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## COVID-19 Infection with Severe Hypothermia in a Fully Vaccinated Patient

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# COVID-19 Infection with Severe Hypothermia in a Fully Vaccinated Patient

## ABSTRACT

Hypothermia is an uncommon presentation of COVID-19 infection, typically observed in patients with severe disease prior to the availability of vaccines. However, the occurrence of hypothermia in vaccinated patients with COVID-19 disease has not yet been documented. This case reports a rare presentation of severe hypothermia in a 41-year-old female with COVID-19 disease, who suffered from several comorbidities, including heart failure with preserved ejection fraction, chronic pericardial effusion, nephrotic syndrome, CKD 4, hypertension, type 2 diabetes, thyroid cancer status post-thyroidectomy with resultant postsurgical hypothyroidism, glaucoma, and anemia of chronic disease. Upon presentation, the patient was encephalopathic with hypothermia of 27.2°C (81 °F) per rectal thermometer and bradycardia of 35 beats per minute. The patient underwent active rewarming, which included warm fluids, heated high flow nasal cannula 5L/min FiO<sub>2</sub> 28%, and Bair hugger with the goal of rewarming the patient at no greater than 2°C per hour. The patient recovered her temperature overnight, but remained encephalopathic. Despite adherence to the established therapeutic measures for severe hypothermia, the patient clinically declined and expired. This case underscores the potential for hypothermia to manifest in patients with COVID-19 who have received two vaccine doses. The implications of this finding will be discussed, highlighting the need for further research and awareness regarding hypothermia as a possible presentation of COVID-19 in vaccinated individuals.

## INTRODUCTION:

Severe hypothermia is defined as a temperature less than 28°C and its clinical features can include apnea, coma, decreased or no activity on electroencephalography, nonreactive pupils, oliguria, pulmonary edema, and ventricular dysrhythmias.<sup>1</sup> These possible symptoms exist on a spectrum with those seen with mild to moderate hypothermia, so each patient may present differently. Treatment of a severely hypothermic patient requires active rewarming. Active rewarming consists of providing an external heat source to the patient's skin, which can be done with convection via forced-air warming systems (e.g., Bair Hugger), via arteriovenous anastomoses, and via airway rewarming with humidified oxygen.<sup>1</sup> In addition to rewarming, hypothermic patients should receive bedside glucose and thiamine and antibiotics and/or steroids if appropriate.<sup>1</sup>

Hypothermia is commonly seen in patients exposed to cold temperatures, but can also be seen in patients with dermal, endocrine, and neurological disease with additional causes including drug-induced, iatrogenic, and sepsis.<sup>1</sup> Notably, hypothermia has also been present in cases of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection with the first documented case study showing hypothermia as an initial presenting symptom.<sup>2</sup> Subsequently, a retrospective study of 57 patients found hypothermia in hospitalized patients with COVID-19 to be associated with "longer intubation periods, longer ICU stays and increased risk of mortality."<sup>3</sup>

A retrospective review of 331 patients showed a significant association between hypothermia and death.<sup>4</sup> These retrospective reviews took place prior to the availability of SARS-CoV-2 vaccines and thus the patients in the studies were not vaccinated.

The Centers for Disease Control and Prevention (CDC) state that a patient is fully vaccinated against SARS-CoV-2 within two weeks of receiving two doses of the Pfizer-BioNTech (BNT162b2) vaccine, two doses of the Moderna (mRNA- 1273) vaccine, or one dose of Johnson and Johnson's Janssen vaccine (JNJ- 78436735).<sup>5</sup> Prior to this publication, there was no preexisting documentation detailing cases of hypothermia in patients with COVID-19 infection who had received full COVID-19 vaccination.

## CASE DESCRIPTION

This is a case of a 49-year-old female with a history of heart failure with preserved ejection fraction, chronic pericardial effusion, nephrotic syndrome, CKD 4, hypertension, type 2 diabetes, thyroid cancer status post thyroidectomy with resultant postsurgical hypothyroidism, glaucoma, and anemia of chronic disease. She had received two doses of the Moderna COVID-19 vaccine less than one year prior and had not received additional doses. Seventeen days prior to the ICU admission detailed by this case, she was diagnosed with COVID-19 and hospitalized for five days for management of ascites and COVID-19. Her family reports that she had slowly been declining since discharge. She presented this admission via ambulance for altered mental status and was found to be profoundly hypothermic with bradycardia.

The patient's vital signs were significant for hypothermia of 27.2 °C (81 °F) per rectal thermometer and bradycardia of 35 beats per minute. Physical exam was significant for acute distress in that the patient was obtunded with GCS 11; the patient was not alert or oriented, but responsive to painful stimuli for which she had movement of all extremities. The patient's right pupil was about 4 mm and her left pupil was pinpoint, which according to the medical record was a chronic constriction due to an unknown cause. Respiratory examination was notable for crackles upon auscultation; patient was protecting her airway. Her skin was very cold to the touch with clammy extremities. Anasarca with 4+ pitting edema of the lower extremities to the abdomen bilaterally.

### Pathological Tests and Other Investigations:

Chemistry panel was significant for mild respiratory acidosis. The patient was hyperglycemic without evidence of high anion gap metabolic acidosis with a hemoglobin A1c of 9.2%. Renal studies showed that the patient's creatinine remained at baseline of 2.1mg/dL. Complete blood count was significant for pancytopenia with elevated LDH and normal reticulocyte count. CK, troponin, CRP, lactate, and triglyceride evaluations were negative. Infectious disease workup was significant for a positive COVID-19 PCR test. HIV, influenza, Streptococcus, and Legionella were negative. Blood cultures and MRSA swab showed no growth. Ammonia was within normal limits. Thyroid stimulating hormone (TSH) was elevated at 43.2 mcIU/mL with low T4 and T3 levels of 0.68 ng/dL and 0.97 pg/dL respectively. Autoimmune studies were negative, including tests for ANA, Anticardiolipin IgG and IgM, and B2 Glycoprotein IgG/IgM. Urine toxicology was negative. Additional labs were notable for Vitamin D deficiency

and thiamine deficiency. The patient's phosphatidylethanol levels were negative for alcohol use. Vitamins B6, B9, and B12 were within normal limits.

Electrocardiogram showed a junctional bradycardia. CT head without contrast showed no acute intracranial findings. Chest X-ray showed decreased mild to moderate right and trace left pleural effusions and improved aeration of the lungs with decreased mild to moderate hazy pulmonary infiltrates. Echocardiogram noted a LVEF of 70% and a small/moderate circumferential pericardial effusion without hemodynamic compromise. The effusion appeared chronic dating back to at least 2020 by previous echocardiograms.

On hospital day 2, that patient began to exhibit intermittent seizing. The patient was intubated for airway protection. Subsequent MRI of the brain without contrast was notable for numerous foci of restricted diffusion involving multiple vascular territories with associated FLAIR signal hyperintensity which was most suggestive of recent embolic phenomenon, including bland and septic etiologies. Electroencephalogram showed a delta wave pattern consistent with severe generalized slowing; there was no active epileptiform activity.

To address the patient's right pleural effusion, a thoracentesis was performed during which 1.5 liters of transudative pleural fluid was removed. Vascular bilateral carotid duplex showed mild scattered heterogeneous plaque formation within the bilateral carotid arterial tree with no evidence for hemodynamically significant stenosis.

