

## Review

# **A SYSTEMATIC REVIEW OF AUTOPSY FINDINGS IN DEATHS AFTER COVID-19 VACCINATION**

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## **Abstract**

**Background:** The rapid development and widespread deployment of COVID-19 vaccines, combined with a high number of adverse event reports, have led to concerns over possible mechanisms of injury including systemic lipid nanoparticle (LNP) and mRNA distribution, spike protein-associated tissue damage, thrombogenicity, immune system dysfunction, and carcinogenicity. The aim of this systematic review is to investigate possible causal links between COVID-19 vaccine administration and death using autopsies and post-mortem analysis.

**Methods:** We searched for all published autopsy and necropsy reports relating to COVID-19 vaccination up until May 18<sup>th</sup>, 2023. We initially identified 678 studies and, after screening for our inclusion criteria, included 44 papers that contained 325 autopsy cases and one necropsy case. Three physicians independently reviewed all deaths and determined whether COVID-19 vaccination was the direct cause or contributed significantly to death.

**Findings:** The most implicated organ system in COVID-19 vaccine-associated death was the cardiovascular system (53%), followed by the hematological system (17%), the respiratory system (8%), and multiple organ systems (7%). Three or more organ systems were affected in 21 cases. The mean time from vaccination to

death was 14.3 days. Most deaths occurred within a week from last vaccine administration. A total of 240 deaths (73.9%) were independently adjudicated as directly due to or significantly contributed to by COVID-19 vaccination.

**Interpretation:** The consistency seen among cases in this review with known COVID-19 vaccine adverse events, their mechanisms, and related excess death, coupled with autopsy confirmation and physician-led death adjudication, suggests there is a high likelihood of a causal link between COVID-19 vaccines and death in most cases. Further urgent investigation is required for the purpose of clarifying our findings.

**Keywords:** Autopsy; necropsy; COVID-19; COVID-19 vaccines; mRNA; SARS-CoV-2 vaccination; death; excess mortality; spike protein; organ system

## **Research in context**

### **Evidence before this study**

COVID-19 vaccines, with known mechanisms of injury to the human body and a substantial number of adverse event reports, represent an exposure that we hypothesized to be possibly linked to death in some cases. Thus, we searched PubMed and ScienceDirect for all published autopsy and necropsy reports relating to COVID-19 vaccination through May 18<sup>th</sup>, 2023 using keywords relating to COVID-19 vaccines, death, autopsy, and necropsy. We found that no comprehensive review of autopsy findings in a large series of deaths after COVID-19 vaccination that accounts for the current state of knowledge has been conducted. The mechanisms of death from COVID-19 vaccination remain largely unexplored.

### **Added value of this study**

Because the state of knowledge has advanced since the time of the original publications, new assessments regarding COVID-19 vaccine adverse events can be made. Based on the previously published literature of COVID-19 vaccine adverse events, their mechanisms, and related excess death, coupled with autopsy confirmation and physician-led death adjudication, we found a high likelihood of a causal link between COVID-19 vaccines and death among most of the 326

included cases. This is the first study that indicates a high probability of causality between COVID-19 vaccine administration and death in many cases. To date, this is the largest review of autopsy findings in deaths after COVID-19 vaccination, helping the medical community to better understand fatal COVID-19 vaccine syndromes.

### **Implications of all the available evidence**

Further urgent investigation is required aimed at confirming our results and further elucidating the mechanisms underlying the described fatal outcomes with the goal of risk mitigation for the large numbers of individuals who have taken one or more COVID-19 vaccines. If a large number of deaths are indeed causally linked to COVID-19 vaccination, the implications could be immense, including: the complete withdrawal of all COVID-19 vaccines from the global market, suspension of all remaining COVID-19 vaccine mandates and passports, loss of public trust in government and medical institutions, investigations and inquiries into the censorship, silencing and persecution of doctors and scientists who raised these concerns, and compensation for those who were harmed as a result of the administration of COVID-19 vaccines.

## **Introduction**

As of May 31<sup>st</sup>, 2023, SARS-CoV-2 has infected an estimated 767,364,883 people globally, resulting in 6,938,353 deaths<sup>1</sup>. As a direct response to this worldwide catastrophe, governments adopted a coordinated approach to limit caseloads and mortality utilizing a combination of non-pharmaceutical interventions (NPIs) and novel gene-based vaccine platforms. The first doses of vaccine were administered less than 11 months after the identification of the SARS-CoV-2 genetic sequence (in the United States, under the Operation Warp Speed initiative), which represented the fastest vaccine development in history with limited assurances of short and long-term safety<sup>2</sup>. At the time of writing, about 69% of the world population have been inoculated with at least one dose of a COVID-19 vaccine<sup>1</sup>.

The most frequently utilized COVID-19 vaccine platforms include inactivated virus (Sinovac – CoronaVac), protein subunit (Novavax – NVX-CoV2373), viral vector (AstraZeneca – ChAdOx1 nCoV-19, Johnson & Johnson – Ad26.COV2.S), and messenger RNA (Pfizer-BioNTech – BNT162b2, Moderna – mRNA-1273)<sup>3</sup>. All utilize mechanisms that can cause serious adverse events; most involve the uncontrolled synthesis of the spike glycoprotein (SP) as the basis of the immunological response. Circulating SP is the likely deleterious mechanism

