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Statistical and numerical errors made by the US Centers for Disease Control and Prevention during the COVID-19 pandemic

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ABSTRACT

Background: The Centers for Disease Control and Prevention (CDC) has been a major source of information during the COVID-19 pandemic, guiding policies and practices in many aspects of life. As such, it is imperative that the information be free of errors, or, if errors are made, that they are corrected quickly. **Methods:** We sought to compile instances of numerical and statistical errors made by the CDC during the COVID-19 pandemic by reviewing CDC publications, press releases, interviews, meetings, and Twitter accounts. Further, we catalogued mortality data from both the National Center for Health Statistics and the CDC COVID Data Tracker and compared reported results. **Results:** We documented 25 instances when the CDC reported statistical or numerical errors. Twenty (80%) of these instances exaggerated the severity of the COVID-19 situation, 3 (12%) instances simultaneously exaggerated and downplayed the severity of the situation, one error was neutral, and one error exaggerated COVID-19 vaccine risks. The CDC was notified about the errors in 16 (64%) instances, and later corrected the errors in 11 (44%) instances. **Conclusion:** A basic prerequisite for making informed policy decisions is accurate and reliable statistics, even during times of uncertainty. Our investigation reveals 25 instances of numerical or statistical errors made by the CDC. Our investigation suggests 1) the need for greater diligence in data collection and reporting, and 2) that the federal entity responsible for reporting health statistics should be firewalled from the entity setting policy due to concerns of real or perceived systematic bias in errors.

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INTRODUCTION

Misinformation is defined as “inaccurate and misleading information.”¹ The Centers for Disease Control and Prevention (CDC) and Food and Drug Administration (FDA) are concerned by the rise of misinformation during the COVID-19 pandemic. Specifically, the FDA commissioner has stated, “I believe that misinformation is now our leading cause of death,”² and the CDC hosts a website addressing COVID-19 vaccine misinformation, which states, “Misinformation often arises when there are information gaps or unsettled science, as human nature seeks to reason, better understand, and fill in the gaps.”³

At the same time, government agencies are not immune to error. False statements may be made by agencies, unintentionally or intentionally. These errors may be amplified in news coverage and on social media. Given the ability to peruse primary data in real time, it is likely some of these errors will be detected by the scientific community. If errors fall in one direction preferentially – either overstating the risk of the virus or understating it – trust may be eroded, and the potential for bias within the agency is raised.

Many entities rely on the CDC for trusted information, as does the lay public. For instance, YouTube links to the CDC website on all videos discussing COVID-19, supporting CDC policy positions.⁴ Spotify links select podcast episodes to the CDC website as well. Many universities, healthcare facilities, daycares, churches, businesses, schools, sports programs, and camps defer to CDC guidance for COVID-19 precautions.

For this reason, it is imperative the CDC avoids errors in their statements, or, if errors are made, that they are rapidly corrected. We set out to identify numerical errors or objectively false statements made by the CDC.

METHODS

Our aim was to compile instances that we (KK, TBH, VP) have documented during the COVID-19 pandemic (2020-23) where the US CDC promoted or utilized demonstrably false numbers or erroneous statistics. We sought to identify errors that were indisputable and incorrect, as a matter of fact, and not preference or opinion.

Dataset

The CDC, like all US federal agencies puts out a voluminous amount of information on their website, social media accounts, scientific publications, such as Morbidity and Mortality Weekly Report (MMWR), press releases, interviews, and meetings (such as the Advisory Committee of Immunization Practices [ACIP]). Complete or even systematic appraisal of these materials is daunting due to lack of a central repository, shifting or deleted webpages, and sheer volume.

We sought to compile errors that we previously identified in our real time observation of the COVID-19 pandemic, including, but not limited to, news sources we read or watched, ACIP meeting or transcripts or slides we observed, the CDC and CDC Director's Twitter accounts, MMWR research, and errors brought to our attention by other observers. To do this, we selected 3 observers who have closely followed the CDC (TBH, VP, and KK) and asked the authors to compile a list of numerical and statistical errors that they have documented. Errors needed to pertain to numerical or objectively false statements. These three authors were assembled because they have closely tracked and have expertise in interpreting statements by the agency. Because of this, they were also frequently alerted to CDC errors by other observers. Duplicate errors were removed.