#### Treatment plan:

The patient was admitted to the ICU for controlled warming measures and additional management of her many medical problems. To address the severe hypothermia, the patient received active rewarming with warm fluids, heated high flow nasal cannula 5L/min FiO<sub>2</sub> 28%, and Bair hugger with the goal of rewarming the patient at no greater than 2°C per hour. A low threshold for intubation was maintained in the event that any hemodynamic issues or worsening mental status were to occur while rewarming.

Additionally, the patient received IV levothyroxine to address her known hypothyroidism and suspicion of myxedema coma. She additionally received IV hydrocortisone prior to concomitant adrenal insufficiency being ruled out. Blood cultures and MRSA swab were performed and she was started on broad-spectrum antibiotics until an infectious etiology could be ruled out. Nephrology and endocrinology were consulted. Electrolytes were monitored closely. Strict inputs/outputs due to the patient's volume overloaded state. With resolution of the hypothermia, the healthcare team expected clinical improvement of the accompanying encephalopathy and bradycardia.

The patient was able to spontaneously recover body temperature overnight. Blood pressure and heart rate normalized. However, the patient remained obtunded. The patient began to demonstrate an irregular flexion of both upper extremities, right lateral gaze with horizontal nystagmus, and was no longer responding with intention as well as audible gurgling that was concerning for aspiration. The patient was intubated to protect the airway.

The patient was found on MRI without contrast of the brain to have a bihemispheric stroke. No definite etiology of embolic phenomenon was identified. The patient was compassionately extubated and placed on comfort care. No further workup was performed. The patient continued to decline clinically and expired. An autopsy was not performed.

## DISCUSSION

This case documents the importance of treating severe hypothermia in patients with COVID-19 infection. This case shows that a patient with several comorbidities is at risk for severe COVID-19 even when vaccinated and that hypothermia may be a presenting symptom, even late in the course of COVID-19 infection. This case supports the existing literature that hypothermia in COVID-19 is associated with increased mortality.<sup>4</sup>

Upon admission to the ICU, warming protocols were initiated and followed the standard of care as described above. The patient's temperature was recovered overnight and the bradycardia resolved. Despite this, the patient clinically declined after a subsequent bihemispheric stroke. One limitation of this case study is the inability to definitively establish the causal relationship between hypothermia, COVID-19, and the subsequent stroke. Because her COVID-19 positive test and symptoms had started more than two weeks prior to the stroke, there is a low likelihood that it contributed to a hypercoagulable state. However, given the existing literature about higher risk of mortality, we believe it to be associated with the patient's clinically declining state and hypothermia.

Nevertheless, without additional investigations or an autopsy, it remains challenging to establish a clear cause-and-effect relationship. The patient's family's decision to forego an autopsy in this case limited the ability to gain a more comprehensive understanding of the specific factors contributing to the patient's clinical decline and subsequent death. While the COVID-19 PCR test remained positive this admission, other etiologies of hypothermia were considered and ruled out, including sepsis, hypoadrenalism, autoimmune, and other viral infection. The patient was initially treated for a presumed myxedema coma, however, the T4 levels were not profoundly low enough and the endocrine team ruled out hypothyroidism as the etiology of hypothermia. Though the patient's thiamine levels were low, the phosphatidylethanol level ruled out alcohol use as the cause of the hypothermia and encephalopathy.

## CONCLUSION

In conclusion, COVID-19 patients who had previously received a two-dose series of the Moderna vaccine can present with severe hypothermia. Hypothermia in COVID-19 has been shown to increase mortality, which can also be seen in patients who have received the two-dose Moderna COVID-19 vaccine series. This case underscores the importance of recognizing and promptly treating severe hypothermia in COVID-19 patients, even in those who have received full vaccination. Further research and investigations are needed to better understand the underlying mechanisms and associations between hypothermia, COVID-19, and related complications.

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## Integration of a Culturally Appropriate Method of Delivering Health Information in a Non-Clinical Setting

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# Integration of a Culturally Appropriate Method of Delivering Health Information in a Non-Clinical Setting

## Cover Page Footnote

Acknowledgements: Malorie Barragan, FHCN Director of Special Programs Veronica Sanchez, FHCN Community Health Supervisor Guadalupe Flores, FHCN Community Health Manager Estefany Torres, FHCN Community Health Representative FHCN Health Coach Navigators at Bailoterapia

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# Integration of a Culturally Appropriate Method of Delivering Health Information in a Non-Clinical Setting

## ABSTRACT

### **Context:**

A.T. Still University School of Osteopathic Medicine in Arizona (ATSU-SOMA) has an established partnership with Family HealthCare Network (FHCN). Initial meetings with the local community outreach department identified that a substantial majority of the Hispanic population served by this health center may lack access to health education. In particular, Spanish-speaking patients at the health center may face language barriers that impair the transfer of health education between the providers, patients, and their families.

### **Objective:**

The purpose of this study was to provide health educational presentations in Spanish in order to improve health knowledge relating to women's and children's health. The goal was to equip participants with necessary health information so that they gain awareness of the importance of scheduling primary care visits for themselves and their families.

### **Methods:**

Two health information sessions on women's and children's health were developed, translated, and advertised via flyers to Spanish-speaking attendees of FHCN Bailoterapia dance classes. Participants were recruited on a voluntary basis after passing out the flyers. During each session, participants first filled out a pre-survey. Next, they listened to a live presentation on either women's or children's health in Spanish. Finally, they completed the post-survey.

Participation entailed attending one of the educational sessions and completing a pre-survey and post-survey. Ordinal data were collected and outcomes were evaluated via a two-tailed t-test to assess changes in health attitudes, knowledge, and participant satisfaction. Each participant received a numbered packet and their responses to the health attitude questions were compared from pre- to post-presentation. The data from each presentation were independently collected in the same manner.

### **Results:**

Forty-seven eligible participants all participated in the surveys. The completed survey rate was 100%. Survey findings showed an improvement in health knowledge after the presentation. Baseline knowledge and health attitude improvement for women's and children's health was 37.9% and 61.25% respectively. Paired t-tests yielded p-values of less than 0.0001.

### **Conclusion:**

The model highlighted how delivering health information in Spanish can empower Spanish-speaking individuals in the community to feel confident in seeking healthcare. We learned from the project that participants displayed an improvement in health knowledge after the presentations. The program was effective in improving participants' knowledge of the respective health topics. On a community level, the affiliated health center also expressed interest in expanding this program to having more sessions. Other organizations and communities may have different

language barriers and thus require additional adjustments. Using this innovative approach to perform outreach and networking with various community organizations will allow new audiences and community members to be reached for future projects.

## INTRODUCTION

Within the Central Valley of California, specifically, Tulare County, migrant and seasonal farm workers (MSFW) are part of a large Spanish-speaking community. The barriers to healthcare access impacting this group include language barriers and clinic hours of operation.<sup>1</sup> Limited access to healthcare can lead to a decreased likelihood of annual screenings and routine check-ups on preventable diseases. Without early intervention, these diseases can progress into chronic illnesses including diabetes, hypertension, obesity, and hyperlipidemia, which increase the risk for complications such as sudden cardiovascular death.