through which COVID-19 vaccines produce adverse effects<sup>4,5,7,8,10,11</sup>. SP and/or subunits/peptide fragments can trigger ACE2 receptor degradation and internalization, which may also cause destabilization of the renin–angiotensin system (RAS), resulting in possible enhanced inflammation, vasoconstriction, and thrombosis<sup>4</sup>. SP activates platelets, causes endothelial damage, and directly promotes arterial and venous thrombosis<sup>5</sup>. Moreover, immune system cells that have taken up the lipid nanoparticles (LNPs) then release them back into the circulation with elevated numbers of exosomes containing SP and microRNAs that play a role in inducing a signaling response in recipient cells at distant sites, resulting in severe inflammatory consequences<sup>5</sup>. Further, long term cancer control may be jeopardized in those injected with mRNA COVID-19 vaccines because of IRF7 and IRF9 suppression<sup>5</sup>. There is a distinct potential of a causal link between SARS-CoV-2 mRNA vaccination and neurodegenerative disease, myocarditis, immune thrombocytopenia, Bell's palsy, liver disease, impaired adaptive immunity, impaired DNA damage response and tumorigenesis<sup>5</sup>.

These findings are supported by the recent discovery that repeated COVID-19 vaccination with mRNA-based vaccines causes production of abnormally high levels of IgG4 antibodies which can lead to immune tolerance to SP, immune suppression, and promote the development of autoimmune diseases, myocarditis, and cancer growth<sup>6</sup>.

Neurotoxic effects of SP may cause or contribute to the post-COVID syndrome, including headache, tinnitus, autonomic dysfunction, and small fiber neuropathy<sup>7</sup>. Specific to the administration of viral vector COVID-19 vaccines (AstraZeneca; Johnson and Johnson) a new clinical syndrome called vaccine-induced immune thrombotic thrombocytopenia (VITT) was identified in 2021 and characterized by the development of thromboses at atypical body sites combined with severe thrombocytopenia after vaccination<sup>9</sup>. The pathogenesis of this life-threatening side effect is currently unknown, though it has been proposed that VITT is caused by post-vaccination antibodies against platelet factor 4 (PF4) triggering extensive platelet activation<sup>9</sup>. mRNA-based vaccines rarely cause VITT, but they are associated with myocarditis, or inflammation of myocardium<sup>10</sup>. The mechanisms for the development of myocarditis after COVID-19 vaccination are not clear, but it has been hypothesized that it may be caused by molecular mimicry of SP and self-antigens, immune response to mRNA, and dysregulated cytokine expression<sup>10</sup>. In adolescents and young adults diagnosed with post-mRNA vaccine myocarditis, free SP was detected in the blood while vaccinated controls had no circulating SP<sup>11</sup>. It has been demonstrated that SARS-CoV-2 spike mRNA vaccine sequences can circulate in the blood for at least 28 days after vaccination<sup>12</sup>. These

data indicate that adverse events may occur for an unknown period after vaccination, with SP playing an important potential etiological role.

A Freedom of Information Act (FOIA) document obtained from the Australian Government, titled Nonclinical Evaluation of BNT162b2 [mRNA] COVID-19 vaccine (COMIRNATY), shows systemic distribution of the LNPs containing mRNA after vaccine administration in rats, concluding that LNPs reached their highest concentration at the injection site, followed by the liver, spleen, adrenal glands, ovaries, and bone marrow (femur) over 48 hours<sup>13</sup>. This biodistribution data suggests that SP may be expressed in cells from many vital organ systems, raising significant concerns regarding the safety profile of COVID-19 vaccines. Given the identified vaccination syndromes and their possible mechanisms, the frequency of adverse event reports is expected to be high, especially given the vast number of vaccine doses administered globally.

Through May 5<sup>th</sup>, 2023, the Vaccine Adverse Events Reporting System (VAERS) contained 1,556,050 adverse event reports associated with COVID-19 vaccines, including 35,324 deaths, 26,928 myocarditis and pericarditis, 19,546 heart attacks, and 8,701 thrombocytopenia reports<sup>14</sup>. If the alarmingly high number of reported deaths are indeed causally linked to COVID-19 vaccination, the

implications could be immense, including: the complete withdrawal of all COVID-19 vaccines from the global market, suspension of all remaining COVID-19 vaccine mandates and passports, loss of public trust in government and medical institutions, investigations and inquiries into the censorship, silencing and persecution of doctors and scientists who raised these concerns, and compensation for those who were harmed as a result of the administration of COVID-19 vaccines. Using VAERS data alone to establish a causal link between COVID-19 vaccination and death, however, is not possible due to many limitations and confounding factors.

Autopsies are one of the most powerful diagnostic tools in medicine to establish cause of death and clarify the pathophysiology of disease<sup>15</sup>. COVID-19 vaccines, with plausible mechanisms of injury to the human body and a substantial number of adverse event reports, represent an exposure that may be causally linked to death in some cases. The purpose of this systematic review is to investigate possible causal links between COVID-19 vaccine administration and death using autopsies and post-mortem analysis.

## **Methods**

We performed a systematic review of all published autopsy and necropsy reports relating to COVID-19 vaccination through May 18<sup>th</sup>, 2023. All autopsy studies that include COVID-19 vaccines as a possible cause of death were included. All necropsy (analysis of dead tissue) studies that include COVID-19 vaccines as a possible cause of organ death were included. No other restrictions were imposed. The following databases were used: PubMed and ScienceDirect. The following keywords were used: ‘COVID-19 Vaccine’, ‘SARS-CoV-2 Vaccine’, ‘COVID Vaccination’, and ‘Post-mortem’, ‘Autopsy’, or ‘Necropsy’. All selected studies were screened for relevant literature contained in their references. Because the state of knowledge has advanced since the time of the original publications, we performed a contemporary review: three physicians (RH, WM, PAM) with experience in death adjudication and anatomical/clinical pathology independently reviewed the available information of each case and determined whether or not COVID-19 vaccination was the direct cause or contributed significantly to the mechanism of death described. Agreement was reached when two or more physicians adjudicated the case concordantly. For the study by Chaves<sup>20</sup>, only cardiovascular and hematological system related cases were adjudicated as being linked to the vaccine due to a high probability of COVID-19 vaccination contributing to death and missing individual case information for the other individuals. Given the presence of some missing data, we used all available

information to calculate the descriptive statistics. Estimated age (exact age not given) and inferred time from last vaccine administration to death (no definitive time given) were excluded from calculations.

