Teaching a Graduate-level Research Methodology Course with Comprehensive COVID-19 Precautions: Implications for Safety Knowledge, Attitudes, Behavior, and Inclusivity

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Research Article

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Abstract

Background

University instructors experience uncertainty regarding how to teach in person in effective, safe, and health-inclusive ways during periods of high COVID-19 transmission. This article provides a blueprint for implementing proven COVID-19 safety precautions based on a small graduate-level health psychology research methods course in 2023.

Method

The article describes communication with students regarding safety precautions, a COVID-19 safety video, and in-class safety precautions. Students (n = 11) completed outcome measures that included COVID-19 safety knowledge at baseline, post-video, and 2-months follow-up. They also completed measures of attitudes and behaviors and perceptions of health inclusivity at two-months follow-up and end-of-semester course evaluations.

Results

COVID-19 safety knowledge increased from 55.5% at baseline to 93.6% and 87.3% at post-test and follow-up, ps < .001. Students masked better (72.7%), promoted improved indoor air quality (90.9%), changed testing strategies (45.5%), helped others manage risk (27.3%), helped others to understand Long COVID (54.5%), and rated the course as more health-inclusive than their other courses (100%). Course evaluations were highly favorable, with 89.3% of all ratings and 96.4% of target ratings as at least a 4 out of 5.

Discussion

This article provides an illustrative example of how to implement an effective, safe, and health-inclusive learning environment in a university classroom during the ongoing COVID-19 airborne infectious disease pandemic. Students experienced improved knowledge of COVID-19 safety, changed attitudes and behaviors, found the class more inclusive than others, and evaluated the course favorably. Findings have implications for instructors wishing to improve classroom safety, collective bargaining negotiations, and future legal cases.

Public Significance Statement:

This article provides practical guidance on teaching in ways that are effective, safe, and inclusive during the COVID-19 pandemic. The findings show that the course made students more knowledgeable about

the pandemic, improved attitudes and behavior surrounding pandemic precautions, and led students to view the course as inclusive to people with health vulnerabilities.

Introduction

The COVID-19 pandemic has challenged instructors with how to teach safely and effectively. COVID-19 has killed 18.5 million people worldwide and continues to infect 17 million per day (Institute for Health Metrics and Evaluation, 2023). Contrary to lay perceptions that the pandemic is "over," U.S. wastewater data indicate that as of today (July 19, 2023), more virus is circulating than during 43% of the pandemic (BioBot Analytics, 2023). Future waves and surges remain concerns. Each infection carries a 10–20% risk of developing Long COVID, an often debilitating post-infection health condition encompassing over 200 persistent, emerging, or relapsing symptoms spanning multiple organ systems (Altmann et al., 2023). Moreover, each reinfection increases the cumulative risk of Long COVID, hospitalization, and death (Altmann et al., 2023). Thus, instructors have every right to be concerned for their students' safety, their own health, their families, and the broader community. Some instructors, students, and family members may have known vulnerabilities, such as cancer diagnosis, being overweight, being pregnant, being immunocompromised, or having a smoking history (Centers for Disease Control and Prevention (CDC), 2023). Others may have unknown vulnerabilities (e.g., undiagnosed diabetes, unknown autoimmune disease, risk factors not yet discovered). Accordingly, providing a safe learning environment remains critical for supporting inclusivity about health status. Over the past several years, the author developed substantial expertise in understanding COVID-19 transmission and mitigation by conducting grant-funded research with extremely medically-vulnerable patients, workers in high-transmission settings, and COVID-19 mitigation aerosol scientists and engineers (Hoerger, Gerhart, et al., 2023; Hoerger et al., In press; Hoerger, Kim, et al., 2023). The lessons learned apply to teaching safely. The goal of this article is to provide instructors with a blueprint for teaching safely, effectively, and inclusively during the ongoing COVID-19 pandemic and other future public health crises.

COVID-19 transmission is now much more clearly understood than early in the pandemic, so preventing transmission in university classrooms has become simpler. Early in the pandemic, the prevailing zeitgeist (Jimenez et al., 2022) was that large SARS-CoV-2 viral droplets would land on surfaces and that the virus primarily transmits through surface or "fomite" transmission. The implication was that most masks and face covers (e.g., cloth masks, gaiters, face shields, procedure masks, surgical masks) could block droplets from coughs and sneezes from landing on surfaces, and hand sanitizer, hand washing, and disinfecting wipes could eliminate surface transmission. However, it is now clear that COVID-19 is predominantly airborne (Greenhalgh et al., 2021; Kalu et al., 2023; Lewis, 2022; Samet et al., 2021; Wang et al., 2021). Infected people simply exhale the virus in very small particles when breathing. These viral-laden aerosol particles can then linger in the air like smoke for up to several hours in poorly ventilated spaces. People inhale the viral-laden aerosol particles and become infected. In fact, the White House COVID-19 Response Coordinator, Ashish Jha, MD, went as far as to contrast COVID-19 from other illnesses by describing it as "purely airborne" (The White House, 2022).