Adjudication of errors

All putative numerical and statistical errors were presented at a meeting with all authors present. These errors were discussed and reviewed. Errors were accepted if and only if 3 authors all felt the errors were demonstrably false. A fourth author, not involved in the collection (AH), made the final determination whether the included errors were demonstrably false. When errors were identified, two reviewers coded them as exaggerating the risk of COVID-19, downplaying it, having a neutral effect, or mixed (KK and AH). If disagreements occurred, they were adjudicated by a third reviewer (VP).

For each error, we noted where it was reported, the source of error, whether the errors pertained to adults, children, or both, whether the CDC had been contacted about the error, and whether the CDC resolved the issue.

As many of the errors pertained to information delivered through the CDC COVID Data Tracker⁵ we compared mortality numbers from the Data Tracker and the National Center for Health Statistics (NCHS).⁶ CDC COVID Data Tracker data were downloaded weekly from April 1, 2022,

through February 9, 2023. CDC COVID Data Tracker mortality data were compared to monthly cumulative COVID-19 mortality data from NCHS.

Statistical analysis

Our analyses were descriptive, and no comparisons were made. Data were presented as frequencies and percentages. Data were collected in a Google Document and analyzed with R statistical software (version 4.2.1).

Our study involved publicly available data and did not involve individual patient data; thus, it was not submitted for institutional review board, in accordance with 45 CFR §46.102(f).

RESULTS

Our mixed method identified 25 instances where CDC statements had numerical or statistical errors. We present all these errors, their context, and explanation in the **Table**.

Twenty (80%) of these instances exaggerated the severity of the COVID-19 situation, 3 (12%) instances simultaneously exaggerated and downplayed the severity of the situation, one instance was neutral, but was false, nonetheless, and one instance exaggerated the risks of the COVID-19 vaccines.

16 (64%) pertained to children alone, and 9 (36%) pertained to both children and adults. Of the 16 cases that included data pertinent to children alone, 15 (94%) enhanced the perceived risk of COVID-19 in children, and one exaggerated their risks from the COVID-19 vaccine. Of the 3 instances where the direction of the error was “mixed”, all 3 (100%) exaggerated risks to children and understated risks to adults.

Errors included basic vital statistics such as the number of deceased children. Thirteen (52%) involved mortality statistics.

An error made in four instances pertained to comparisons of different causes of childhood death. The CDC compared COVID-19 deaths, where COVID-19 was one of multiple causes listed on the death certificate, to other causes of death in children, which were listed as the single underlying cause of death. This error exaggerated the risk of COVID-19 death.

The sources where the errors were originally reported were: CDC COVID Data Tracker (n=8; 32%), ACIP meeting (n=4; 16%), CDC Twitter page (n=3; 12%), COVID-19 website (n=3; 12%), White House press briefing (n=2; 8%), MMWR reports (n=2; 8%), CDC slide deck (n=1; 4%), CDC Excess Mortality Dashboard (n=1; 4%), and CDC COVID Data Tracker and testimony (n=1; 4%).

Figure 1 shows the number of deaths reported by both the CDC COVID Data Tracker and NCHS for people 0-17 years of age. CDC COVID Data Tracker numbers were consistently higher than NCHS numbers in children and adolescents. **Figure 2** shows the number of deaths reported by both the CDC COVID Data Tracker and NCHS for people 18 years of age and older. CDC COVID Data Tracker numbers were consistently lower than those reported by the NCHS in individuals 18 years and older. The discrepancies were brought to the attention of the CDC and, although adjustments were made to counts, the major discrepancies persisted (see **Table**, dates March 15, 2022 and August 26, 2022, **Figure 1** and **Figure 2**).

The CDC was notified about the errors identified in this paper in 16 (64%) instances, and later corrected the errors in 11 (44%) of total instances and partially corrected the error in 2 (8%) instances. In one instance, the error was raised at an ACIP meeting.⁷ The Top 5 cause of death claim was presented at a June 2022 ACIP meeting, and later included in comments during a White House press briefing and repeated in a September 2022 ACIP meeting. It was also included in an ACIP webpage detailing vaccination evidence for young children, which is the only source where it was corrected.

DISCUSSION

If a public health agency chooses to campaign against misinformation, it is important that the agency accurately present basic statistical information. Our search identified 25 instances of demonstrably false information offered by the CDC. In at least three instances, this was documented in the lay media or medical journals.⁸⁻¹⁰ In 16 instances, the CDC was informed of their error, and fully corrected their error in 11/25 (44%) instances. In 80% of instances, the CDC's errors exaggerated the risk of COVID-19, and yet in only one did it exaggerate risks from the COVID-19 vaccine. Most instances (64%) pertained to children. Of the 16 errors that pertained to COVID-19 risk in children, 94% exaggerated their COVID-19 risks.