## **Results**

A database search yielded 678 studies that had potential to meet our inclusion criterion. 562 duplicates were screened out. Out of the remaining 116 papers, 36 met our specified inclusion criterion. Through further analysis of references, we located 18 additional papers, with 8 of them meeting our inclusion criterion. In total, we found 44 studies that contained autopsy or necropsy reports of COVID-19 vaccinees (Figure 1).

Table 1 summarizes the 44 studies<sup>16-59</sup>. There were a total of 325 autopsy cases and 1 necropsy case (heart). The mean age of death was 70.4 years and there were 139 females (42.6%). Most received a Pfizer/BioNTech vaccine (41%), followed by Sinovac (37%), AstraZeneca (13%), Moderna (7%), Johnson & Johnson (1%), and Sinopharm (1%).

The cardiovascular system was most frequently implicated (53%), followed by hematological (17%), respiratory (8%), multiple organ systems (7%),

neurological (4%), immunological (3%), and gastrointestinal (1%). In 7% of cases, the cause of death was either unknown, non-natural (drowning, head injury, etc.) or infection (Figure 2). One organ system was affected in 302 cases, two in 3 cases, three in 8 cases, and four or more in 13 cases (Figure 3).

The number of days from vaccination until death was 14.3 (mean), 3 (median) irrespective of dose, 7.8 (mean), 3 (median) after one dose, 23.2 (mean), 2 (median) after two doses, and 5.7 (mean), 2 (median) after three doses. The distribution of days from last vaccine administration to death is highly right skewed, showing that most of the deaths occurred within a week from last vaccination (Figure 4). 240 deaths (73.9%) were independently adjudicated by three physicians to be significantly linked to COVID-19 vaccination (Table S1). Among adjudicators, there was complete independent agreement (all three physicians) of vaccination causing or contributing to death in 203 cases (62.5%). The one necropsy case was judged to be linked to vaccination with complete agreement.

## **Discussion**

We found 73.9% of deaths after COVID-19 vaccination were attributable to fatal vaccine injury syndromes. The cardiovascular system was by far the most

implicated organ system in death, followed by hematological, respiratory, multiple organ systems, neurological, immunological, and gastrointestinal (Figure 2), with three or more organ systems affected in 21 cases (Figure 3). The majority of deaths occurred within a week from last vaccine administration (Figure 4) and were independently adjudicated by three physicians to be significantly associated with vaccination (Table S1). These results corroborate known COVID-19 vaccine-induced syndromes and show significant, temporal associations between COVID-19 vaccination and death involving multiple organ systems, with a predominant implication of the cardiovascular and hematological systems. Criteria of causality from an epidemiological perspective have been met including biological plausibility, temporal association, internal and external validity, coherence, analogy, and reproducibility with each successive report of death after COVID-19 vaccination.

Our findings amplify concerns regarding COVID-19 vaccine adverse events and their mechanisms. SP's deleterious effects<sup>5,6,7,8,10,11</sup>, especially on the heart<sup>10,11</sup>, likely explains the high proportion of cardiovascular deaths seen in our study. They also highlight the involvement of multiple organ systems in some of the deaths associated with COVID-19 vaccination. This might be attributed to the Multisystem Inflammatory Syndrome (MIS) that has been detected following

COVID-19 vaccination in both children<sup>60</sup> and adults<sup>61</sup>. A possible mechanism by which MIS occurs after vaccination could be the systemic distribution of the LNPs containing mRNA after vaccine administration<sup>13</sup> and the consequent systemic SP expression and circulation resulting in system-wide inflammation. A significant proportion of cases were due to hematological system adverse events, which is not surprising given that VITT<sup>62</sup> and pulmonary embolism (PE)<sup>63</sup> have been reported in the literature as serious adverse events following COVID-19 vaccination. Deaths caused by adverse effects to the respiratory system were also relatively common in our review, a finding that is in line with the possibility of developing acute respiratory distress syndrome (ARDS) or drug-induced interstitial lung disease (DIILD) after COVID-19 vaccination<sup>64,65</sup>. Although uncommon among cases in this study, immunological<sup>66</sup>, neurological<sup>67</sup>, and gastrointestinal<sup>68</sup> adverse events can still occur after COVID-19 vaccination and, as with the cardiovascular system, may be directly or indirectly caused by the systemic expression or circulation of SP. Given the average time (14.3 days) in which cases died after vaccination, a temporal association between COVID-19 vaccination and death among most cases is further supported by the finding that SARS-CoV-2 spike mRNA vaccine sequences can circulate in the blood for at least 28 days after vaccination<sup>12</sup>. Most of the deployed vaccine platforms are associated with death, suggesting that they share a common feature that causes adverse effects, which is most likely SP.

