE COVID-19 PANDEMIC IN 2020

In 2020, the United States surpassed 20 million infections from SARS-CoV-2, and more than 346,000 deaths.[16] In terms of total death, COVID-19 is the deadliest pandemic in U.S. history, surpassing the 1918 influenza pandemic.[25] To put these numbers into perspective, the CDC estimates between 12,000 and 52,000 people die each year in the United States from annual influenza disease outbreaks.[26] Even when comparing the high end of that estimate (52,000 annual deaths), the COVID-19 pandemic killed over 6 times more people in the U.S. in 2020.

In the state of Tennessee, there were 514,922 confirmed cases and 6,760 deaths attributed to COVID-19 in 2020.[6] These 6,760 deaths exceed the equivalent of two 9/11 terrorist attacks happening in the state of Tennessee in the same year.[27] It is also important to note that these confirmed COVID-19 specific deaths do not encompass the total burden of death due to the COVID-19 pandemic. The concepts of excess mortality and indirect burden of death will be discussed in more detail in Chapter 2.

THE HAMMER AND THE DANCE

       Strategies for responding to infectious disease outbreaks have long been established by epidemiologists and other public health professionals.[28,29] These strategies tend to revolve around the fundamental ideas of surveillance, containment, and development of treatment/vaccines.[28,29] In March of 2020, Tomas Pueyo published an article outlining a framework to decrease the impact of COVID-19 disease spread that aligns with, and summarizes, these long-established guiding principles.[30] Pueyo's theory is referred to as "The hammer and the dance". The hammer refers to strict initial lockdown measures aimed at containing the spread of disease, and the dance refers to the surveillance, testing, contact tracing, isolation/quarantine, and eventual vaccination that allows for safe reopening.[30] The primary purpose of this comprehensive public health approach is not to eradicate an infectious disease, but to slow the spread of disease, to prevent the healthcare system from being overwhelmed, and to buy time while vaccinations and therapies are developed and tested. If done properly, this would allow people to return to most of their normal activities within a couple of months with some restrictions in place such as group gathering limits, masking in public spaces, and regular testing.[30]

       This ability to return to a life that closely resembles pre-pandemic times would be made possible by initially enforcing strict lockdown measures at the first sign of community outbreaks to halt the spread of disease before reaching the exponential phase of transmission, when a disease can be nearly impossible to contain. Another key element necessary for this framework to be effective is for regional, state, and federal leaders to utilize the time in lockdown to create and mobilize robust testing, contact tracing, treatment/vaccine rollout plans, and other prevention infrastructure in preparation for disease outbreaks as communities emerge from lockdowns.

       Below is a graph (Figure 2) created by Tomas Pueyo, that provides a visual representation of the hammer and the dance theory.[30] The black line represents the number of COVID-19 cases if the disease were allowed to spread naturally. The red line represents the number of COVID-19 cases if only mitigation strategies (such as case isolation, reducing large public gatherings, wearing masks, etc.) are employed.[30] Finally, the green curve represents the number of COVID-19 cases when employing the hammer and the dance framework.
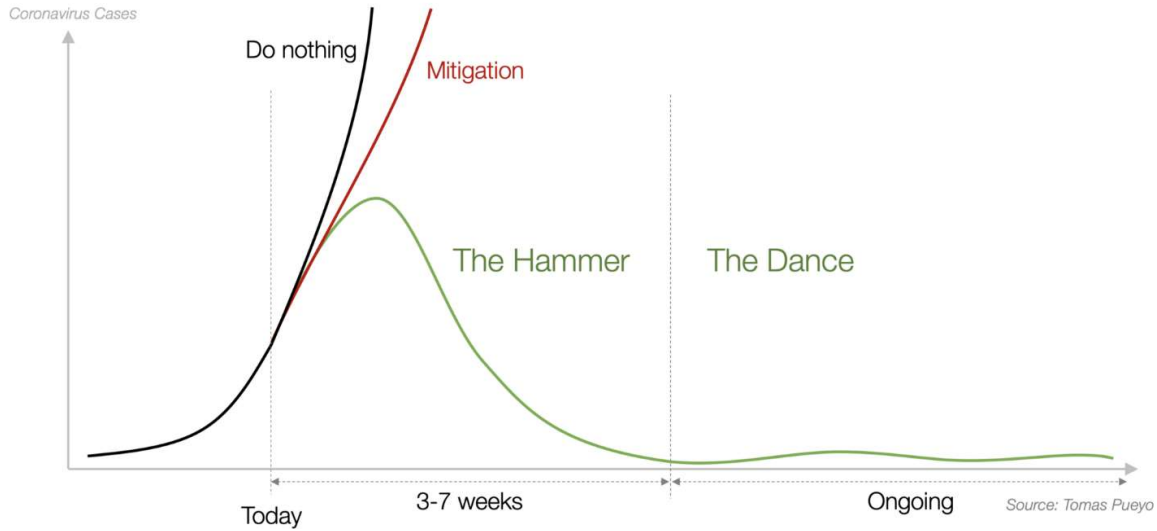
FIGURE 2 – HAMMER AND THE DANCE THEORY VIZUALIZATION [30]