Many instances of misinformation from the CDC were related to pediatric mortality data, exaggerating the impact of COVID-19 in children. While the European CDC provided reassuring data on SARS-CoV-2 in children,¹¹ the errors we found show the US CDC has overstated risks. In all identified instances where the CDC made an error in reporting pediatric COVID-19 deaths, they overstated the number, while understating deaths for adults. Many of these claims about pediatric deaths have stemmed from the CDC's COVID Data Tracker Demographics page, which has been cited by journalists, the CDC, and the CDC Director.

According to the CDC, the CDC COVID Data Tracker is a only a surveillance system meant to monitor real-time trends, while official death statistics are tracked by the NCHS, offering "the most accurate death counts."¹²

The footnote on the CDC COVID Data Tracker Demographics page states, "Demographic data for COVID-19 cases and deaths is based on a subset of individuals where case-level data are reported by state and territorial jurisdictions to the Centers for Disease Control and Prevention (CDC) since January 21, 2020," implying the counts are underreported.¹³ However, official data counts from NCHS indicates the CDC COVID Data tracker is instead consistently providing overcounts for children.

Several instances of misinformation we identified involved a pre-print cited by the CDC, which ranked COVID-19 as one of the top five leading causes of death in children of all age groups.¹⁴ That pre-print compared COVID-19 deaths where COVID-19 was one of several contributing causes to deaths from other causes which were only using death statistics where that disease was identified as the single underlying cause of death. It also compared cumulative COVID-19 deaths over 26 months to annual (12 month) death rates for other diseases. These led to statements that COVID-19 was a top 5 leading cause of death in children (**Table**). But this was incorrect and was based on a flawed comparison which by design exaggerates COVID-19 risks compared with other causes of death in children

This claim was cited in an FDA Vaccines and Related Biological Products Advisory Committee meeting, at an ACIP meeting, and widely shared on social media and in traditional media before errors were brought to light. It was also cited by CDC Director Walensky in a White House COVID-19 briefing¹² and by the Chair of the ACIP in a subsequent meeting²³, after the errors were identified.¹⁵ Although the study authors revised their pre-print,¹⁶ the CDC's only public

acknowledgement of the misinformation was a note on the ACIP evidence page for childhood vaccination, added 4 months after the original misinformation was shared.¹⁵

The CDC's webpage "Estimated COVID-19 Burden" also misstated information on pediatric deaths at times.¹⁷ The page includes a graph of estimated cases, hospitalizations, and deaths by age group. When mortality estimates were first added with data through May 2021, the graph and associated data table incorrectly listed pediatric COVID-19 deaths as 4% of COVID-19 deaths instead of 0.04% of deaths (the percentages totaled 104%). When the page was updated with data through September 2021, the estimated number of infections decreased for ages 0-17, and increased for every other age group.

In addition, the estimated rate of infections was less than the estimated rate of symptomatic illness for children (this error was corrected when the CDC was contacted in November 2021). The graph and table at the bottom of this webpage were not updated, with the exception of the date in the header, so the original 4% error remained on the page, while the correct data now showed 0.07% of total COVID-19 deaths were in children. When that error was discovered in March 2022, CDC was notified, and they corrected the error. However, the incorrect data had been displayed on the CDC website for 7 months before being identified by an outside observer.

In multiple cases, pediatric hospitalization numbers were also overstated on the CDC website. This led to the false appearance of increasing pediatric hospital admissions and simultaneously inflated the total number of pediatric hospital admissions. When the Department of Health and Human Services was responsible for collecting this data, the errors were corrected promptly. Hospital data collection transitioned to CDC on December 15, 2022, and an error with North Carolina data on December 27, 2022 (139 new pediatric admissions in one day after prior 7-day average of 2.3/day) has not yet been corrected, despite notification to CDC on January 9, 2023.

These errors suggest the CDC consistently exaggerates the impact of COVID-19 on children. At the same time, the CDC has expressed significant concern about COVID-19 misinformation. In order for the CDC to be a credible source of information, they must improve the accuracy of the data they provide.