The large number of COVID-19 vaccine induced deaths evaluated in this review is consistent with multiple papers that report excess mortality after vaccination. Pantazatos and Seligmann found that all-cause mortality increased 0-5 weeks post-injection in most age groups resulting in 146,000 to 187,000 vaccine-associated deaths in the United States between February and August of 2021<sup>69</sup>. With similar findings, Skidmore estimated that 278,000 people may have died from the COVID-19 vaccine in the United States by December 2021<sup>70</sup>. These concerning results were further elucidated by Aarstad and Kvitastein, who found that among 31 countries in Europe, a higher population COVID-19 vaccine uptake in 2021 was positively correlated with increased all-cause mortality in the first nine months of 2022 after controlling for alternative explanations<sup>71</sup>. Furthermore, excess mortality from non-COVID-19 causes has been detected in many countries since the mass vaccination programs began<sup>72,73,74,75,76,77</sup>, suggesting a common deleterious exposure among populations. Pantazatos estimated that VAERS deaths are underreported by a factor of 20<sup>69</sup>. If we apply this underreporting factor to the May 5<sup>th</sup>, 2023, VAERS death report count of 35,324<sup>14</sup>, the number of deaths in the United States alone becomes 706,480. If this extrapolated number of deaths were to be confirmed, the COVID-19 vaccines would represent the largest medical failure in human history.

In summary, we identified a large series of deaths after COVID-19 vaccination, confirmed with autopsy and necropsy, to help the medical community better understand fatal COVID-19 vaccine syndromes. The consistency seen among cases in this review with known COVID-19 vaccine adverse events, their mechanisms, and related excess death, coupled with autopsy confirmation and expert physician death adjudication, suggests there is a high likelihood of a causal link between COVID-19 vaccines and death in most cases. Even with substantial evidence, our paper cannot definitively determine causality as our paper has all the limitations of systematic reviews of previously published papers including selection bias, publication bias, and confounding variables. Further urgent investigation is required aimed at confirming our results and further elucidating the mechanisms underlying the described fatal outcomes with the goal of risk mitigation for the large numbers of individuals who have taken one or more COVID-19 vaccines.

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None.

### **Conflict of Interest**

Drs Alexander, Amerling, Hodkinson, Makis, McCullough, Risch, Trozzi are affiliated with and receive salary support and or hold equity positions in The

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## **Figure Legends**

Figure 1: Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA) flow diagram detailing the study selection process.

Figure 2: Proportion of Cases by Affected Organ System

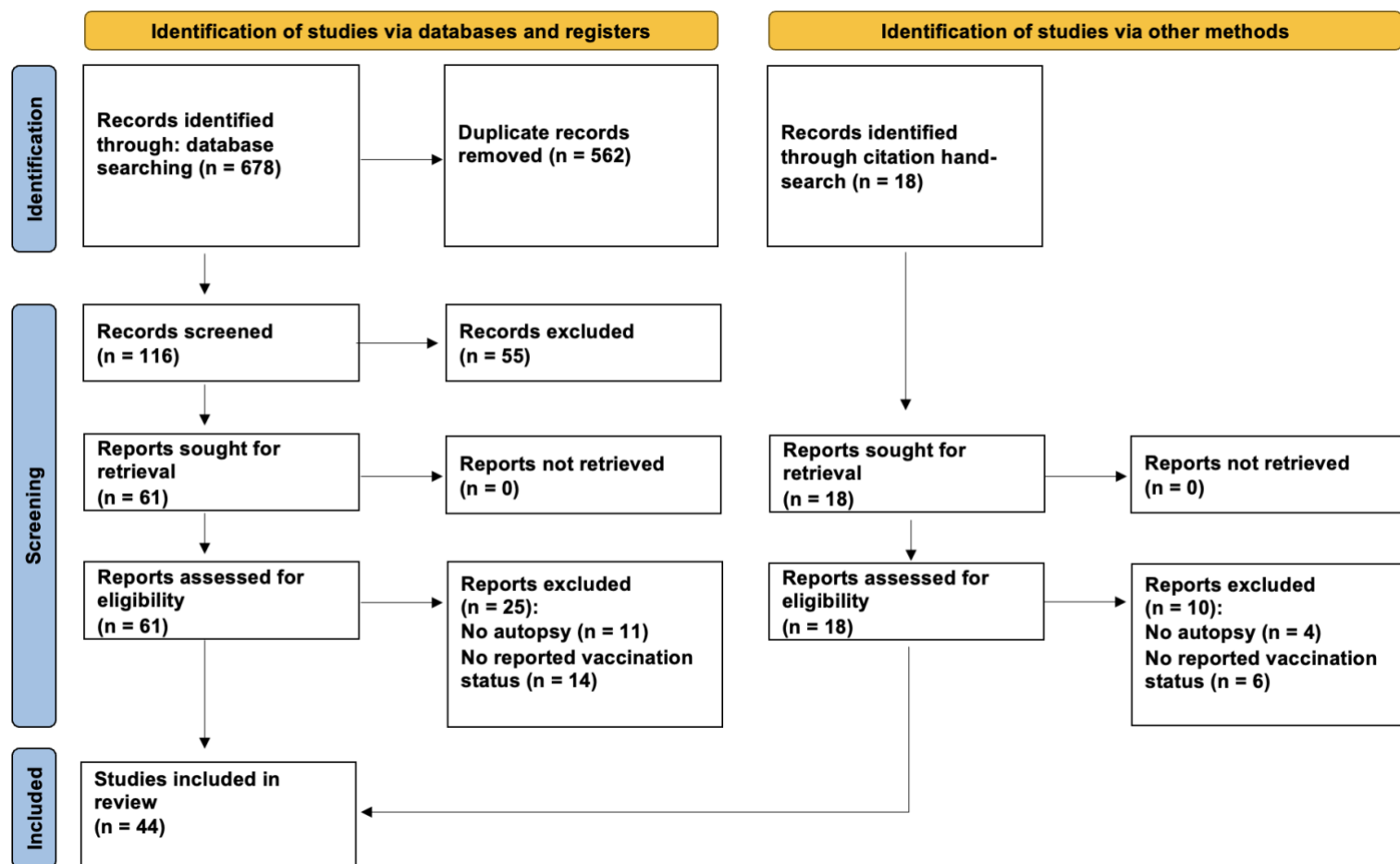
Figure 3: Number of Affected Organ Systems by Cases