Common services requested by MSFW include pediatrics', men's, and women's care.<sup>1</sup> In a report that provides a profile of farmworkers and experiences during the COVID-19 pandemic in Monterey, Tulare, and Kern counties, California, the majority of the surveyed are Spanish-speaking and one-third of the respondents utilized health care services. Findings emphasized there is a need for ongoing training and information in farmworkers' preferred language.<sup>2</sup> In 2017, 62.7% of the population of Tulare County, California consisted of Spanish-speaking individuals.<sup>3</sup>

Also, in Tulare County, the childhood obesity rate is above the national average. For example, in 2014-2015, the obesity rate for children in the 5<sup>th</sup> grade in Tulare County was 23.3% compared to the national average of 17.4% for children aged 6-11 years old.<sup>3,4</sup> Children with obesity have an increased risk of developing hypertension, hyperlipidemia, type 2 diabetes, and mental problems related to low self-esteem. Primary prevention for childhood obesity requires early intervention and improving health knowledge in areas regarding nutrition.

In addition to barriers to child health, recent studies have suggested that Latina women of childbearing age also face barriers to women's health. Latinos are the largest minority group in the United States and suffer a disproportionate burden of sexually transmitted infections (STIs) as compared to whites.<sup>5</sup> Latinas are 1.7 times more likely than other racial/ ethnic minorities to develop high-risk Human Papilloma Virus (HPV) infection and hence have higher rates of cervical cancer as compared to African American and white women.<sup>5</sup> Providing health education to vulnerable populations in their native language can lead to improved health outcomes. As such, the purpose of this project was to determine if providing health education in their native language of Spanish can improve knowledge in the Tulare County community

## METHODS

Two health information sessions were developed, translated, and advertised via flyers to Spanish-speaking people who were regular attendees of the Family HealthCare Network (FHCN) Bailoterapia dance classes. The project was conducted on two separate days with one health session offered to those present before each dance class. Each health session was a 45-minute live presentation by ATSU-SOMA medical students. The first day's topic was Women's health primary prevention and the second day's topic was Children's health primary prevention. The

project used credible, peer-reviewed resources to provide information regarding screening, timing, and procedure overview, namely the American College of Physicians, American Council of Gynecologists, American Association of Pediatrics, CDC guidelines, and UptoDate. The curriculum was curated together by medical students. The presentations were reviewed and approved by multiple healthcare providers at FHCN.

Participants were recruited on a voluntary basis through flyers. The participants are based on the convenience of those who choose to attend the Bailoterapia program. The inclusion criteria were Spanish-speaking attendees of the Bailoterapia class. Although there was no gender or age restriction, the dance classes consisted of adult women.

During each health information session, participants first filled out a pre-survey. Next, they listened to a live presentation on either women's or children's health in Spanish, depending on the day. Finally, they completed the post-survey. The main tool of measurement was the survey packets that contained the pre- and post-surveys. The pre- and post-surveys were based on completed presentations and contained five questions each (Table 1). The surveys asked about health knowledge and interest. The survey packets were labeled with a numerical identifier for anonymous collection and distribution.

Ordinal data were collected in the manner of the level of satisfaction. Evaluation of the results was conducted by the principal investigator and sub-investigators. Outcomes were evaluated via a two-tailed t-test to assess changes in health attitudes, knowledge, and participant satisfaction. Participants' responses to the health attitude questions were compared from pre- and post-presentation. The data from each presentation were independently collected in the same manner. The ATSU-Arizona Institutional Review Board approved non-jurisdiction on January 13, 2022.

## RESULTS

There were a total of 47 participants. Data from each of the two health information sessions were collected after each session. 100% of participants completed both a pre- and post-survey. Baseline knowledge was compared based on the pre- and post-survey responses. Of the 20 participants of in the Women's Health presentation, 90% self-scored less than 9 out of 10 in health knowledge on the pre-survey. In the post-session survey, 25% self-scored less than 9 out of 10 in health knowledge. The average change showed a 37.9% increase in knowledge and health attitude. The mean score of baseline knowledge based on a range of 1-10 before the presentation was 7.1 and after the presentation was 9.3. Between the pre- and post-survey scores, the paired t-test was highly significant ( $p < 0.0001$ ). See Table 1 for pre- versus post-survey results for Women's Health.

Of the 27 participants who went to the Children's Health presentation, 81% self-scored less than 9 out of 10 in health knowledge pre-survey. In the post-session survey, 22% self-scored less than 9 out of 10 in health knowledge. The average change showed a 61.3% increase in knowledge and health attitude. The mean score of baseline knowledge based on a range of 1-10 before the presentation was 7.6 and after the presentation was 9.7. Between the pre- and post-survey scores, the paired t-test was highly significant ( $p < 0.0001$ ). See Table 1 for pre- versus post-survey results for Children's Health.

**Table 1.** Pre versus Post Health Attitudes Questions

	<b>Pre-Survey on Women's Health (n=20)</b>	<b>Post-Survey on Women's Health (n=20)</b>	<b>Pre-Survey on Children's Health (n=27)</b>	<b>Post-Survey on Children's Health (n=27)</b>
How knowledgeable are you on this topic, on a scale of 1-10?				
<i>1-3 self-score</i>	5%	5%	3%	0%
<i>4-6</i>	25%	5%	15%	0%
<i>7-9</i>	60%	15%	63%	22%
<i>10</i>	10%	75%	19%	78%
How interested are you in learning about this topic on a scale of 1-10?				
<i>1-3 self-score</i>	0%	0%	0%	0%
<i>4-6</i>	0%	0%	0%	0%
<i>7-9</i>	10%	10%	7%	7%
<i>10</i>	90%	90%	93%	93%
I know where I can learn more about this topic.				
<i>Yes</i>	60%	95%	59%	85%
<i>No</i>	30%	0%	22%	0%
<i>No response</i>	10%	5%	19%	15%
I am comfortable talking about this topic with my healthcare provider and can apply my knowledge on this topic in my everyday life.				
<i>Agree</i>	60%	65%	70%	81%
<i>Neutral</i>	25%	10%	4%	0%
<i>Disagree</i>	10%	20%	4%	4%
<i>No Response</i>	5%	20%	22%	15%
I am comfortable in talking about this topic with my friends, family, and/or loved ones.				
<i>Yes</i>	50%	90%	62%	85%
<i>No</i>	40%	5%	19%	0%
<i>No Response</i>	10%	5%	19%	15%

## DISCUSSION

The purpose was to improve knowledge relating to family health and by promoting knowledge in the participants' native language of Spanish. We learned from this project that participants reported an improvement in health knowledge after live presentations in a community setting. Based on the data collected, the program was effective in improving participants' knowledge of the health topics that were presented. As a result, the affiliated health center expressed interest in expanding this program by offering more sessions in the community.

Additionally, by presenting the information in Spanish, participants were more engaged and able to learn preventative medicine. Participants reported feeling more empowered and more comfortable in talking about these health topics with their friends, family, and healthcare provider. This method of delivering health information in a non-clinical setting showed increased participants' willingness to seek healthcare information. Other organizations and communities may have different language barriers and thus may require alternative adjustments. Using this innovative approach to perform outreach and networking with various community organizations

will allow new audiences and community members to be reached for future projects. Findings indicated meaningful efforts to disseminate information can improve health knowledge, however, there is still a need for further longitudinal studies to evaluate if the improvement of health knowledge results in lifestyle modifications, increased healthcare visits, and improved health outcomes.