Strengths and Limitations

Our paper has several strengths and key limitations. The major strength is we report all errors and underlying documentation in the Table. Since we believe these are objective errors, we encourage readers to interrogate them directly. Additionally, the errors come from a single

agency and are factual errors. They span multiple domains, including social media and news coverage, as well as journals and public meetings. Arguably, errors of this nature should simply not be made by a federal organization at a time of crisis, and the dissemination in news outlets and social media means these may have massive implications on public perception.

We have 3 limitations. Ours is ultimately a convenience sample based on the records of three observers of the agency. Critics may contend that these observers were biased towards identifying errors made by the agency and errors of a certain nature. We agree with this criticism, but we point out that the errors are not a matter of opinion but are demonstrably wrong. Moreover, systematic approaches to tackle this question are limited because of lack of central repository, shifting or deleted webpages, and sheer volume. Moreover, all investigations will be biased by the policy ideas of the investigators – this is an inherent bias. The best method to overcome the bias is full reporting of the dataset, as we have done here. We encourage reanalysis and addition of errors we may have missed.

Our second limitation is that our method likely underestimates the true number of factual errors. Although our method involved the careful appraisal of a large portion of CDC communications, it also required the reader to question or dispute a finding, prompting detailed investigation. It is likely that we were unaware of some information that may have called other findings into question or doubt. Third, we did not evaluate all CDC claims to determine the percentage of claims that have errors or not. Our intent was to point out that errors are being made in reporting of data – data that were used to influence policy, often through news or social media coverage.

Conclusion

In times of crisis, decisions must be made based on uncertain evidence, and inevitably disagreements may arise regarding unprecedented policy choices. Yet, a basic prerequisite to make informed policy decisions is the provision of accurate and reliable statistics. Our investigation revealed 25 instances of indisputable numerical or statistical errors made by the CDC.

In 84% (21/25) of identified cases, these errors only enhanced perceptions of risk, one of which led to an increased perception of risk from vaccination. 94% of the errors we identified that pertained to children alone exaggerated their COVID-19 risks. All 13 errors involving COVID-19 mortality risks were exaggerations of pediatric deaths. This is a group that has a COVID-19

infection fatality ratio of at least 1000-fold less than older groups,¹⁸ and the CDC's errors have likely led the public to believe children's risks are higher than they truly are in non-erroneous data.

The errors we identified include basic facts like the number of children who have died, and the ranking of COVID-19 among causes of pediatric death. These errors have been made repeatedly and were likely to have affected discussion of pandemic policies. During the years the errors occurred, CDC's guidance repeatedly called for restrictions being placed on children, including school closures, mask mandates, and strong recommendations for vaccinations and multiple boosters even among children who have recovered from the virus.

Our investigation, essentially a fact checking exercise, suggests 1) a greater diligence is needed to avoid errors in public health data, and 2) that the federal entity responsible for reporting health statistics should be firewalled from the entity setting policy, for concerns of real or perceived systematic bias in errors.

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Authorship contribution: VP and KK conceptualized study design; KK, VP, and TBH reviewed and abstracted data; AH reviewed and confirmed abstracted data; VP and KK wrote first draft of manuscript; and AH and TBH reviewed and revised subsequent and finalized draft of manuscript.

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Figure 1. Cumulative deaths reported by the CDC COVID Data Tracker and the National Center for Health Statistics (NCHS) for individuals 0-17 years of age.