Figure 4: Distribution of Time from Last Vaccine Administration to Death

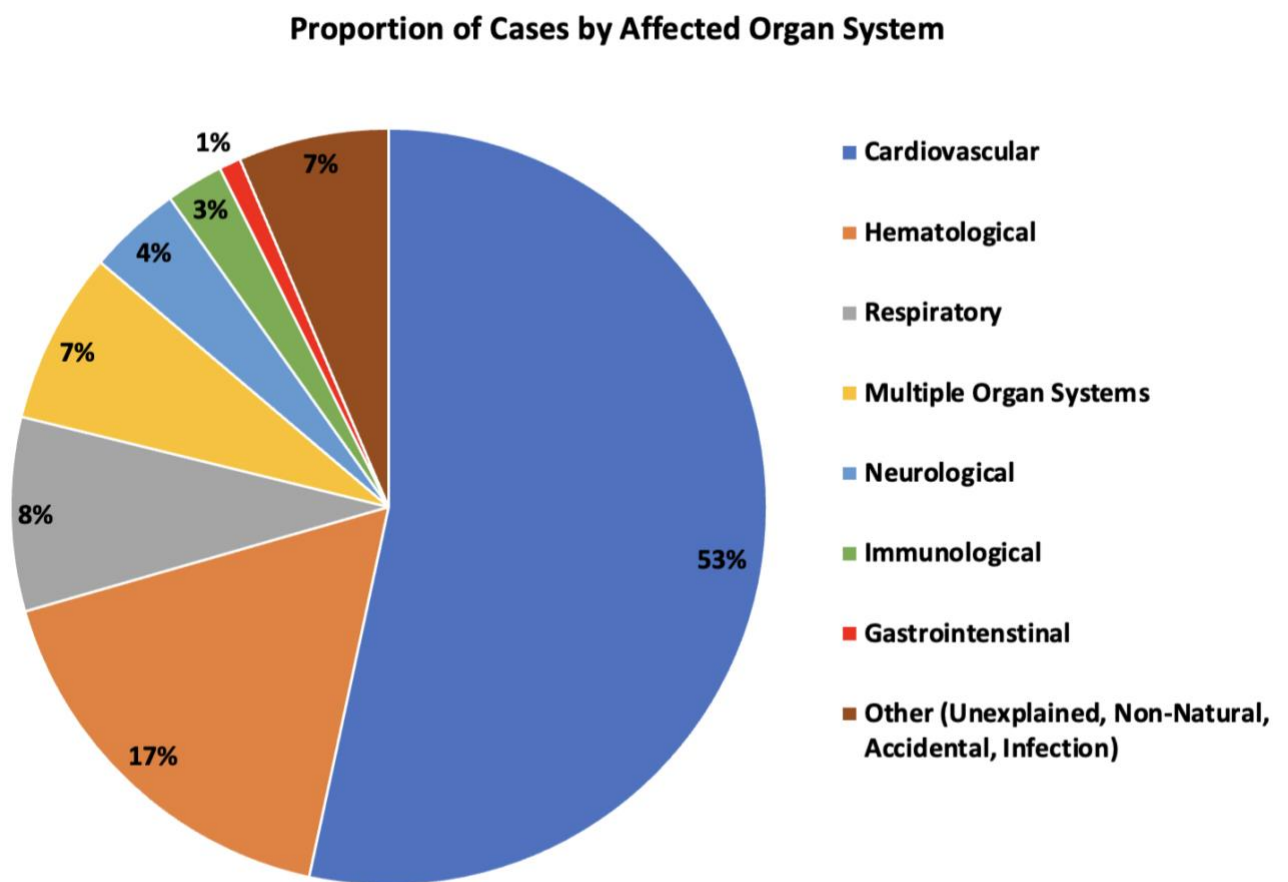
## **Table Legends**

Table 1: Characteristics of included studies on COVID-19 vaccination possibly causing death.