TENNESSEE'S INITIAL SHUTDOWN

Looking at the initial response to COVID-19, the proverbial hammer phase, Tennessee did briefly employ lockdown measures.[31] Through executive order NO. 27, Tennessee Governor Bill Lee issued an official lockdown on March 30, 2020, 10 days after the first COVID-19 death in the state and 25 days after the first confirmed case in TN.[4,5,31] These lockdown measures prohibited social gatherings of 10 or more people; directed restaurants, bars, and similar food and drink establishments to offer take-out or delivery options only; directed gyms and fitness/exercise centers to temporarily close and suspend in-person services; restricted visitation in nursing homes, retirement homes, and long-term care or assisted-living facilities; and required that all persons in Tennessee stay at home unless engaging in essential activity or essential services.[31] This executive order was effective until April 30, 2020, which is shorter than the recommended lockdown time outlined in "the hammer and the dance" framework.[30,31] However, when executive order NO. 27 expired on April, 30, 2020, despite increasing COVID-19 case numbers in the state, the lockdown measures were lifted.[6,31,32] This timeline is represented in Figure 3.
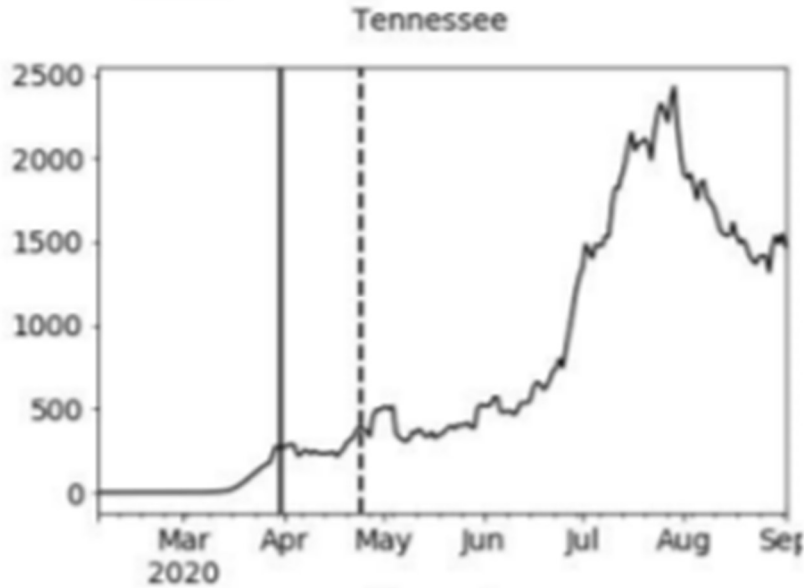
Tennessee

FIGURE 3[*] – TENNESSEE EXECUTIVE ORDER LOCKDOWN TIMELINE [33]

TENNESSEE'S SUBSEQUENT ACTION

By May 2020, the month-long lockdown measures in the state of TN had been lifted.[31,32] As previously outlined, for the hammer and the dance framework to be effective and life to return to near pre-pandemic conditions, this lockdown time should have been used by state, regional, and local elected and public health officials to acquire and mobilize robust testing, contact tracing, treatment/vaccine rollout plans, and other proactive prevention. In Tennessee, like much of the country during the early stages of the pandemic, proper steps had not been taken to adequately prepare for safe reopening. Therefore, as reflected in Figure 2, case numbers began drastically increasing again in Tennessee after a brief plateau during lockdown.[33,34]

One of the shortfalls that led to the lockdown/reopening measures being ineffective was the lack of available COVID-19 tests in the United States during that time.[35,36] Despite the early identification and publication of the SARS-CoV-2 genome, which allowed for the development of specified testing for the virus, the United States struggled to develop an effective test or obtain tests/supplies from other countries.[37,38] One of the fundamental tenants of containing disease spread is the ability to identify infected populations through robust testing.[39] Without access to testing, it was nearly impossible to conduct effective surveillance.