The primary limitation of this study was the time constraint, preventing us from collecting longitudinal data assessing the incorporation of the lifestyle modifications presented to them. A single intervention with a sample of convenience is not generalizable to the entire population. Additionally, due to the anonymous nature of the survey, there is no confirmation of how many participants from the first session attended the second session. There is a possibility of residual positivity from the first session, leading to higher scores in the second session.

## CONCLUSION

In conclusion, this project highlighted how delivering health information in Spanish can empower Spanish-speaking individuals in the community to feel more confident in seeking healthcare. Also, it emphasized that health promotion can be done in non-traditional or non-healthcare settings such as dance classes and support groups. By collaborating with local community outreach departments in creating future health education programs, many community members can become advocates for their own health as well as for the health of their children and spouses.

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## Preparing for Pandemics: Lesson Plan Design for Children in Elementary School

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## Preparing for Pandemics: Lesson Plan Design for Children in Elementary School

### Cover Page Footnote

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# Preparing for Pandemics: Lesson Plan Design for Children in Elementary School

## ABSTRACT

### **Context:**

The COVID-19 pandemic necessitated distance learning to attenuate the spread of the virus, and school-aged children were particularly affected by this change. Because of their age and education level, children generally lacked understanding about the pandemic and the preventive measures necessary to prevent the spread of this and other infectious diseases. It is unknown how many schools nationwide incorporated disease-prevention education in their curriculums during the pandemic. Therefore, developing distance learning interventions that convey these topics at their level of understanding is important to improve health literacy and raise their awareness of factors that positively influence health.

### **Objective:**

To implement a distance learning intervention that teaches elementary-aged children about infectious diseases and pandemics and to evaluate their understanding of the material.

### **Methods:**

A four-week program with weekly lessons was developed to teach fifth grade students about infectious diseases and pandemics. Weekly lessons involved one or two instructional videos, preintervention and postintervention quiz, live online interactive session. Participants also completed a survey before (Presurvey) and after (Postsurvey) the entire 4-week program to evaluate their understanding of the material.

### **Results:**

61 fifth graders (ages 10-11) participated in the project. Quiz scores improved from preintervention to postintervention for week 1 (74% [3.0] vs 86% [2.2],  $P<.001$ ), week 2 (85% vs 88%,  $P=.34$ ), and week 3 (78% vs 83%,  $P=.20$ ). Scores were the same in week 4 (95%,  $P=.86$ ). Survey responses before and after the program also improved, particularly for questions related to understanding what it means to be in a pandemic (33% [18/54] vs 55% [24/44],  $P=.008$ ) and that SARS-CoV-2 is a virus and causes COVID-19 (4% [2/54] vs 27% [12/44],  $P<.001$ ). For the extra survey item, 52% (23/44) felt they had learned something about the topics after the lessons.

### **Conclusion:**

Project results suggested that our distance learning intervention improved fifth grade students' knowledge about infectious diseases and pandemics. Although it was difficult to maintain the same response rate for weekly quizzes or to fully engage participants during the virtual lessons, the live interactive sessions were well received and seemed to improve their understanding of these topics. Because our project intervention seemed to provide participants with greater health literacy, similar interventions should be considered for other grade levels at elementary schools across the country to promote awareness about infectious diseases or other global health issues.



## INTRODUCTION

In 2020, the COVID-19 pandemic caused multiple challenges for all levels of education. School-aged children were affected by the rapid change to distance learning to control the spread of the virus. According to the United States Census Bureau, 93% of households transitioned to various types of distance learning during the COVID-19 pandemic. Once the pandemic was somewhat abated, education returned to in-person learning.<sup>1</sup> Although children can copy parent behaviors, school-aged children generally lacked the understanding of preventative measures to diminish the spread of COVID-19 and other infectious diseases.<sup>2</sup>

In a 2020 study on pediatric cases of COVID-19, the authors had a cohort of 192 children and 49 (26%) were diagnosed with acute SARS-CoV-2 infection, and only 25 of those diagnosed 49 children (51%) presented with fever, other nonspecific symptoms, or no symptoms. Although children tended to have milder disease than adults and many had asymptomatic COVID-19 infections, they were still significantly impacted. Further, healthy children could potentially pass the virus on to more vulnerable people.<sup>4-7</sup> Thus, educating children about COVID-19 and other infectious diseases is important, so they understand the consequences of such diseases, whether they experience symptomatic disease or not.

There have been studies that investigated educating children about infectious diseases.<sup>8,9</sup> Because of the severe acute respiratory syndrome outbreak of 2003, Koller et al. investigated children's (N=21) knowledge of pandemics and found that they understood the need for planning to minimize the challenges of future pandemics.<sup>8</sup> Children in that study also recognized the importance of addressing psychosocial needs, infection control, communication, and management of resources.<sup>8</sup> After the 2009 H1N1 influenza virus outbreak, Remmerswaal and Huris studied the fear reactions of 223 children aged 7-12 years.<sup>9</sup> They found that children had higher fear levels the more their parents warned them about the dangers of the disease ( $P<.001$ ).<sup>9</sup> Additionally, when parents conveyed the threat information, there was an increase in children's fear scores, even after controlling for other sources of information about the H1N1 virus ( $P<.001$ ).<sup>9</sup> Results of these studies highlight the need for proper education of children about infectious diseases and pandemics to mitigate misinformation and to provide information without unnecessarily increasing fear.<sup>8,9</sup>

For school-aged children, interactive and experiential learning have been shown to facilitate knowledge acquisition.<sup>10-12</sup> For instance, conversations verbalizing the information being taught or having children teach learned information to friends and family can reinforce retention.<sup>10</sup> Similarly, performing activities that reinforce learning, such as hand washing or social distancing when teaching health education, can increase understanding of the material.<sup>11</sup> This kind of experiential learning is supported by a systematic review that found children may benefit most from hands-on experiences.<sup>12</sup> In distance learning environments, like that caused by the COVID-19 pandemic, interactive and collaborative teaching methods are critical for effective learning. In a study by Hyman et al, children who were comfortable and confident with distance learning benefited from digital health education and were more likely to make healthier life choices.<sup>13</sup> Therefore, combining hands-on and distance learning may be an effective method for improving health literacy to children.

In general, health literacy is a modifiable factor that can improve understanding of strategies to mitigate the spread of communicable diseases.<sup>14</sup> Throughout the COVID-19 pandemic, the spread of false information highlighted the importance of proper health education<sup>10</sup> and the need for basic health literacy<sup>15</sup> to prevent psychosocial consequences<sup>7</sup> of misinformation.<sup>7,10,15</sup> Because of the misinformation, many people were confused about what a virus is, how it spreads, and how prevention and intervention work.<sup>7</sup> This confusion and misinformation were particularly stressful for children, and as a result, they may experience long-

lasting negative effects on their overall health.<sup>7</sup> Because health literacy is so vital, Aghazadeh et al evaluated 365 second graders before and after health literacy lessons.<sup>16</sup> Using a pretest–posttest project design, the authors found that the mean (SD) health literacy score increased from preintervention quizzes (2.23 [1.47]) to postintervention quizzes (3.34 [1.35],  $P<.001$ ), which indicated proficient health literacy.<sup>16</sup> These results suggest that children can learn the knowledge and skills necessary to navigate situations involving infectious diseases, improving their overall health literacy and reducing their susceptibility to health misinformation.