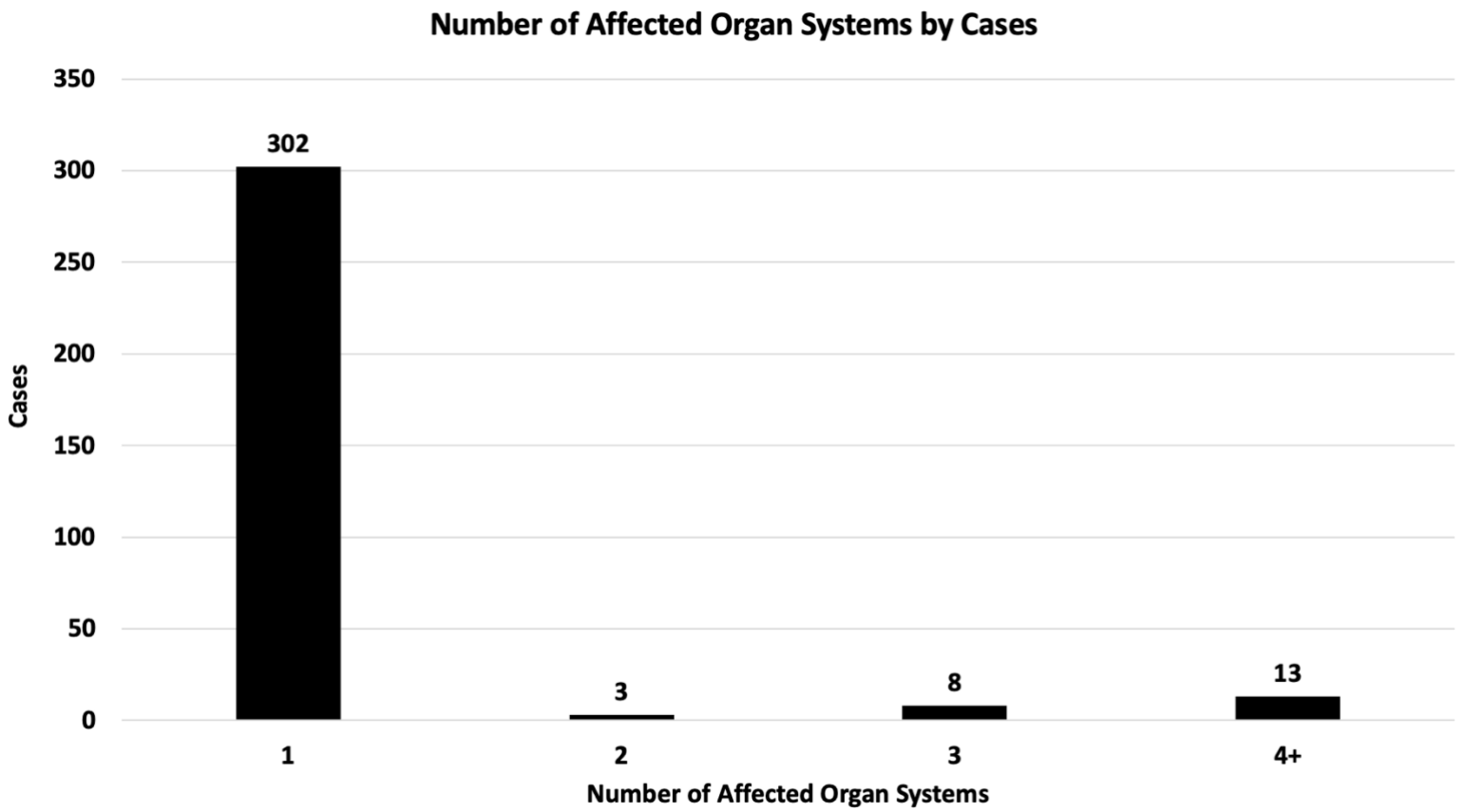
Supplemental Table 1: Detailed Case Information and Death Adjudications