Contact tracing is the next major line of defense in quenching disease spread.[40] Effective contact tracing relies on both extensive testing and a robust public health work force capable of conducting thorough investigations.[41] Unfortunately, over the last several years, the state of Tennessee, along with many other states in the U.S., has consistently reduced funding for public

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[*] The solid vertical line marks the date of lockdown, and the dashed vertical line marks the lifting of lockdown restrictions.[33] The vertical axis shows daily confirmed COVID-19 cases, and the horizontal axis is months in 2020.

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health infrastructure.[42,43] This trend has resulted in a depleted public health work force that made the state more vulnerable and less prepared to combat disease spread.[43,44]

Another hurdle that prevented a safe and effective reopening was the inconsistent adoption of universal mask mandates, quarantine measures, and other best practices to help prevent the spread of disease.[45] Tennessee Governor, Bill Lee, signed an executive order (in July 2020) giving each county their own authority to enforce masking.[46] Beyond that, little was done at the state level to encourage counties to utilize these measures. A growing body of evidence supports the relationship between political affiliation and pandemic preparedness and overall response.[47–50] Despite drastic increases in COVID-19 case numbers, hospitalizations, and deaths as 2020 wore on, Republican led states hesitant to implement universal masking, limit public gatherings, impose quarantine measures, and eventually even vaccination efforts.[50]

CONCLUSION

Soon after the Sars-CoV-2 virus was discovered, it had spread to nearly every country in the world and the death toll began rising dramatically by the second quarter of 2020. In response to the increasing threat that COVID-19 posed, the United States opted to delegate the pandemic response onto the states, counties, and smaller communities.[51] Therefore, each state was responsible for responding to the pandemic with limited input and support from national leadership. In 2020, hundreds of thousands of Tennesseans were infected with Sars-CoV-2 and thousands of Tennessee lives were lost. However, it could be argued that even with a complete lockdown of Tennessee for a longer period, many lives would still have been lost since SARS-CoV-2 continued to spread globally and would have likely been reintroduced to Tennessee when lockdown measures were lifted.

SECTION 2: USING PUBLIC FUNERAL AND OBITUARY LISTINGS TO IDENTIFY SPIKES IN EXCESS MORTALITY

INTRODUCTION

In 2020, the Tennessee Department of Health reported 6,760 deaths from COVID-19 in Tennessee, the first occurring on March 20.[6,52] However, it is important to understand that confirmed COVID-19 deaths do not completely capture the overall impact of the COVID-19 pandemic in Tennessee. There are additional deaths that resulted either directly from the COVID-19 disease, or indirectly from the COVID-19 pandemic.[53] One method of identifying and quantifying the actual death toll from the pandemic is to assess excess deaths. Excess deaths are defined as the difference between the observed numbers of deaths in a specific time and expected numbers of deaths in the same time periods.[54] Taking this approach to assess overall loss of life is more likely to accurately capture the deaths that occurred due to the COVID-19 pandemic but may not be directly attributed to COVID-19 disease. However, delays in official data reporting often lead to delays in identifying spikes in excess mortality. This section will outline how excess mortality is calculated, assess excess mortality in Washington County, Tennessee in 2020 using three different data sources, and identify a relatively simple method for public health professionals to rapidly identify excess mortality using publicly available data.

BACKGROUND

While state-reported mortality data are the gold-standard for assessing total deaths in any area, these data have the disadvantage of not being readily available during an event associated with a short-term increase in mortality.[55] In Tennessee, mortality data is officially reported in October for the previous year, meaning that these data are anywhere from 10 to 22 months delayed in their reporting. The availability of mortality data can also vary widely by location and cause of death.[56]

It is important for local public health workers to have access to timely, accurate data to identify, and potentially respond to, unexpected or unanticipated increases in the number of deaths occurring in their communities. This study uses the COVID-19 pandemic as a natural experiment to identify potential public data sources that could be used to rapidly identify spikes in excess mortality at the county level. Two data sources that are publicly available and easily accessible to a local health officer include online listings of recent deaths by local funeral homes and obituaries published in local newspapers. The COVID-19 pandemic provided a unique opportunity to evaluate whether these two public data sources might be useful for identifying excess mortality in a timely way, at a local level.

Excess mortality, for the purposes of this study, will be defined using the CDC definition: "the difference between the observed numbers of deaths in specific time periods and expected numbers of deaths in the same time periods".[57]

A February 1, 2021, determination by the Institutional Review Board (IRB) for East Tennessee State University confirmed that IRB review and approval for this study was not required.

