

Forensic Medical Examiner Safety During COVID-19 Outbreak



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Abstract

The emergence of the COVID-19 pandemic has seen a rise in the need for medical workers. Often, the focus is put on first responders but there are a group of medical workers who are vital in fighting a pandemic such as COVID-19. Forensic Pathologists are an essential part of the medical field. They are sometimes referred to as 'last responders' because while the other medical personnel deal with live, sick patients, they deal with dead people or patients. Forensic pathologists provide valuable data on the trends of causes of deaths which aids in the research for a vaccine and/or a cure for the COVID-19 disease. SARS-CoV-2 or COVID-19 is a respiratory disease that spreads from person to person and there is currently no evidence that dead COVID-19 patients can infect people or Forensic Pathologists, but the possibility exists. To determine if there is any validity to the argument that dead COVID-19 patients are contagious, this research study analyzed the data of confirmed infected medical personnel and forensic pathologists. A Two Sample Independent T-test was used to analyze the data. This research was done under the assumption that all infected Forensic Pathologists got the virus from infected dead bodies at work. The study found that the test was not significant which means that the data provided little or no evidence that the null hypothesis is false. However, the high probability value is not evidence that the null hypothesis is true.

Keywords: COVID-19; Contagious; Coronavirus; Forensic pathologist

Background

Coronavirus 2019 (COVID-19) is a newly identified strain of the coronavirus and it is highly contagious; therefore, everyone is at risk of getting infected, especially medical personnel and forensic medical examiners who have close contact with live and dead infected persons. Coronaviruses are a large family of viruses that are common in people and many different species of animals, including camels, cattle, cats, and bats. Rarely, animal coronaviruses can infect people and then spread between people such as with MERS-COV, SARS-COV, and now with this new virus, named SARS-CoV-2 or COVID-19 [1]. This new virus is very contagious and has a high mortality rate. Of the 2.7 million of confirmed COVID-19 infected individuals, there have been 192,000 deaths. As the global COVID-19 numbers keep rising, a study shows a 1.4% fatality rate [2]. Therefore, contact with anyone infected puts individuals at risk because this is a virus that kills. This means medical personnel who deal with infected people are at the highest risk of contracting the virus. Another group of people who are at high risk of contracting the virus are forensic medical examiners because they have to examine infected and non-infected dead bodies.

Literature Review

Forensic medical examiners, also called forensic pathologists, are doctors who undergo intensive training to examine dead bodies to determine the likely cause of death [3]. They are a crucial part of criminal investigations. They are also essential workers during this COVID-19 pandemic. As doctors, researchers and all medical personnel work to contain the virus and find a cure, all data is vital. Therefore, forensic pathologists are vital in providing data during this time about the cause of deaths of individuals, deaths caused by COVID-19 and the demographics of COVID-19 deaths.

Coronaviruses

Coronaviruses are a large group of viruses that usually cause mild to moderate upper-respiratory tract illnesses, like the common cold. Hundreds of coronaviruses exist and most circulate among such animals as pigs, camels, bats and cats. Sometimes those viruses jump to humans—called a spillover event—and can cause disease. Four of the seven known coronaviruses that sicken people cause only mild to moderate disease. However, three of the

new coronaviruses that have emerged from animal reservoirs over the past two decades cause serious and widespread illness, and death [4,5]. Coronaviruses can cause diarrhea in cows and pigs, and upper respiratory disease in chickens. In humans, the viruses can cause mild respiratory infections, like the common cold, but can lead to serious illnesses, like pneumonia. Coronaviruses are named for the crown-like spikes on their surface. Human coronaviruses were first identified in the mid-1960s. Since then, deadly coronaviruses like SARS, MERS and CoV-2 have emerged [4,5]. Severe Acute Respiratory Syndrome (SARS) originated in small mammals and emerged to infect people. SARS was first reported in Southern China in 2002 and the illness spread to more than two dozen countries in North America, South America, Europe, and Asia. After the emergence of SARS-COV in China, it spread to 26 countries within a few months, largely by infected passengers who traveled. More than 8,000 people fell ill and 774 died.