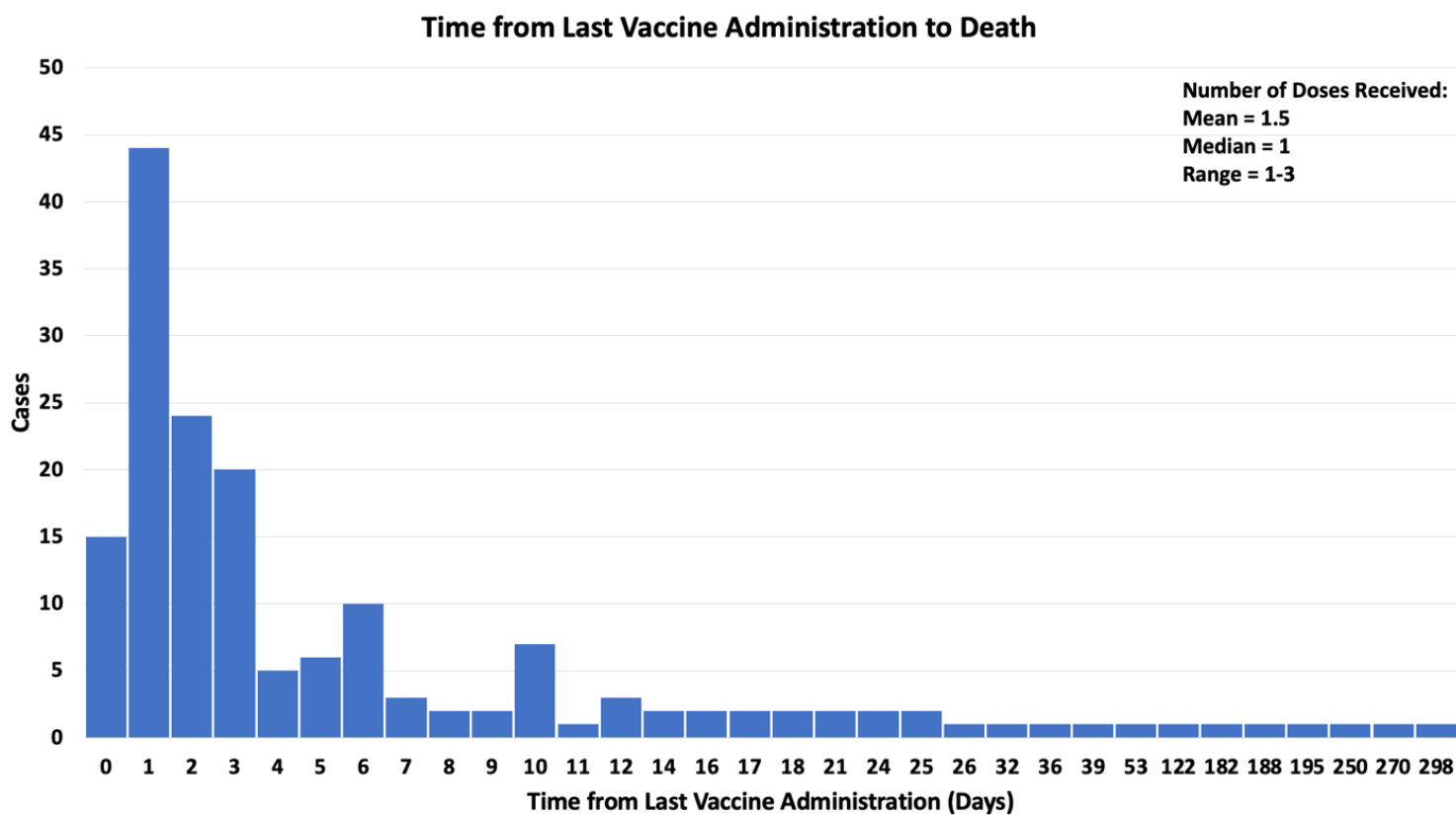
**Figure 1.**



**Figure 2.**



**Figure 3.**



**Figure 4.**

| AUTHOR         | YEAR | COUNTRY  | CASES* | AGE       | SEX   | VACCINE             | DOSE** | DISEASE                   | ORGAN SYSTEM                  | PERIOD*** | PROCEDURE |
|----------------|------|----------|--------|-----------|-------|---------------------|--------|---------------------------|-------------------------------|-----------|-----------|
| HOJBERG [16]   | 2023 | USA      | 1      |           |       | Moderna             |        | Eosinophila               | Immunological                 | ‘recent’  | Autopsy   |
| NUSHIDA [17]   | 2023 | Japan    | 1      | 14        | F     | Pfizer              | 3      | MIS                       | MIS                           | 2 days    | Autopsy   |
| JEON [18]      | 2023 | Korea    | 1      | 19        | M     | Pfizer              | 2      | Multiple sclerosis        | Neurological                  | 182 days  | Autopsy   |
| ESPOSITO [19]  | 2023 | Italy    | 1      | 83        | M     | Pfizer              | 2      | COVID-19                  | MIS                           |           | Autopsy   |
| CHAVES [20]    | 2022 | Columbia | 121    | 84 (mean) | 52% F | Sinovac, AZ, Pfizer | 1-2    | SCD, MI, PE               | Cardiovascular, Hematological |           | Autopsy   |
| MORZ [21]      | 2022 | Germany  | 1      | 76        | M     | Pfizer              | 2      | Encephalitis, myocarditis | MIS                           | 21 days   | Autopsy   |
| ALUNNI [22]    | 2022 | France   | 1      | 70        | M     | AZ                  | 1      | VITT                      | Hematological                 | 25 days   | Autopsy   |
| TAKAHASHI [23] | 2022 | Japan    | 1      | ‘90s’     | M     | Pfizer              | 3      | Pericarditis              | Cardiovascular                | 14 days   | Autopsy   |
| MURATA [24]    | 2022 | Japan    | 4      | 34 (mean) | M     | Moderna, Pfizer     | 2      | Cytokine Storm            | Immunological                 | 1-10 days | Autopsy   |
| SATOMI [25]    | 2022 | Japan    | 1      | 61        | F     | Pfizer              | 1      | Myocarditis               | Cardiovascular                | 10 days   | Autopsy   |

| Author [ref]    | Year | Country     | n  | Age (mean)  | Sex      | Vaccine         | Days since onset | Organ system                                | Findings       | Time to death | Autopsy          |
|-----------------|------|-------------|----|-------------|----------|-----------------|------------------|---------------------------------------------|----------------|---------------|------------------|
| SUZUKI [26]     | 2021 | Japan       | 54 | 68.1 (mean) | 37% F    | Pfizer, Moderna | 1-2              | Various                                     | Various        | <7 days       | Autopsy          |
| MELE [27]       | 2022 | Italy       | 1  | 54          | M        | J&J             | 1                | VITT                                        | Hematological  | ~21 days      | Autopsy          |
| YOSHIMURA [28]  | 2022 | Japan       | 1  | 88          | F        | Moderna         | 2                | VI-ARDS                                     | Respiratory    | 18 days       | Autopsy          |
| RONCATI [29]    | 2022 | Italy       | 3  | 72.3 (mean) | 2 F      | Pfizer          | 1-2              | VITT                                        | Hematological  | 18-122 days   | Autopsy          |
| KANG [30]       | 2022 | Korea       | 1  | 48          | F        | AZ, Pfizer      | 2                | Myocarditis (required transplant, no death) | Cardiovascular | 15 days       | Necropsy (heart) |
| KAMURA [31]     | 2022 | Japan       | 1  | 57          | M        | Moderna         | 1                | Thrombosis/rhabdomyolysis                   | MIS            | 53 days       | Autopsy          |
| ISHIOKA [32]    | 2022 | Japan       | 1  | 67          | M        | Pfizer          | 1                | Exacerbation of UIP                         | Respiratory    | 3 days        | Autopsy          |
| GILL [33]       | 2022 | USA         | 2  | ‘teenage’   | M        | Pfizer          | 2                | Myocarditis                                 | Cardiovascular | 3-4 days      | Autopsy          |
| POMARA [34]     | 2022 | Italy       | 1  | 37          | F        | AZ              | 1                | VITT                                        | Hematological  | 24 days       | Autopsy          |
| YEO [35]        | 2022 | Singapore   | 28 | 65.1 (mean) | 17.9 % F | Pfizer, Moderna | 1-2              | Various                                     | Various        | <3 days       | Autopsy          |
| AMERATUNGA [36] | 2022 | New Zealand | 1  | 57          | F        | Pfizer          | 1                | Myocarditis                                 | Cardiovascular | 3 days        | Autopsy          |