Therefore, implementing distance learning interventions at an elementary-aged education level may limit the spread of current and future infectious diseases and potentially save lives. By teaching children about the COVID-19 pandemic and other infectious diseases, we may be able to mitigate the psychological stress and fear caused by such diseases and improve overall health literacy. The purpose of the current project was to implement a distance learning intervention to teach elementary-aged children about infectious diseases and pandemics and to evaluate their understanding of the material. We hypothesized that our distance learning intervention would improve their understanding of infectious diseases and basic preventative measures. Ideally, our intervention would provide them with the appropriate tools to help prevent the spread of future pandemics.

The project closely follows the osteopathic model of care with regards to the behavioral aspect of health care. This model is an important aspect of healthcare which is often overlooked and demonstrates one of the everlasting impacts of the pandemic that may not be given much attention with societal views on mental health. However, as children may show the psychological and mental effects from the pandemic, it brings to light the importance of addressing the behavioral model of osteopathic medicine.

## METHODS

### Participants

The current project used a preintervention quiz and postintervention quiz design and convenience sampling to recruit children in fifth grade (aged 10-11 years) from three separate classes at an elementary school in a metropolitan area in the Southwestern United States. Since the mean reading ability of adults in the United States is estimated to be at the eighth-grade level, it is recommended that educational materials be written below a sixth-grade reading level.<sup>16-18</sup> For an appropriate assessment of the intervention, we therefore included fifth graders in our project, with their lower than national average reading level.<sup>19</sup> Although participation in the project was voluntary, we incentivized participation by offering prizes (toys, masks, small items), to individuals and the overall class that participated the most.

No identifying information was collected, but the total number of responses per survey and quiz were monitored to assess participation. Identifying information was unnecessary since the overall score among the entire project cohort was analyzed. The students' participation was monitored by the schoolteachers present on the school's distance-learning platform. Quizzes were collected anonymously by the teachers and assessed for overall participation by the total amount of quizzes received compared to the number of students enrolled in the project. The local institutional review board determined our project to be non-jurisdiction. Before participation, each child provided their assent, and informed consent was obtained from the child's parent or guardian.

The resulting four-week program focused on a specific infectious disease topic each week. In week 1, the intervention focused on viruses and taught the children a basic understanding of viruses. In week 2, the intervention taught the children about the pandemic and how germs spread.

In week 3, the intervention included general strategies to prevent infectious diseases. In week 4, the intervention focused on prevention strategies specific to the COVID-19 pandemic.

The intervention followed the same format each week. On Mondays, the children completed a preintervention quiz about that week's topic to measure their baseline understanding. Next, they watched one or two short instructional YouTube videos about the topic followed by an experiential learning activity or a Kahoot competitive quiz. Week 1 YouTube videos focused on what a virus is and how to teach kids about viruses.<sup>20, 21</sup> Week 2 YouTube video detailed the importance of washing hands.<sup>22</sup> Week 3 YouTube videos concentrated on hand washing, coughing, and sneezing.<sup>23, 24</sup> Week 4 YouTube video centered on social distancing.<sup>25</sup>

On Wednesdays, the children attended a 30-minute virtual meeting to discuss the contents of the videos. During these interactive sessions, the children were encouraged to ask questions and answer the teams' questions about that week's learning topic. They also played games or performed activities that supplemented the information. The materials for the Wednesday interactive learning activities were disseminated to the children before the session by their teachers. On Fridays, the children completed a postintervention quiz that was identical to the preintervention quiz to assess changes in their knowledge. All lesson plans were pre-approved by the teachers of the three classes and the principal of the elementary school.

The week 1 activity materials required a writing instrument and paper. All students were instructed to draw a smiley face on the piece of paper that signified a healthy cell. Then all students showed their respective drawings on their computer cameras. Via a private online chat message, we informed 5-10 random students to draw a face with scary teeth and scary eyes to represent an infected cell. The remaining students were instructed to draw another smiley face, so all students had two drawings. We informed the students that in our hypothetical scenario, a student visited a friend, went to the grocery store, or attended a birthday party where someone was ill. Next, all students showed their drawings on their computer screens. We explained through this activity how some cells become infected with a virus and how easily it can spread.

For the week 2 virtual meeting, we first reviewed the previous week's material and answered any questions the students had. The only material required was standard hand soap. Students were asked to put a pump of soap on their hands and have it sit on their hands while they watched a YouTube video.<sup>26</sup> After the video, we asked the children if any of the soap got on anything they might have touched around them. This demonstration highlighted how easily "germs" can be spread and were asked questions that included: what did the "germs" (soap) get on? Which objects? Your face? Who avoided touching things because they knew they had "germs" (soap) on them? Students were then allowed to wash their hands and were asked to come back to view the final YouTube video for the live session.<sup>27</sup> After the video, the team opened the meeting to any questions that the children had, which were answered accordingly.

The week 3 live activity followed a similar format. After answering questions regarding the previous week's material, we discussed proper handwashing techniques, how to cover a cough/sneeze, and how to correctly wear a mask. A YouTube video was shown that reviewed the contagiousness of a sneeze and how to effectively block it.<sup>28</sup> When reviewing proper handwashing, students required a bowl of water, black pepper, and soap. The students then watched another YouTube video detailing the experiment and added black pepper to the bowl of water, symbolizing germs in the environment.<sup>29</sup> Students placed their non-washed finger into the bowl and observed how the pepper remained in place in the water. Then, students put soap on their index finger and put their finger in the water bowl, which repelled the pepper. This experiment highlighted the importance of handwashing to repel germs. The second activity for week 3 required a paper pinwheel provided by the investigators. Children blew on the pinwheel with and without their

masks on to show the importance of wearing a mask in prevention of spreading respiratory droplets.

Week 4 followed a similar format. First, any questions about the material from previous weeks were answered and students were instructed to share their activities during quarantine to stay busy and connected with peers. The students were asked to give examples of a 6-foot distance based on their own experiences and from what they learned in the video<sup>25</sup> they watched a few days prior. An online Kahoot trivia game created by the investigators was played with the students to test their knowledge on social distancing and review lessons from previous weeks. Finally, we answered any remaining questions.

All quiz questions were written at an appropriate reading level for our participants (Table 1). The week 1 quiz included 4 items, and each of the remaining quizzes had 3 items. Participants also completed a survey before (Presurvey) and after (Postsurvey) the program to evaluate their understanding of the material. The surveys were developed specifically for the current project and included 5 Likert-scale items with values ranging 1 - 5, with 1 being “strongly disagree” and 5 being “strongly agree” (Table 2). An extra Likert-scale item was included in the Postsurvey. Both the Presurvey and Postsurvey also included free-text items that were included so the participants could use their own words to explain their comprehension of pandemics and preventative measures. The Postsurvey had 3 free-text items: (1) tell me what you know about pandemics, (2) I can help stay safe and stop the spread of COVID-19 by—, and (3) after everything you have learned, will you plan to do anything differently to help stop the spread of any disease (not just COVID-19)? The Presurvey included only the first 2 items. Quizzes and surveys were completed electronically using the school’s online portal. It is estimated that each of the quizzes and surveys took approximately 5-10 minutes to complete.