SARS drew the collective focus of researchers throughout the world. The disease disappeared in 2004, likely due to intensive contact tracing and case isolation measures. Symptoms of SARS include fever, chills, and body aches, acute respiratory distress (severe breathing difficulty), and may progress to pneumonia. SARS has a mortality rate of about 10 percent. No human cases of SARS have been reported anywhere in the world since 2004 [4-6]. Middle East Respiratory Syndrome (MERS) was first reported in 2012 in Saudi Arabia and spread to more than 25 other countries. MERS originated in camels and emerged to infect people. Symptoms usually include fever, cough, and shortness of breath, and often progress to pneumonia. About 3 or 4 out of every 10 patients reported with MERS died. MERS cases continue to occur, primarily in the Arabian Peninsula; however, as of 2019, there have been only two confirmed cases of MERS in the US, both in 2014 [4,5,7]. Research efforts from the SARS and MERS outbreaks have prepared scientists to quickly assess the severity and transmission potential of SARS-CoV-2 (COVID-19), and to develop countermeasures. The novel coronavirus (SARS-CoV-2) that causes the disease Coronavirus Disease 2019 (COVID-19) emerged in a seafood and poultry market in the Chinese city of Wuhan in 2019. Cases have been detected in most countries worldwide, and on March 11, 2020, the World Health Organization characterized the outbreak as a pandemic. Human-to-human transmission occurs through close contact. Symptoms include but are not limited to – fever, cough, sneezing and headache. With the emergence of each virus, it is essential to note:

- a) What kind of virus is it?
- b) How is it spread?
- c) Is it Contagious?
- d) What are the symptoms?
- e) Is it curable?

f) Can the virus be spread through dead bodies, as well as live bodies?

Most people get infected with human strains of coronaviruses at some point in their lives. Human coronaviruses can spread through coughing and sneezing; close personal contact (such as touching or shaking hands); touching an object or surface with the virus on it, then touching your mouth, nose, or eyes; fecal contamination (rarely). The illnesses derived from coronavirus usually last for a short amount of time, except when it is serious like pneumonia or bronchitis. The serious illnesses that arise from coronavirus are more common in individuals with heart and lung disease, those with weakened immune systems, infants, and older adults.

COVID-19 Contagion

Researchers posit the SARS-CoV-2 virus or COVID-19, as it is commonly known, started in China through animal-to-person spread. Later, a growing number of patients with no exposure to animals reported having the disease, indicating a spillover event, where the virus jumped to humans, and started spreading from person to person. From then on, the spread of the virus has gone global. There are also instances of community spread, which means some people have been infected and it is not known how or where they became exposed [1]. This new strain of coronavirus is highly contagious. It is a respiratory virus and it is spread primarily from person to person through small droplets from the nose or mouth, which are expelled when a person with COVID-19 coughs, sneezes, or speaks. These droplets are relatively heavy, do not travel far and quickly sink to the ground. People can catch COVID-19 if they breathe in these droplets from a person infected with the virus. This is why it is important to stay at least 2meter (6 feet) away from others. These droplets can land on objects and surfaces around the person such as tables, doorknobs and handrails. People can become infected by touching these objects or surfaces, then touching their eyes, nose or mouth. Therefore, it is important to wash hands regularly with soap and water or clean with alcohol-based hand rub. Studies have shown that the COVID-19 virus can survive for up to 72 hours on plastic and stainless steel, less than 4 hours on copper and less than 24 hours on cardboard [8]. It is important to note whether the virus can survive on or in dead bodies, thereby endangering the lives of forensic pathologists.