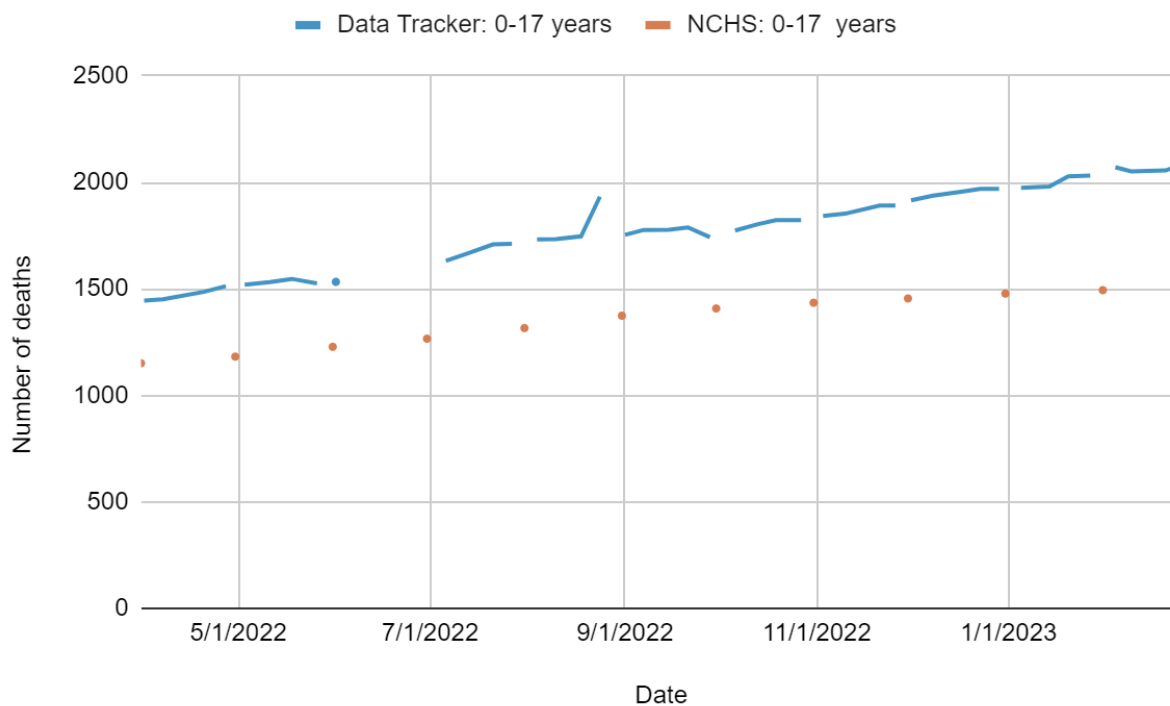


Figure 2. Cumulative deaths reported by the CDC COVID Data Tracker and the National Center for Health Statistics (NCHS) for individuals 18 years and older.

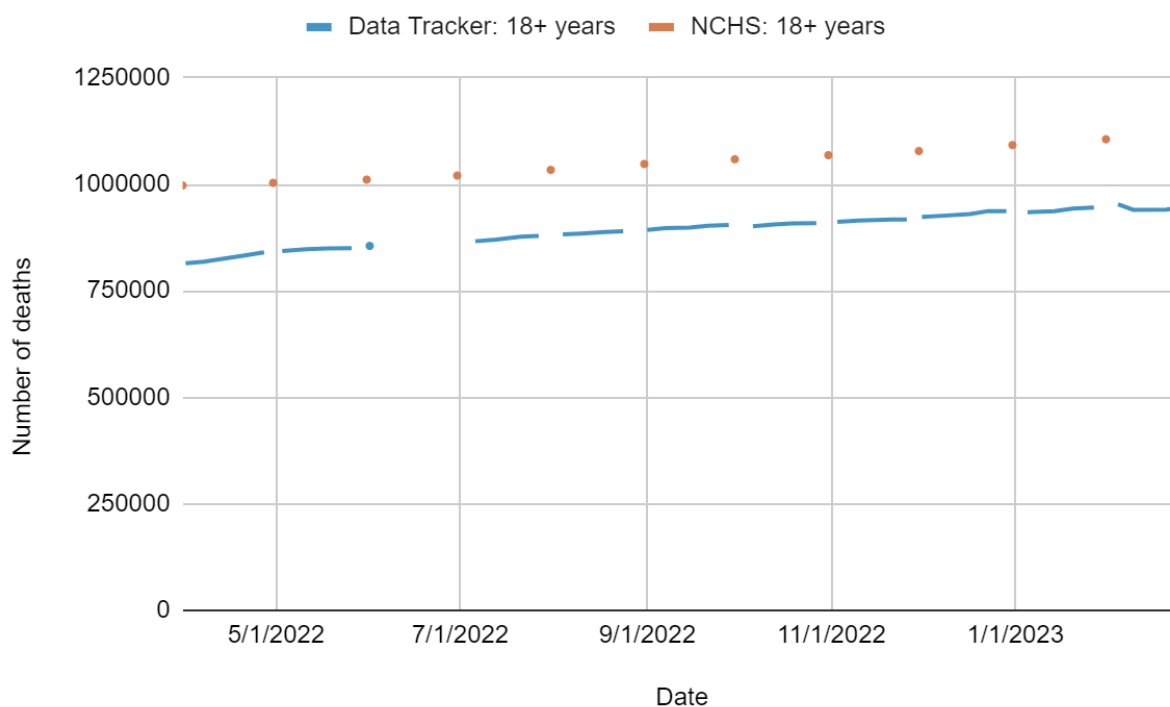


Table. Instances of numerical and statistical errors in CDC reporting of COVID data