METHODS

ESTABLISHING A CALCULATION OF EXCESS MORTALITY

Four years of total mortality data for Washington County, Tennessee were obtained from the Tennessee Department of Health through a formal data request.[58] These data were analyzed, looking at month-by-month total reported deaths for 2017, 2018, 2019 and 2020. Using a simple linear regression, deaths by month for 2017, 2018 and 2019 were used to predict expected deaths for each month of 2020 as the baseline for comparison. By subtracting expected 2020 monthly deaths from the actual monthly deaths, monthly number of excess deaths for 2020 were calculated. This calculated difference was then divided by the expected deaths for the same month to calculate percent change.

Excess Death Equation:
(2020 Actual – 2020 Expected) / 2020 Expected = Difference *100 = % Difference

ESTABLISHING THE VALUE OF FUNERAL HOME AND NEWSPAPER OBITUARY DATA

Funeral Home Data:

Four years (2017-2020) of publicly available death listings were collected from four of the approximately eighteen funeral homes in Washington County, the second most populous county in Northeast Tennessee. Three of the funeral homes were identified as the most utilized in the region, and the fourth was selected because it was the most utilized by the region's African American population.

Webpage obituary listings from the funeral homes were counted and stratified by month based on date of death from January 2017 through December 2020 for each funeral home. The 2017-2019 monthly totals were used to create simple linear regressions for each month. These linear regressions were used to calculate expected total deaths for each month of 2020. These monthly expected listings were used as a baseline for comparison to the number of actual 2020 monthly listings. The difference between expected and actual 2020 counts was calculated for each month and then divided by the expected counts for the same month to calculate percent difference.

Newspaper Obituary Data:

The newspaper with the greatest local circulation, The *Johnson City Press*, was selected and four years of obituary listings were collected. These data were obtained from indexes maintained by the Johnson City Public Library. These indexes were quality checked by randomly

identifying 10% of listings for review on the Johnson City Press online archive website. Collected obituary listings were stratified by month, based on the date of death, and the same linear regression calculations, outlined above, were applied to determine 2020 expected monthly listings.

RESULTS

WASHINGTON COUNTY: MONTH-BY-MONTH EXCESS MORTALITY

In 2020, the Tennessee Department of Health reported 165 deaths from COVID-19 in Washington County with the first COVID-19 death occurring on July 28, 2020. However, the total number of excess deaths in 2020 in Washington County was 322 (1,489 expected vs. 1,811 actual), representing a 21.63% increase over the expected number of deaths. The 165 deaths attributed to COVID-19 represent only 51.24% of the total excess deaths in the county.

An analysis of month-by-month mortality data from the Tennessee Department of Health suggests that Washington County was seeing excess mortality prior to the first reported COVID-19 death. In the first quarter of 2020, Washington County experienced 30 excess deaths (386 expected vs. 416 actual), representing a 7.68% increase over the expected number of deaths. Of the 30 excess deaths, none were attributed to COVID-19.

In the second quarter of 2020, Washington County experienced 66 excess deaths (348 expected vs. 414 actual), representing an 18.85% increase over the expected number of deaths. Of the 66 excess deaths, none were attributed to COVID-19.

In the third quarter of 2020, Washington County experienced 47 excess deaths (388 expected vs. 435 actual), representing a 12.21% increase over the expected number of deaths. Of the 47 excess deaths, 38 (80.28%) were attributed to COVID-19.

In the final quarter of 2020, Washington County experienced 179 excess deaths (367 expected vs. 546 actual), representing a 48.91% increase over the expected number of deaths. Of the 179 excess deaths, 127 (70.82%) were attributed to COVID-19.

Table 1 shows the Tennessee Department of Health's number of reported COVID-19 deaths, by month and quarter, compared to the calculated excess mortality for Washington County. It also shows the percent of excess mortality attributed to COVID-19. There was, in retrospect, considerable under-recognition of COVID-19-related deaths in Washington County, Tennessee in 2020. It was not until August 2020 that the percent of excess deaths attributed to COVID-19 reach the 75-88% predicted by the CDC.[60]