There are currently no vaccines available to protect against human coronaviruses, but preventative steps can be taken like washing hands often with soap and water for at least 20 seconds; avoid touching eyes, nose, or mouth; covering mouth and nose when coughing or sneezing; cleaning and disinfecting objects and surfaces; avoiding close contact with people who are sick; and staying home while sick [1,5,8,4]. Not only is COVID-19 highly contagious, it also has a significant Infection Fatality Rate (IFR) of approximately 0.1% - 0.37%. The IFR estimates the fatality rate

in all those with infection: the detected disease (cases) and those with an undetected disease (asymptomatic and not tested group). This number may not be accurate because the data is constantly changing as new confirmed cases and deaths are documented daily [9]. The populations at risk of dying from the disease are 65+ older individuals, people with compromised immune systems, people undergoing treatment for cancer and in some cases, newborns who haven't yet had the chance to build a strong immunity [10,11]. The most common symptoms of COVID-19 are fever, dry cough, and tiredness. Some patients may have aches and pains, nasal congestion, sore throat or diarrhea. These symptoms are usually mild and begin gradually. Some people become infected but only have very mild symptoms. Most people (about 80%) recover from the disease without needing hospital treatment. Around 1 out of every 5 people who gets COVID-19 becomes seriously ill and develops difficulty breathing. Older people, and those with underlying medical problems like high blood pressure, heart and lung problems, diabetes, or cancer, are at higher risk of developing serious illness. However, anyone can catch COVID-19 and become seriously ill. Even people with very mild symptoms or no symptoms of COVID-19 can transmit the virus [8]. The average incubation period of the virus is estimated at 5 to 6 days, ranging from 0 to 14 days.

Since the emergence of the COVID-19 virus in China in December 2019, the number of confirmed infected people has steadily increased, so have the number of confirmed deaths from the virus. Today there are approximately 2,968,627 confirmed COVID-19 infected individuals and 204,402 confirmed COVID-19 deaths. In the United States of America, there are 964,937 confirmed COVID-19 infected and 49,700 confirmed COVID-19 deaths [11]. While there is currently no specific treatment or vaccine against COVID-19, some people have recovered from the virus. In the world today, of the 2,968,627 confirmed COVID cases, approximately 863,000 people have recovered. In the United States of America, of the 964,937 confirmed COVID-19 cases, approximately 109,000 people have recovered [8,11]. Medical researchers posit that dead COVID-19 bodies may still be infectious. Even after death, the bodies could still be hiding the virus in the respiratory secretions that can come out of the nose or mouth. The pathogen can also still be reproducing in lung cells that haven't yet died. Soft tissues like muscles, nerves and fat in a dead body could also pose risk of infection, according to the International Society for Infectious Diseases. Forensic medical examiners and morgue workers often come in contact with these tissues and bodily fluids during autopsies [10,12].

Forensic Pathologists

Forensic Pathologists also sometimes called Forensic medical examiners, are doctors who undergo intensive training to examine dead bodies to determine the likely cause of death [3]. There are around 500 full-time, board-certified forensic pathologists in the U.S., according to the National Commission on Forensic Science,

but experts estimate that based on the size of the U.S. population, there is a need of 1,100 to 1,200 forensic pathologists or forensic medical examiners, in order to adequately handle the demand for forensic autopsies [3]. Forensic pathologists are also known as last responders and they are essential in the medical field and public health field. They are vital in compiling and reporting crucial data as it relates to trends in causes of death, which shapes regulations that can improve public health and safety. This task or responsibility is particularly important during health pandemics like COVID-19, in assessing the death toll of the infected. This task also puts the forensic pathologists' lives at risk because there is a possibility that the dead bodies of infected people may still carry the contagious virus [1,3]. In a report that was posted on April 11, 2020 in the Journal of Forensic and Legal Medicine speculated that an infected forensic practitioner working in Bangkok, Thailand, most likely caught the COVID-19 virus from a deceased patient. The report was written in March when majority of the 272 confirmed COVID-19 cases (which included the forensic practitioner and a nurse assistant) at the time in Thailand, were imported. Meaning the confirmed COVID-19 cases were from people who had just travelled into the territory. The researchers argued that due to the seclusion of the forensic practitioner's job and the statistics of the confirmed infected, it was unlikely that the forensic practitioner caught the new coronavirus outside of work or even from a patient at the hospital [7,13].