**Table 1.** Weekly Preintervention and Postintervention Quiz Questions Used in the Current Project

<b>Quiz Item</b>	<b>Type of Response</b>
<b><u>Week 1</u></b>	
1. What is a virus?	Multiple choice
2. How does a virus make us sick?	Multiple choice
3. About how long does it usually take us to get better after we get sick with a virus in general?	Multiple choice
4. Older people or people who are already sick with other illnesses (like asthma) might have a harder time fighting viruses.	Binary True or False
<b><u>Week 2</u></b>	
1. What is a pandemic?	Multiple Choice
2. How do germs spread?	Multiple Choice
3. Virulence refers to how harmful a microbe may be. Some can be very harmful and make us very sick, while others do not.	Binary True or False
<b><u>Week 3</u></b>	
1. How long should you scrub when washing your hands?	Multiple Choice

- |   |                 |
|---|-----------------|
| 2. Why should we sneeze into our elbows?              | Multiple Choice |
| 3. Who is wearing their mask correctly? (Image shown) | Multiple Choice |

**Week 4**

- |   |                         |
|---|-------------------------|
| 1. At least how much distance should you keep when physically distancing from another person? | Multiple Choice         |
| 2. Why is it important to quarantine if you believe you could have caught COVID-19?           | Multiple Choice         |
| 3. What are some ways you can help stop the spread of COVID-19? Click all that are correct.   | Select Multiple Answers |
- 

**Table 2.** Presurvey and Postsurvey Questions Used in the Current Project before and after the entire 4-week program, respectively.

Survey Item	Response Type
1. I understand what an infectious disease is.	Likert scale
2. I understand what it means for the world to be in a pandemic.	Likert scale
3. I understand what the SARS-CoV-2 virus is and how it causes COVID-19.	Likert scale
4. I understand how to prevent the spread of viruses.	Likert scale
5. I understand why washing my hands is important.	Likert scale
6. I feel like I learned something about the topics presented after these lessons. <sup>a</sup>	Likert scale
7. Tell me what you know about pandemics (what they are, how they spread, how to stop them).	Free text
8. I can help stay safe and stop the spread of COVID-19 by:	Free text
9. After everything you have learned, will you plan to do anything differently to help stop the spread of any disease (not just COVID-19)? <sup>a</sup>	Free text

<sup>a</sup>This question was only included in the postintervention survey.

## Statistical Analysis

Project data was downloaded from the elementary school's online portal. Quiz scores were calculated as the number of correct responses and reported as a percentage. A mean (SD) score was calculated for each week and for each quiz item for that week. Survey responses were ranked ordinally on a scale of 1-5 points with 1 being strongly disagree and 5 being strongly agree. Ranked scores were summarized using frequency and percentage, and aggregate scores were calculated for preintervention and postintervention surveys. Aggregate scores were utilized as it is a common way to provide statistical analysis for a group of people and produce a summary data. Wilcoxon rank sum tests were used to test for differences between Likert-scale questions for the Presurvey and Postsurvey. Fisher exact tests were used to assess percent change in score for each quiz item. For participant responses to the survey's free-text items, responses were grouped by common domains using recurring keywords. They were grouped to qualitatively assess the responses. Microsoft Excel was used for analyses, and a  $P < .05$  was considered statistically significant.

## RESULTS

Sixty-one fifth graders participated in the project. Because participation was voluntary, the number of participants in each session varied.

Quiz scores improved from preintervention to postintervention for week 1 (74% vs 86%,  $P < .001$ ), week 2 (85% vs 88%,  $P = .34$ ), and week 3 (78% vs 83%,  $P = .20$ ). Scores were the same in week 4 (95%,  $P = .86$ ) (Table 3). Only week 1 had a significant difference between preintervention and postintervention scores. During that week, a significant percent change of 24% ( $P = .02$ ) was found between scores for item 2.

**Table 3.** Preintervention and Postintervention Quiz Scores of Project Participants (N=61)

Quiz Item	Preintervention	Postintervention	P Value
	No. Correct (%)	No. Correct (%)	
Week 1 (n=56)	(74)	(86)	<.001
Question 1	54 (96)	40 (100)	.51
Question 2	26 (46)	28 (70)	.02
Question 3	30 (54)	29 (73)	.08

Question 4	55 (98)	40 (100)	>.99
Week 2 (n=54)	(85)	(88)	.34
Question 1	54 (100)	48 (98)	.48
Question 2	39 (72)	39 (80)	.49
Question 3	44 (81)	43 (88)	.43
Week 3 (n=46)	(78)	(83)	.20
Question 1	42 (91)	38 (97)	.37
Question 2	19 (41)	16 (41)	>.99
Question 3	46 (100)	39 (100)	NA
Week 4 (n=43)	N = 43 (95)	N = 39 (95)	.86

Quiz Item	Preintervention	Postintervention	P Value
	No. Correct (%)	No. Correct (%)	
Question 1	43 (100)	39 (100)	NA
Question 2	37 (86)	35 (90)	.74
Question 3	42 (98)	37 (95)	.60

Results for survey responses are presented in Table 4. Between the preintervention survey (N=56) and postintervention survey (N=44), aggregate scores increased; more participants agreed

or strongly agreed with survey items than disagreed or strongly disagreed. Significant differences were found for questions related to understanding what it means to be in a pandemic (33% [18/54] vs 55% [24/44],  $P=.008$ ) and that SARS-CoV-2 is a virus and causes COVID-19 (4% [2/54] vs 27% [12/44],  $P<.001$ ). Table 4 outlines these results.

**Table 4.** Presurvey (n=54) and Postsurvey (n=44) Scores of Project Participants for Likert-Scale Questions

Survey Item	Likert Responses, No. (%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Question 1					
Presurvey	18 (33)	20 (37)	10 (19)	4 (7)	2 (4)
Postsurvey	24 (55)	19 (43)	1 (2)	0 (0)	0 (0)
Question 2					
Presurvey	18 (33)	26 (48)	7 (13)	3 (6)	0 (0)
Postsurvey	16 (36)	21 (48)	6 (14)	1 (2)	0 (0)
Question 3					
Presurvey	2 (4)	17 (31)	11 (20)	16 (30)	8 (15)



Survey Item	Likert Responses, No. (%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Postsurvey	12 (27)	16 (36)	12 (27)	3 (7)	1 (2)
Question 4					
Presurvey	38 (70)	14 (26)	1 (2)	1 (2)	0 (0)
Postsurvey	37 (84)	6 (14)	1 (2)	0 (0)	0 (0)
Question 5					
Presurvey	47 (87)	7 (13)	0 (0)	0 (0)	0 (0)
Postsurvey	39 (89)	3 (7)	2 (5)	0 (0)	0 (0)
Question 6 <sup>a</sup>	14 (32)	23 (52)	5 (11)	1 (2)	1 (2)

<sup>a</sup>This question was only included in the postintervention survey.