Month	2020 Expected Deaths	Actual Reported Deaths in 2020	Number of Excess Deaths	Percent Excess Deaths	COVID-19 Reported Deaths in 2020	Percent of Excess Deaths Attributed to COVID-19
Calculated Excess Mortality and COVID-19 Attributed Excess Mortality in Washington County, TN						
1st Quarter						
January	134.00	135	1.00	0.75%	-	0.00%
February	123.33	137	13.67	11.08%	-	0.00%
March	129.00	144	15.00	11.63%	-	0.00%
Total	386.33	416	29.67	7.68%	-	0.00%
2nd Quarter						
April	107.00	134	27.00	25.23%	-	0.00%
May	123.33	131	7.67	6.22%	-	0.00%
June	118.00	149	31.00	26.27%	-	0.00%
Total	348.33	414	65.67	18.85%	-	0.00%
3rd Quarter						
July	122.00	139	17.00	13.93%	2	11.76%
August	142.33	136	(6.33)	-4.45%	11	173.68%
September	123.33	160	36.67	29.73%	25	68.18%
Total	387.67	435	47.33	12.21%	38	80.28%
4th Quarter						
October	123.67	156	32.33	26.15%	21	64.95%
November	137.67	189	51.33	37.29%	49	95.45%
December	105.33	201	95.67	90.82%	57	59.58%
Total	366.67	546	179.33	48.91%	127	70.82%
2020						
Total	1,489	1,811	322	21.63%	165	51.24%

USING FUNERAL HOME AND NEWSPAPER OBITUARY DATA

Funeral Home Listings:

The expected number of funeral home reports for 2020, based on our simple regression modeling, was 911. By quarter, there were 269, 212, 236 and 195 expected funeral home reports. The total actual listings in 2020 was 1,037, representing a 13.79% increase over the expected. By quarter, 2020 actual listings differed from the expected by Q1: -9.29%, Q2: 11.50%, Q3: 7.36% and Q4: 55.90%. Table 2 outlines funeral home listings (expected and actual) by quarter.

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† 2020 Expected Deaths were calculated using 2017-2019 TDH data to create projections. Actual Reported Deaths in 2020 were obtained through a TDH data request. Number of Excess Deaths is the difference between 2020 Expected and 2020 Actual Reported Deaths. Percent Excess Deaths was calculated by dividing the Number of Excess Deaths by 2020 Expected Deaths. COVID-19 Reported Deaths in 2020 were obtained through TDH Downloadable Datasets. Percent of Excess Deaths Attributed to COVID-19 was calculated by dividing COVID-19 Reported Deaths in 2020 by Number of Excess Deaths.

Selected Funeral Home Reports in Washington County, TN				
Month	2020 Expected Reports	Actual Funeral Home Reports 2020	Number of Excess Funeral Reports	Percent Excess Funeral Reports
1st Quarter				
January	99	88	(11)	-10.81%
February	77	80	3	3.45%
March	93	76	(17)	-18.28%
Total	269	244	(25)	-9.29%
2nd Quarter				
April	83	77	(6)	-7.60%
May	55	73	18	33.54%
June	74	86	12	16.74%
Total	212	236	24	11.50%
3rd Quarter				
July	77	90	13	16.88%
August	75	68	(7)	-9.73%
September	83	95	12	14.00%
Total	236	253	17	7.36%
4th Quarter				
October	59	94	35	59.32%
November	80	97	17	20.75%
December	56	113	57	102.99%
Total	195	304	109	55.90%
2020				
Total 2020	911	1,037	126	13.79%

Newspaper Obituaries:

The expected number of newspaper obituaries for 2020, based on simple regression modeling, was 1,550. By quarter, there were 410, 345, 409, and 385 expected newspaper obituaries. The total actual newspaper obituaries in 2020 was 1,864 representing a 20.28% increase over the expected. By quarter, 2020 actual newspaper obituaries differed from the expected by Q1: 8.05%, Q2: 20.00%, Q3: 9.93% and Q4: 44.55%. Table 3 outlines newspaper obituary listings (expected and actual) by quarter.

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‡ 2020 Expected Reports were calculated using 2017-2019 Funeral Home data to create projections. Actual Funeral Home Reports 2020 were obtained from funeral home websites. Number of Excess Funeral Reports is the difference between 2020 Expected and 2020 Actual Reported Deaths. Percent Excess Funeral Reports was calculated by dividing the Number of Excess Funeral Reports by 2020 Expected Reports.

The newspaper obituary excess mortality percentages closely paralleled the calculated excess mortality for Washington County outlined above using state reported data. The most notable difference being that the newspaper obituary data was available in near real time, whereas the state reported Washington County data was not made available until October of 2021.