There is a low chance of forensic medicine professionals coming into contact with infected patients, but they can have contact with biological samples and corpses. "It's not surprising that the body of a recently deceased COVID-19 patient might be contagious," said Dr. Otto Yang, a professor in the Department of Medicine and the Department of Microbiology, Immunology and Molecular Genetics at the David Geffen School of Medicine at UCLA [3,13]. COVID-19 dead bodies could still be contagious for hours or days. Even after death, the bodies could still be hiding the SARS-CoV-2 virus in the respiratory secretions that can come out of the nose or mouth. The pathogen can also still be reproducing in lung cells that haven't yet died. COVID-19's possible longevity in the body may be problematic for people in the funerary industry like Forensic Medical Examiners and morgue workers, who often come in contact with these tissues and bodily fluids during autopsies. Despite the risk to Forensic Medical Examiners, they are needed for the compilation of research data on the trends of causes of deaths, to combat the COVID-19 pandemic [1,3,10,12]. Researchers argue the merits of the theory that the COVID-19 contagion persists in dead bodies because pathogens that kill people don't survive long enough to spread to others after the person's death. Human remains only pose a substantial risk to health in a few special cases, such as deaths from cholera or hemorrhagic fevers [8]. However, considering the novel nature of the virus, it is still unclear if dead bodies carry the virus and just how long the virus remains infectious in a dead body. In light of this uncertainty and the deadly nature of the SARS-CoV-2 virus or

COVID-19, forensic scientists should take a number of precautions while examining the remains of COVID-19 patients [1,13].

Problem Statements

Usually, pathogens that kill people don't survive long enough to spread to others after the person's death, according to the World Health Organization (WHO) but the knowledge of SARS-CoV-2 is still evolving. Therefore, the possibility that the body of a recently deceased COVID-19 patient might be contagious exists. [3,14]. There is no evidence so far of transmission of SARS-CoV-2 through the handling of bodies of deceased persons but the potential risk of transmission exists when it relates to the direct contact with human remains or bodily fluids where the virus is present, and direct contact with contaminated fomites. As viable SARS-CoV-2 may persist on surfaces for days, there is the possibility that the virus also persists on deceased bodies [14]. "COVID-19 is a respiratory pathogen and can be transmitted via respiratory droplets, but also through the blood of a viremic patient. Even though decedents don't cough, they can expel bodily fluids while they are being moved or transported,"- Dr. Melinek [15].

Research Questions

Does COVID-19 remain in dead bodies? Are Forensic Medical Examiners or Forensic Pathologists at risk of contracting the disease from dead bodies?

a) Hypothesis

- I. Null Hypothesis (H₀)–COVID-19 dead patients are contagious.
- II. Alternative Hypothesis (H₁) – COVID-19 dead patients are not contagious.

Methodology

To determine if COVID-19 dead patients are contagious, secondary data of confirmed COVID-19 cases and deaths were compiled and analyzed. A Two Sample T-Test was run to determine if the COVID-19 contagion is viable in dead bodies. The sample population used for this study is the United States of America. Below is the data, analysis and findings.

a. Data

- a. Dependent Variable –COVID-19 confirmed cases
- b. Independent Variables –Infected Forensic Pathologists& Infected Medical Personnel
- c. Sample – The United States of America

Analysis of Data

A Two Sample T-Test will help determine if we reject the null hypothesis or not. For the purpose of this study, the significance level is 0.05. If the p-value is less than or equal to the significance level, we will reject the null hypothesis. This means that COVID-19 dead bodies are not contagious. However, if the p-value is greater

than the significance level, we fail to reject the null hypothesis. This means that the data provided little or no evidence that the COVID-19 dead bodies are not contagious. For the purpose of this study COVID-19 infected Forensic Pathologists are FP (this also includes morgue workers and coroners) and COVID-19 infected Medical Personnel (hospital personnel that deal with live patients) are MP.