	Claim/Statement	Error	Source of Error	Risks	Children-or-adult-specific data	CDC Notified	CDC Corrected
2021							
Feb 26	<i>MMWR stated that during the study period, the 7-day moving average of cases identified by PCR or antigen testing ranged from 152 to 577 cases⁹</i>	Multiple errors. Reported case rates during the study period were described as a 7-day moving average of cases per 100,000 persons including PCR and antigen cases, but the paper actually reported the raw 7 day moving average (without adjusting for population) and for PCR only (not including antigen tests) ²⁰	MMWR	Exaggerated	Children	Yes	Yes
Jul 26	<i>Delta Variant is as contagious as chicken pox⁹</i>	Delta is not as contagious as varicella. The CDC overstated Delta R0 and understated chicken pox R0 (Delta estimate was overlaid directly on a New York Times graphic)	CDC slide deck	Exaggerated	Both	No	No
Jul 27	<i>4% of COVID-19 deaths are in children 0-17⁸</i>	Actual number was 0.04% based on original CDC estimated data. When the estimated data were updated later, the percentages were not updated. The actual percentage based on the updated data was 0.07%.	COVID-19 website	Exaggerated	Children	Yes	Yes
Oct 15	<i>"COVID-NET data for the week ending Sept. 25 show that rates of COVID-19-associated hospitalizations in children ages 5–11 years are the highest they've been."²¹</i>	COVID-NET hospitalizations were already falling from Sept peak. Rate was 1.1 week ending Sept. 11 and Sept. 25. (Now week of Sept. 11 shows 1.2) ²²	Twitter @CDCgov	Exaggerated	Children	No	No
Oct 27	<i>CDC Director Walensky said "there have been 745 deaths in children less than 18."²³</i>	As of 10/27/21, NCHS data showed 558 deaths with COVID-19. Final NCHS data shows 679 pediatric deaths with COVID-19 through Oct. 30, 2021 ²⁴	White House Press Briefing	Exaggerated	Children	No	No
Nov 8	<i>Among ages 0-17, CDC's reported rate of symptomatic illness was more than the total infection rate (asymptomatic + symptomatic – an impossible claim), and this error occurred among children (infection rate also fell only for children from May 21 to Sept 21 estimates)^{17,25}</i>	Estimated infection rate was 35,490 per 100K, not 29,885 per 100K (symptomatic illness remained at 30,253 per 100K)	COVID-19 website	Neutral	Both	Yes	Partially
Dec 20	<i>Omicron makes up 73% of new infections in the US¹⁰</i>	Error with Nowcast estimate, a week later, they revised to 23% (outside the previous 95% CI)	Data Tracker	Exaggerated	Both	No	Yes
2022							
Feb 24	<i>COVID-19 hospitalizations had a sudden >1.6-fold increase in Georgia per HHS/CDC data²⁶</i>	Very likely a dramatic multi-week increase was due to imputation error on behalf of the reporting state or municipality, yet this was not audited or detected	Data Tracker	Exaggerated	Both	Yes	Yes
Mar 15	<i>Pediatric deaths on the Data Tracker demographics page were overstated while adult deaths were understated⁸</i>	On 3/15/22, CDC removed 416 pediatric deaths from Data Tracker from 1755 to 1339 (still overstated) and almost 72,000 adult deaths, blaming an algorithm for classifying deaths as COVID-19 related	Data Tracker	Mixed	Both	Yes	Partially
Jun 17	<i>COVID-19 is a top 5 cause of death in children of all age groups²⁷</i>	Pre-print had inaccurate data, and CDC chose the most extreme version of the flawed data. Specifically, for COVID-19 they used cumulative counts (which spanned more than 2 years), and death was attributed if it was one of any multiple cause of death, whereas for other causes of death, they used only a single year, and attributed it only if it was the single underlying cause of death)	ACIP Meeting	Exaggerated	Children	Yes	No
Jun 23	<i>At a White House COVID-19 briefing, CDC Director Walensky cited the claim that COVID-19 is a "top 5 cause of death" in children¹²</i>	Flawed pre-print, ¹⁴ authors already acknowledged that fact, and COVID-19 was not a top 5 cause of death	White House Press Briefing	Exaggerated	Children	No	No