TABLE 3§

Selected Obituary Reports in Washington County, TN				
Month	2020 Expected Reports	Actual Newspaper Obituaries 2020	Number of Excess Newspaper Obituaries	Percent Excess Newspaper Obituaries
1st Quarter				
January	154.67	146	(8.67)	-5.60%
February	117.33	140	22.67	19.32%
March	138.00	157	19.00	13.77%
Total	410.00	443	33.00	8.05%
2nd Quarter				
April	112.67	136	23.33	20.71%
May	120.00	122	2.00	1.67%
June	112.33	156	43.67	38.87%
Total	345.00	414	69.00	20.00%
3rd Quarter				
July	141.00	137	(4.00)	-2.84%
August	144.00	140	(4.00)	-2.78%
September	124.33	173	48.67	39.14%
Total	409.33	450	40.67	9.93%
4th Quarter				
October	126.67	170	43.33	34.21%
November	132.67	172	39.33	29.65%
December	126.00	215	89.00	70.63%
Total	385.33	557	171.67	44.55%
2020				
Total 2020	1,550	1,864	314	20.28%

§ 2020 Expected Reports were calculated using 2017-2019 Obituary data to create projections. Actual Newspaper Obituaries 2020 were obtained from newspaper listings. Number of Excess Newspaper Obituaries is the difference between 2020 Expected and 2020 Actual Newspaper Obituaries. Percent Excess Newspaper Obituaries was calculated by dividing the Number of Excess Funeral Reports by 2020 Expected Reports.

DISCUSSION

Given the extensive media coverage of the pandemic, it is hard to imagine that excess deaths associated with COVID-19 were not recognized from the earliest days of the pandemic. However, as documented in this report, the percent of excess deaths in Washington County attributed to COVID-19 in 2020 varied significantly with under-recognition taking place in the early months of the pandemic. This analysis of excess mortality in Washington County in 2020 documents that, despite considerable media attention focused on the COVID-19 pandemic, there was both an under-recognition, and a substantial delay in identifying excess mortality associated with the COVID-19 pandemic.

The failure or delay in recognition of excess deaths can have multiple public health implications. For example, in the case of COVID-19, delay in recognizing excess mortality may have contributed to the difficulty in convincing the public of the significance of the pandemic, especially in the face of suggestions coming from national-level officials and news outlets that the severity of the pandemic was being exaggerated as mentioned in Section 1 of this report.[60,61] During non-pandemic times, failure to recognize excess mortality could result in delays in recognizing, or even failure to recognize, an unanticipated cause of death in a community. Because state level death data can take over a year to be made available to local public health officials, they may not be particularly useful for local and state-level health officials in identifying and responding to unexpected changes in the number of deaths in a region.

The COVID-19 pandemic provided a useful natural experiment to see if online funeral home listings and/or newspaper obituaries could have provided local health officials an early indication that deaths were exceeding the expectations of death data trends. This study documents that online public reports from selected funeral homes and newspaper obituary listings can provide local health officers, with useful, accessible, and reliable "real time" indications of excess mortality within their region.