$$H_0: \mu_{FP} = \mu_{MP}$$

$$H_1: \mu_{FP} \neq \mu_{MP}$$

$$NMP = 15,827$$

$$NFP = 39$$

Number of Confirmed COVID-19 Reported Cases = 315,521

Estimated number of Forensic Pathologists = 500

b. P value and statistical significance

The two-tailed P value equals 0.3847. Therefore, the test is not statistically significant.

c. Confidence interval

The mean of Medical Personnel (MP) minus Forensic Pathologists (FP) equals 165404.50

$$\mu_{FP} - \mu_{MP} = 165404.50$$

95% confidence interval of this difference: From -479335.58 to 810144.58

d. Intermediate values used in calculations

$$t = 1.1038$$

$$df = 2$$

$$\text{standard error of difference} = 149847.177$$

Findings

e. P value and statistical significance

The two-tailed P value equals 0.3847 which is greater than the significance level (α) of 0.05. Therefore, the test is not statistically significant. So, we fail to reject the null hypothesis. Which means the data provided little or no evidence that the null hypothesis is false. However, the high probability value is not evidence that the null hypothesis is true. So, there is a high possibility that COVID-19 dead patients are contagious.

Limitations of Study

This is an important study, especially during this COVID-19 pandemic where the need for accurate data is essential for the research and creation of vaccines and cures, but there are serious limitations to the study at this time.

- a) Insufficient specified data. There is hardly any data on the number of forensic pathologists with confirmed COVID-19 diagnosis.

b) The COVID-19 data is fluid. There are new numbers of confirmed COVID-19 cases and deaths daily; therefore, the data is constantly changing. Even so, with the available data a preliminary study on the risk of contamination from dead COVID-19 bodies is plausible.

c) There is currently no way to ascertain that infected forensic pathologists contracted the virus from dead bodies. This study is based on the assumption that all Forensic Pathologists with confirmed COVID-19 diagnoses obtained the virus from dead bodies.

d) Even though the test failed to reject the null hypothesis, it does not necessarily mean that the null hypothesis is true. A statistically significant result might not be practically significant.

Conclusion

Other illnesses that are contagious in human 'remains' include tuberculosis, bloodborne viruses (such as hepatitis B and C and HIV) and gastrointestinal infections (including *E. coli*, hepatitis A, Salmonella infection and typhoid fever), according to the WHO [12]. There is no evidence so far of transmission of SARS-CoV-2 through the handling of bodies of deceased persons. The potential risk of transmission related to the handling of bodies of deceased persons with suspected or confirmed COVID-19 is considered low and the results of this research study are inconclusive or not strong enough to support the argument that dead COVID-19 patients are contagious. Despite the findings of the study being inconclusive, the danger of possible infection from dead COVID-19 patients still exist. and can be related to; direct contact with human remains or bodily fluids where the virus is present; direct contact with contaminated fomites. Also, viable SARS-CoV-2 may persist on surfaces for days, so there is the possibility that the virus also persists on deceased bodies [8,14]. The potential for future research on this subject is rich and will be essential in compiling data about the COVID-19 virus. This will help medical personnel and researchers prepare accordingly for future treatments and/or disposal of COVID-19 corpses. It is important that health care facilities and organizations, in charge of data collection, start collecting occupational data of confirmed COVID-19 cases. It is vital for determining where the infected may have gotten the contagion and it is also necessary to determine conclusively, if dead COVID-19 patients are contagious. Because while there is no evidence so far of transmission of SARS-CoV-2 through the handling of bodies of deceased persons, there is no evidence to support the theory that dead COVID-19 patients are not contagious [15-18].

Declarations

All the data used in this research study are public data from public secondary data banks for institutions like the Center for Disease Control & Prevention, National Foundation for Infectious Diseases, National Institute of Allergy and Infectious Diseases, European Center for Disease Prevention & Control, and John Hopkins University. Due to the fact that all the data used in this research is publicly accessible and does not contain personal information, no consent was needed.

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