|                |      |           |    |             |       |                          |     |                           |                                            |            |         |
|----------------|------|-----------|----|-------------|-------|--------------------------|-----|---------------------------|--------------------------------------------|------------|---------|
| GUNTHER [37]   | 2021 | Germany   | 1  | 54          | M     | AZ                       | 1   | VITT                      | Hematological                              | ~121 days  | Autopsy |
| PERMEZEL [38]  | 2022 | Australia | 1  | 63          | M     | AZ                       | 1   | ADEM                      | Neurological                               | 32 days    | Autopsy |
| CHOI [39]      | 2021 | Korea     | 1  | 22          | M     | Pfizer                   | 1   | Myocarditis               | Cardiovascular                             | 5 days     | Autopsy |
| SCHNEIDER [40] | 2021 | Germany   | 18 | 62.6 (mean) | 50% F | AZ, Pfizer, Moderna, J&J | 1-2 | Various                   | Various                                    | 1-14 days  | Autopsy |
| VERMA [41]     | 2021 | USA       | 1  | 42          | M     | Moderna                  | 2   | Myocarditis               | Cardiovascular                             | ~14 days   | Autopsy |
| WIEDMAN N [42] | 2021 | Norway    | 4  | 41.8 (mean) | F     | AZ                       | 1   | VITT                      | Hematological                              | 7-25 days  | Autopsy |
| POMARA [43]    | 2021 | Italy     | 2  | 43.5 (mean) | 1 F   | AZ                       |     | VITT                      | Hematological                              | 16-24 days | Autopsy |
| ALTHAUS [44]   | 2021 | Germany   | 2  | 36 (mean)   | 1 F   | AZ                       | 1   | VITT                      | Hematological                              | 16-17 days | Autopsy |
| EDLER [45]     | 2021 | Germany   | 3  | ‘elderly’   | 1 F   | Pfizer                   | 1   | COVID-19, MI, PE          | Cardiovascular, Hematological, Respiratory | 2-12 days  | Autopsy |
| HANSEN [46]    | 2021 | Germany   | 1  | 86          | M     | Pfizer                   | 1   | Renal/respiratory failure | MIS                                        | 26 days    | Autopsy |

|                          |      |          |    |                |       |                                                     |     |             |                |                     |         |
|--------------------------|------|----------|----|----------------|-------|-----------------------------------------------------|-----|-------------|----------------|---------------------|---------|
| BARONTI<br>[47]          | 2022 | Italy    | 5  | 64<br>(mean)   | 1 F   | Pfizer,<br>Moderna                                  | 1-2 | MI          | Cardiovascular | <1 day –<br>21 days | Autopsy |
| ITTIWUT<br>[48]          | 2022 | Thailand | 13 | 42.8<br>(mean) | 23% F | AZ,<br>Sinopharm,<br>Sinovac,<br>Pfizer,<br>Moderna | 1-3 | Various     | Various        | 1-7 days            | Autopsy |
| GREINACHER [49]          | 2021 | Germany  | 1  | 49             | F     | AZ                                                  | 1   | VITT        | Hematological  | 10 days             | Autopsy |
| MAURIELLO [50]           | 2021 | Italy    | 1  | 48             | F     | AZ                                                  | 1   | VITT        | Hematological  | 39 days             | Autopsy |
| BJØRNSTAD-TUVENG<br>[51] | 2021 | Norway   | 1  | ‘young’        | F     | AZ                                                  | 1   | VITT        | Hematological  | ~10 days            | Autopsy |
| SCULLY<br>[52]           | 2021 | U.K.     | 1  | 52             | F     | AZ                                                  | 1   | VITT        | Hematological  | ~>10<br>days        | Autopsy |
| CHOI [53]                | 2021 | Korea    | 1  | 38             | M     | J&J                                                 | 1   | SCLS        | Hematological  | 2 days              | Autopsy |
| SCHWAB<br>[54]           | 2023 | Germany  | 5  | 57.6<br>(mean) | 3 F   | Pfizer,<br>Moderna                                  | 1-2 | Myocarditis | Cardiovascular | <7 days             | Autopsy |
| HIRSCHBUHL [55]          | 2022 | Germany  | 29 | 32-97          | 45% F | Pfizer,<br>AZ,<br>Sinovac                           | 1-2 | COVID-19    | Various        | ~1-307<br>days      | Autopsy |
| HOSHINO<br>[56]          | 2022 | Japan    | 1  | 27             | M     | Moderna                                             | 1   | Myocarditis | Cardiovascular | 36 days             | Autopsy |

|                 |      |          |   |                  |     |        |   |         |                     |                 |         |
|-----------------|------|----------|---|------------------|-----|--------|---|---------|---------------------|-----------------|---------|
| COLOMBO<br>[57] | 2023 | Italy    | 5 | 72<br>(mean<br>) | 2 F | Pfizer | 2 | Various | Respiratory,<br>MIS | 188-298<br>days | Autopsy |
| MOSNA<br>[58]   | 2022 | Slovakia | 1 | 71               | M   | Pfizer | 2 | GBS     | Neurological        | 10 days         | Autopsy |
| KAIMORI<br>[59] | 2022 | Japan    | 1 | 72               | F   | Pfizer | 1 | TMA     | Hematologica<br>l   | 2 days          | Autopsy |

**\*Cases = Number of deaths examined post-mortem**

**\*\*Dose = Cumulative number of vaccine doses received**

**\*\*\*Period = Time (in days) from most recent vaccine administration to death**

**~ = Inferred Period (Estimated period using all available information, definitive period not given)**

**Table 1.**