When comparing online funeral listings and newspaper obituaries to state reported data for Washington County (Figure 4 and Figure 5), it is clear that either of the public data sources could have been used to identify spikes in excess mortality throughout 2020. The trend of funeral listings (Figure 4) shows peaks and valleys that are relatively consistent with state health department data with the first major spike occurring in May 2020, and two additional larger spikes in October and December 2020. However, with the public data sources available and the current utilization of funeral listing and obituary services in Washington County, it is clear to see that newspaper obituaries more closely mirror the Tennessee Department of Health date for Washington County (Figure 5). Aside from very minor differences in February and June, the two lines in Figure 4 are remarkably similar. Therefore, had this technique for identifying excess mortality been employed prior to the pandemic, health officials in Washington County, Tennessee would have begun seeing increases in mortality as early as February 2020 and these trends would have later, in October 2021, been corroborated by state health department data.
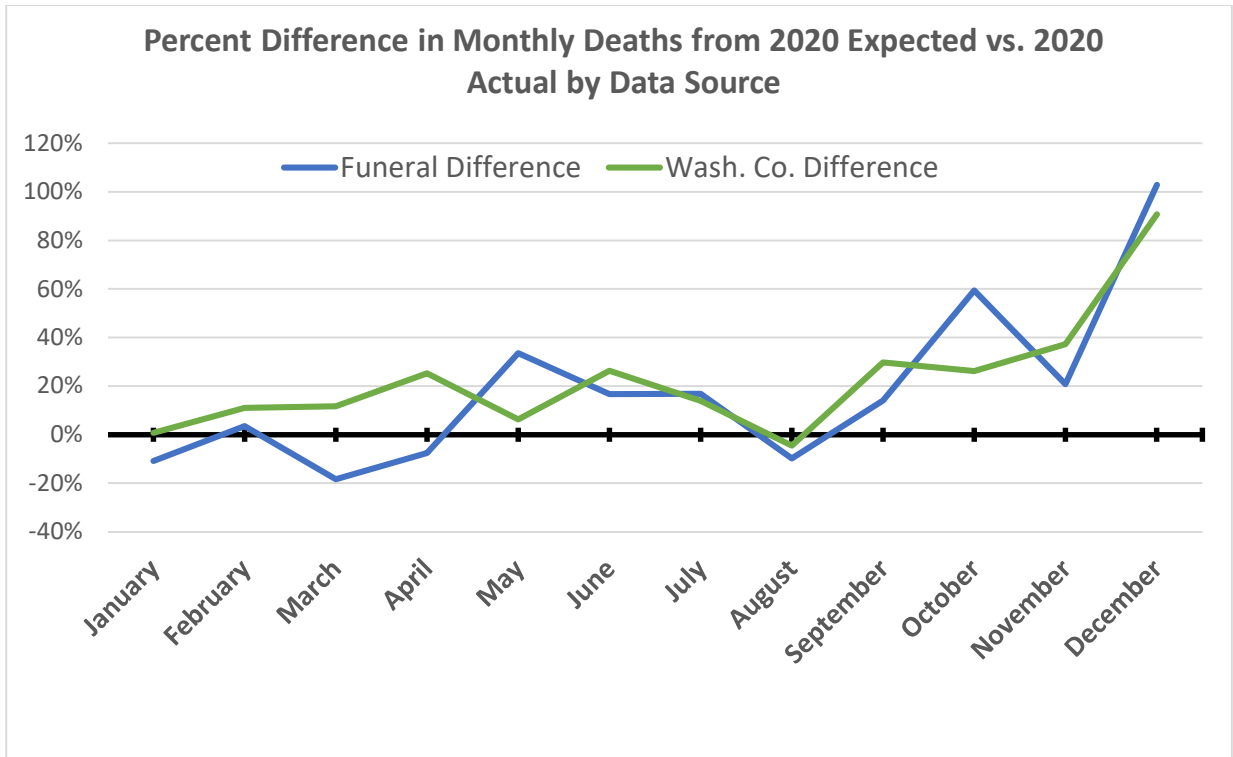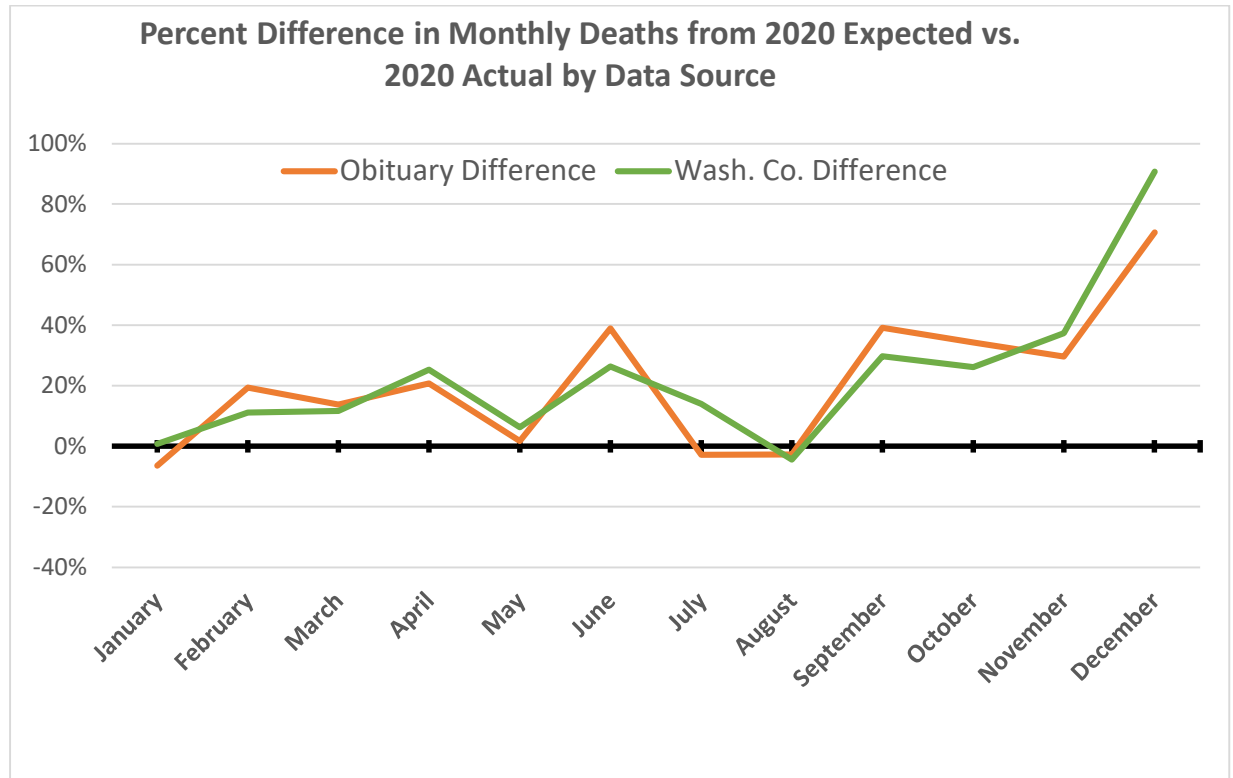
FIGURE 4