Common response themes for the free-text survey items are reported in Table 5. For the item about pandemics, participants indicated that pandemics are diseases that “spread around the world, deadly or make people sick, and infectious/contagious.” For the item about how they could stay safe and stop the spread of COVID-19, participants identified staying home, covering their coughs and sneezes, and washing hands. For the last item about how they planned to use their new knowledge to stop the spread of any disease, participants reiterated their suggestions on the free-text section of the Postsurvey.

**Table 5.** Common Themes From the Free-Text Survey Items From the Presurvey(n=54) and Postsurvey (n=44)

Free-Text Survey Item	Common Themes
Question 7	Infectious/Diseases that spread Deadly Places shut down/close Worldwide Preventable
Question 8	Staying at home Social distancing Wearing masks Washing hands
Question 9	Using learned knowledge to prevent the spread Help myself/others stay safe

<sup>a</sup>This question was only included in the postintervention survey.

## DISCUSSION

In the current program, we implemented a distance learning education-based intervention to teach elementary-aged children about infectious diseases and pandemics and to evaluate their understanding of the material. Results suggested that our four-week program improved fifth grade students’ knowledge about infectious diseases and pandemics. Quiz scores improved from preintervention to postintervention for the first 3 weeks and were statistically significant for week 1. We also found similar increases in aggregate scores between the preintervention and postintervention surveys. The COVID-19 pandemic highlighted the importance of health literacy and overall understanding of preventative measures that can reduce negative outcomes.<sup>30</sup>

Therefore, as elementary-aged children returned to in-person classes, it was essential that they understood infectious diseases and how to diminish their spread. Our educational intervention significantly improved our participants’ level of understanding about these diseases and how they spread. This finding was supported by responses to our free-text survey item about future actions to slow the spread of disease: most participants indicated they planned to follow the preventative measures learned during the program. Given our positive results, our 4-week distance learning intervention may serve as a model for preventative medical outreach for children.

Improving the overall health literacy of children and adults is vital for preventing infectious disease, particularly in underserved populations. By teaching children about infectious diseases and pandemics at their level of understanding, we can provide them with the knowledge and empowerment to take charge of their personal health.<sup>31</sup> Such empowerment may also mitigate the psychological stress caused by fear of the unknown and poor health.<sup>8,9</sup> This increased awareness may also lead to better disease prevention and improvements in healthcare outcomes. Given the

negative effects of the “infodemic” regarding COVID-19, healthcare professionals, educators, and government officials should develop programs tailored specifically for children and adults to minimize misinformation in the future and reduce polarization of health-related issues.<sup>31,32</sup>

The current project had several limitations. Our participants were fifth graders from a single elementary school, so our results may not be generalizable to fifth graders at other schools or to elementary-aged children in general. To assess our distance learning intervention more fully, future studies should include a larger number of schools and recruit children from a variety of grades and socioeconomic and educational backgrounds. Future studies should also consider measurement of the change in spread of disease after the intervention. Another limitation of the current project may be related to a lack of long-term follow-up of participants. We intentionally did not include a longitudinal aspect in our project design, and it is unknown whether our results would continue to show positive changes in understanding of the material over time. Even though we included prize incentives to increase participation, the number of project participants varied during the program, which may have impacted our results. Despite these limitations, overall results suggested the intervention provided the children with greater understanding and an improved ability to slow the spread of infectious diseases. Future studies should investigate whether this type of distance learning program can be used to teach elementary-aged children about similar health literacy topics.

## CONCLUSION

The COVID-19 pandemic created unique educational challenges because of the rapid transition to distance learning to diminish the spread of disease. Elementary-aged children were particularly affected by this change, and as they returned to in-person education, it was essential to teach them about infectious diseases and preventative measures to keep them healthy. Results of our distance learning intervention suggested that the 4-week program improved fifth graders understanding about infectious diseases and pandemics. Overall, quiz and survey scores improved from preintervention to postintervention. The live interactive sessions were well received and seemed to improve their understanding of these topics. Because age-appropriate health education is necessary to improve health literacy, programs such as ours should be considered across all education levels to promote awareness about pandemics and other global healthcare issues and to instill greater confidence and abilities for navigating similar infectious disease scenarios in the future.

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## Breastfeeding Education of Medical Students and Resident Physicians

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# Breastfeeding Education of Medical Students and Resident Physicians

## ABSTRACT

Breastfeeding is widely recognized for its medical and neurodevelopmental benefits, leading to the American Academy of Pediatrics (AAP) recommending exclusive breastfeeding for the first 6 months of an infant's life with continuation through 2 years of age and beyond.<sup>1</sup> However, this literature review finds that despite the 2022 update to the AAP's recommendations, education on breastfeeding for physicians-in-training is inadequate. Though interventions have been shown to increase the breastfeeding knowledge and confidence of physicians, more research is needed to evaluate the efficacy of educational interventions. This paper emphasizes the urgency of implementing comprehensive interventions that address the gaps in breastfeeding education for physicians-in-training and underscores the importance of evidence-based approaches to improve the healthcare professionals' support of breastfeeding mothers in order to optimize health outcomes.

## INTRODUCTION

Breastfeeding and human milk represent the natural and optimal standards for infant nutrition.<sup>1</sup> In particular, breastfeeding is associated with reduced incidence of otitis media, acute diarrheal disease, lower respiratory illnesses, sudden infant death syndrome (SIDS), inflammatory bowel disease, childhood leukemia, diabetes mellitus, obesity, asthma, and atopic dermatitis. Additionally, mothers who breastfeed also experience a lower risk of type 2 diabetes mellitus, breast, ovarian, and endometrial cancer, and hypertension. These extensive health benefits and positive impact on immediate and long-term medical and neurodevelopmental development highlight the crucial role of breastfeeding as a vital public health priority.<sup>1</sup> However, when physicians lack comprehensive training in breastfeeding, they will not be well-equipped to provide accurate information, guidance, and support to new mothers. Thus, it is notable that insufficient physician knowledge in breastfeeding has been correlated with decreased initiation and continuation of breastfeeding.<sup>2</sup> The decreased initiation of breastfeeding has a direct impact on the health outcomes of infants, as evidence by the increased incidence of various acute and chronic diseases in infants who are not breastfed compared to those who receive human milk.<sup>1</sup> Despite efforts to address gaps in medical education of breastfeeding, informant interviews and physician surveys in 2020 demonstrate that gaps still exist and physicians in pediatrics, obstetrics-gynecology, and family medicine desire to have more education about breastfeeding.<sup>3</sup> Failure to address these gaps can result in inadequate support for breastfeeding mothers, leading to suboptimal outcomes for both mothers and infants.<sup>1</sup> The aim of this paper is to assess the current state of breastfeeding education for physicians-in-training, both at the undergraduate and graduate medical education levels. To explore this, a review of the literature was conducted.

## METHODS



A review of the literature was conducted to identify studies that report on breastfeeding education at the levels of undergraduate and graduate medical education in the United States. A review of available studies was conducted in June 2022. Articles in one database, PubMed, were searched based on the following keywords: breastfeeding medical education. The search was then supplemented with the “snowball” method by looking at the references within each of the included articles. Studies that explored breastfeeding in medical education outside of the United States were excluded. *Breastfeeding: A Guide for the Medical Profession*<sup>4</sup> is a reference text that was additionally used to supplement the search. A total of 18 references were used.