Jun 27	ACIP web site includes the "top 5 cause of death" claim ¹⁵	Flawed pre-print, ¹⁴ authors already acknowledged that fact, and COVID-19 was not a top 5 cause of death	ACIP website	Exaggerated	Children	Yes	Yes
Aug 9	COVID-19 has killed 1500 children ages 17 & younger ²⁸	As of 8/10/22, NCHS data showed 1201 deaths with COVID-19. As of 2/5/23, NCHS data shows 1323 pediatric deaths with COVID-19 through August 6, 2022 ²⁴	Twitter @CDCgov	Exaggerated	Children	No	No
Aug 12	"COVID-19 hospitalizations for children and teens are increasing again in the U.S." ²⁹	CDC hospitalization data showed hospitalizations had peaked 2 weeks prior, on 7/29/22	Twitter @CDCgov	Exaggerated	Children	No	No
Aug 20	CDC Excess Mortality Dashboard overstated recent deaths in North Carolina & Connecticut ³⁸	Model for weighting due to death reporting lag was poorly adjusted	CDC Excess Mortality Dashboard	Exaggerated risk of all-cause mortality	Both	Yes	Yes
Aug 22	Alabama pediatric hospitalizations had a dramatic single week increase from <10/day to >50/day ^{30, 13}	Very likely a dramatic single week increase was due to imputation error on behalf of the reporting state or municipality, yet this was not audited or detected	Data Tracker	Exaggerated	Children	Yes	Yes
Aug 26	CDC Data Tracker made a single week jump of 186 pediatric deaths and 1679 adult deaths, which is unusually high for children and unusually low for adults ³¹	Incorrect death data. CDC corrected this days later, removing 173 pediatric deaths and adding 2484 adult deaths	Data Tracker	Mixed	Both	Yes	Yes
Sep 1	ACIP Chair Grace Lee repeated the "top 5 cause of death" claim in ACIP meeting to approve bivalent booster ¹	Flawed pre-print ¹⁴ was corrected two months prior. Unknown if ACIP committee informed	ACIP meeting	Exaggerated	Children	Yes	No
Nov 9	Florida pediatric hospitalizations had a dramatic single week increase from 7 to 112 (7-day new admissions) ^{32, 13}	Very likely a dramatic single week increase was due to imputation error on behalf of the reporting state or municipality, yet this was not audited or detected	Data Tracker	Exaggerated	Children	Yes	Yes
Dec 30	XBB.1.5 variant reported at 41% of new infections in the US ³³	A week later they revised to 18% (outside the original 95% CI)	COVID-19 website	Exaggerated	Both	Yes	Yes
Dec 31	North Carolina pediatric hospitalizations had a dramatic single week increase from 2 to 19 (7-day new admissions) ¹³	Very likely a dramatic single week increase was due to imputation error on behalf of the reporting state or municipality, yet this was not audited or detected	Data Tracker	Exaggerated	Children	Yes	No

2023

Thru Mar 3	Data Tracker continues to report too many pediatric deaths and too few adult deaths ³⁴	Inaccurate mortality data by age group is updated weekly on the CDC Data Tracker Demographics page	Data Tracker	Mixed	Both	Yes	No
Feb 9	Dr. Walensky testified before Congress that there had been "2000 pediatric deaths from COVID-19" ⁹⁵	This number comes from the flawed Data Tracker. Actual number is 1400-1500	Data Tracker/ testimony	Exaggerated	Children	No	No
Jan 13	Table 2 listed 62 events for children needing medical care as 13.9% ³⁶	It should be 1.9%. It is correct in the text, but not the table	MMWR	Exaggerated risk of vaccine	Children	Yes	Yes
Feb 23	ACIP slide claimed 1489 pediatric deaths in ages 6 months - 17 years ³⁷	They did not remove 305 deaths in infants <6 months. Actual number should have been 1184 using the NCHS data source cited on the slide	ACIP meeting	Exaggerated	Children	No	No

ACIP: Advisory Committee on Immunization Practices; CDC: Centers for Disease Control and Prevention; COVID-NET: Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network; Data Tracker: CDC COVID-19 Data Tracker; HHS: Department of Health and Human Services; MMWR: Morbidity and Mortality Weekly Report.