FIGURE 5

Because state level death data can take over a year to be made available to local public health officials,[56] there is the possibility that a short-term increase in deaths may not be immediately obvious. Creating a historical month-by-month registry of the number of deaths in the region, collated from a selected number of funeral homes and/or newspaper obituaries is an inexpensive and relatively quick method for local health officials to have an early indication that something has changed in their region.

While this study was conducted during the COVID-19 pandemic, when it was widely recognized that there were excess deaths, the results would be applicable in a wide variety of settings such as the introduction of heroin laced with an unprecedented amount of Fentanyl, an unrecognized contamination of drinking water or other consumer product, or an environmental pollutant. Based on these findings, it could be beneficial for health officials to create and maintain a database of deaths at a city or county level, based on funeral home data and newspaper obituaries that could serve as an early indicator that a change has happened in the number of deaths in their region. Though not done in this study, in larger regions, it may also be possible to create more specific databases that reflect changes in death rates for different age, race, gender or socioeconomic groups, over time.

LIMITATIONS

There are several caveats and limitations to using funeral home and/or obituary data to identify excess mortality in any region. Importantly, neither is an accurate reflection of total deaths in a region. For example, not everyone who dies will have their funeral service held in the region where they die. Conversely, some people who die outside the region will have a local funeral service and/or a locally reported obituary. An additional limitation is that it isn't possible, from this type of review, to identify the cause of the excess mortality.

Additionally, creating simple linear regressions with only three years of data lends itself to inaccuracies. This was done because, at the time of data collection, online funeral home listings prior to 2017 were unattainable. However, since the method for establishing 2020 monthly expected deaths was replicated for all data sources using the same number of years, it is believed that the comparisons provided are valid. This limitation would also be addressed in time, given that the longer this data is collected, the more years of data would be available for use in the regression modeling, thereby strengthening confidence in expected death calculations.

Finally, while online funeral listings and newspaper obituaries were readily available data sources in Washington County, TN, the utilization, and composition of public death listing sources in each region is likely to vary. This study should be considered a pilot study and, should public health professionals seek to employ these techniques for identifying excess mortality, they should identify the most utilized and reliable data sources available in their region. Undoubtedly, this is an imperfect technique that is susceptible to inaccuracy and should never be the only process employed for identifying increases in mortality. However, it can be another, relatively simple and useful, tool in the local public health professional's arsenal that can be used to rapidly identify and react to potential threats to the health of a community.

CONCLUSION

        After collecting and analyzing four years of mortality data from three distinct sources, two publicly available and one state health department managed, it is clear that two public data sources (online funeral listings and newspaper obituaries) could have been used to quickly identifying excess mortality in a community. Using the COVID-19 pandemic as a natural experiment, data were collected, and relatively simple statistical analyses were conducted to establish the expected deaths for the year 2020. Actual deaths in 2020 were then compared to identify excess mortality. In the wake of the devastating COVID-19 pandemic, the technique outlined in this report could be used to identify future public health threats and ultimately prevent the loss of life at the city/county level. This has significant implications for local and state-level public health leaders, and others who currently rely on "official" state-level mortality data, which may not be available for a year or more after the deaths occur. Online funeral home listings and newspaper obituaries provide an accessible and inexpensive "real time" mechanism to identify excess mortality.

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