## HISTORY OF BREASTFEEDING EDUCATION

In 1956, La Leche League was formed by mothers who wanted to be resources to women on their breastfeeding journeys.<sup>5</sup> It wasn't until 1979 that the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) held an urgent meeting on infant and young child feeding and one of the themes called for more information, education and training of health workers.<sup>6</sup> The United States held its first meeting exclusively about breastfeeding in 1984, entitled the *Surgeon General's Workshop on Breastfeeding and Human Lactation*, in which education of health care workers was one of the areas of needs discussed.<sup>4</sup> Though it has been almost four decades since this meeting, implementation continues to be a challenge despite the agreement amongst healthcare organizations that there needs to be accountability in the training of healthcare workers in breastfeeding and human lactation.<sup>4</sup>

## UNDERGRADUATE MEDICAL EDUCATION (UGME)

Undergraduate medical education in the United States consists of 4 years of learning that traditionally consists of 2 years of didactics followed by 2 years of clinic training. This training culminates in the D.O. degree for osteopathic medical students and M.D. degree for allopathic medical students. A review of undergraduate medical education curriculum on breastfeeding found that there were deficiencies in meeting the curricular objectives.<sup>7</sup> In particular, when 137 medical students were surveyed, the results showed that 85% of respondents rated a score of 5/10 or less when questioned about their confidence in counseling patients about milk supply and common breastfeeding problems. Furthermore, a scoping review in 2019 found a deficiency in research looking at education about breastfeeding for physicians and nurses and additionally noted that breastfeeding education is not standardized across institutions.<sup>8</sup>

This lack of standardization varies from didactic delivery to clinical exposure and training to insufficient emphasis of breastfeeding concepts on board examinations.<sup>4</sup> For example, there are instances of passionate faculty developing curriculum. However, this is neither consistent across institutions, nor a sustainable solution. Additionally, with the enormous amount of medical knowledge expected of medical students to learn, few will seek out this information because it is not emphasized on board examinations. Thus, it is essential that the board examiners include this content so that medical schools follow suit by including breastfeeding medicine into their curriculum. Lastly, in the clinical environment, breastfeeding education is often provided by non-physician providers, leading to gaps in medical students' understanding of how to incorporate breastfeeding medicine into future medical practice.<sup>4</sup>

In *Medical Education and Leadership in Breastfeeding Medicine*, Julie Scott Taylor and Esther Bell suggest a two-part educational framework to drive medical student learning via didactics and clinical work.<sup>9</sup> Options for completing the didactic portion include a course with the Academy of Breastfeeding Medicine, American Academy of Pediatrics content, and other evidence-based curriculum. The clinical framework can include exposure to breastfeeding from postpartum wards to clinics such as primary care, as well as prenatal and postnatal visits.<sup>9</sup>

In summary, this review of the literature finds that undergraduate medical education in the United States currently lacks standardization and sufficient emphasis on breastfeeding medicine, with notable deficiencies in medical students' knowledge and confidence in counseling patients about breastfeeding. Furthermore, there is a deficiency in research and limited data available regarding the effectiveness of breastfeeding education for medical students. Thus, more research and data collection are needed to further evaluate the impact of educational interventions and improve the incorporation of breastfeeding medicine into medical curricula.

## RESIDENT TRAINING

Residents in the fields of pediatrics, obstetrics-gynecology, and family medicine have direct relationships with lactating patients and receive education about breastfeeding throughout their training. A multidisciplinary approach to teaching about breastfeeding is achievable and accepted by residents.<sup>10</sup> Furthermore, a targeted curriculum has been found to improve knowledge, practice, and confidence in breastfeeding management in residents as well as increase exclusive breastfeeding in patients.<sup>11</sup> In pediatric residents, a multimodal intervention assessing their knowledge, behaviors, and confidence found that accurate breastfeeding management increased from 22% to 65% after a breastfeeding training.<sup>12</sup> In obstetrics-gynecology residents, a combined lecture and simulation curriculum at Boston University School of Medicine improved residents' knowledge and confidence in breastfeeding.<sup>13</sup> In 25 primary care residents, a video training improved their knowledge and confidence of breastfeeding, however they did not have increased comfort.<sup>14</sup>

One challenge of implementing a breastfeeding curriculum into resident education programs is a lack of time. A 2011 cross-sectional study surveyed pediatric program directors and found that residents receive a median of 9 hours of breastfeeding education throughout the 3 years of residency training.<sup>15</sup> A subsequent 2017 cross-sectional study surveyed program directors of obstetrics- gynecology (OB) and family medicine (FM) programs and found that OB residents receive a median of 23 hours and FM residents receive a median of 8 hours of in 4 and 3 years, respectively.<sup>16</sup> Of the barriers to breastfeeding education, 60% of the FM and OB programs reported that limited time was the most common with limited faculty time and lack of faculty with sufficient knowledge also being reported. Rodriguez and Shattuck note that there is a likelihood for this insufficient education to be affecting the residents' ability to provide education about breastfeeding initiation and duration, which contributes to the national suboptimal rates of breastfeeding.<sup>16</sup>

A 2019 CERA Program Directors Survey<sup>17</sup> of breastfeeding education in family medicine residents similarly found that a passive didactic approach was used; however, they found the residents receive more hours than previously reported with a median of 15 hours of instruction in the 3 years of training. They found that time with lactation consultants, maternal child health visits in the resident continuity clinic, maternal child health practice after graduation, and competency evaluations by faculty were all seen in programs with the most breastfeeding education time and

perceived resident competence. Thus, to strengthen the resident training in breastfeeding counseling, programs may include lactation consultants, faculty observation, and group prenatal care.<sup>17</sup>

Apart from residency curriculum, additional opportunities exist for physicians to educate themselves about breastfeeding. Optional continuing education courses can be completed by interested learners and tutorials exist that achieve 8 of the Healthy People 2020 Maternal, Infant, and Child objectives.<sup>18</sup> For those who are motivated, fellowships exist in breastfeeding medicine, women's health, and academic medicine. Physicians can also undergo training to become a Certified Lactation Counselor, an International Board-Certified Lactation Consultant, or a Fellow of the Academy of Breastfeeding Medicine.

In summary, resident physicians receive variable amounts of breastfeeding education during their postgraduate medical training. However, more research is needed to assess the impact of these educational interventions and address time constraints in incorporating comprehensive breastfeeding education into residency programs.

## CONCLUSION

In conclusion, the findings of this review highlight the ongoing deficiency of research into breastfeeding education for medical students and resident physicians in the United States. Furthermore, breastfeeding medicine is a topic that is not consistently taught in medical schools and residency programs and thus physicians lack the confidence to educate mothers throughout the prenatal, postpartum, and infancy periods, which can ultimately result in suboptimal breastfeeding rates and decreased health benefits of both infants and mothers. There is a lack of standardized breastfeeding curriculum in undergraduate and graduate medical education, and more research is needed to evaluate the effect that standardization could have on medical student and physician knowledge and confidence in counseling the breastfeeding patient as well as if it impacts outcomes on the health of mothers and infants. It is important to note that this study is limited in scope in that it focuses on breastfeeding education for medical students and resident physicians in the United States and does not consider the global perspective or specific context of other healthcare professions.

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