With a highly transmissible airborne virus, the approach to reducing transmission in university classrooms is highly actionable through three critical layers of mitigation (Prather, Marr, et al., 2020; Prather, Wang, et al., 2020; Samet et al., 2021). One, students who are ill should remain home (Prather, Wang, et al., 2020). Two, because people can transmit the virus without knowing they are infected, a reasonable next step of mitigation would be for students and instructors to wear well-fitting, high-quality masks that are designed specifically for reducing the airborne transmission of small viral-laden aerosol particles (e.g., N95, KN95, KF94) rather than merely blocking droplets from coughs and sneezes (Hoerger, Gerhart, et al., 2023; Hoerger et al., In press; Moran et al., 2023; Prather, Marr, et al., 2020; Prather, Wang, et al., 2020; Samet et al., 2021). Three, because some people will mask imperfectly at times, air cleaning remains essential for removing viral-laden aerosol particles from the air before people breathe an infectious dose (Prather, Marr, et al., 2020; Samet et al., 2021). Air cleaning includes bringing in outdoor air (ventilation) using open windows or HVAC systems as well as cleaning the air with air purifiers (filtration) using HEPA filters or do-it-yourself (DIY) consumer-built air cleaners, often called Corsi-Rosenthal Boxes or SAFE air purifiers (Dal Porto et al., 2022; Dodson et al., 2022; Hoerger, Gerhart, et al., 2023; Hoerger et al., In press; Srikrishna, 2022). Richard Corsi, PhD, the Dean of Engineering at the University of California-Davis and a leading COVID-19 mitigation scientist, endorses this three-pronged approach, noting that its elegance is “not rocket science” (Corsi, 2022).

The current investigation was designed to document closely how the instructor implemented an in-person COVID-19-cautious graduate-level health psychology research methods course in the spring 2023 semester and show preliminarily how it benefited students without harming course evaluations. Key outcomes were students’ COVID-19 safety knowledge, attitude and behavior change surrounding precautions, perceptions of health-related inclusivity, and course evaluations. Findings have implications for teaching safely, effectively, and inclusively during public health crises.

Method

The author instructed a graduate-level health psychology research methods course designed to be COVID-safe for students regardless of health vulnerabilities and assessed safety knowledge, attitudes, behaviors, perceptions of inclusivity, and course evaluations. The methods describe the course content, communication regarding COVID-19 precautions in a pre-semester email and the syllabus, a COVID-19 educational video, in-class precautions, measures, and analyses. The author’s university Institutional Review Board approved the project as post-hoc analyses of deidentified course data (IRB#: 2023 – 1136).

Course Description

A tenured Health Psychology PhD program director teaches this health psychology research methods course, “Clinical and Community-Based Research Methods.” Students span health psychology, school psychology, and social psychology doctoral programs, a terminal master’s program in behavioral health, and occasionally advanced undergraduates who will begin graduate training in the fall. The course aims

to equip students with the knowledge and skills needed to design and execute psychosocial studies in communities, therapy clinics, schools, medical centers, and similar settings. Course content focuses on research topic identification, literature review, big-picture methodologic decisions in experimental design, nuts-and-bolts of implementing experiments (e.g., protocol delineation, randomization, recruitment, retention, and fidelity monitoring), complex experimental design, quasi-experiments, observational studies, program evaluation, community-based participatory research, measurement reliability and validity, scale development, career development, cultural humility, budgeting, publishing, and grant funding. Major assignments include weekly discussion papers based on readings, an exam, a randomized controlled trial (RCT) protocol, and protocol presentations. The course combines readings, lectures, discussion, and independent protocol design with moderate mentorship.

COVID-19 Precautions

Communication about COVID-19 Precautions

As depicted in Fig. 1, the course was designed to be safe and inclusive to all students regardless of health status, even during a hypothetical COVID-19 surge. Before the start of the spring semester, the instructor emailed all enrolled students to orient them to the planned COVID-19 precautions grounded in safety and inclusivity and requested any feedback. The course syllabus detailed expectations regarding classroom health and safety precautions (see Fig. 1, bottom), and the instructor and students addressed any nuanced considerations through email and classroom dialogue.

COVID-19 Safety Video

Before the first day of class, students were required to complete a pre-test on COVID-19 safety knowledge, watch a 40-minute video presentation by the instructor on COVID-19 safety, and complete a post-test identical to the pre-test. The video topics are noted in Fig. 1 (middle) and are grounded in the instructor's substantial expertise in COVID-19 mitigation in community-based and medical settings (Hoerger, Gerhart, et al., 2023; Hoerger et al., In press; Hoerger, Kim, et al., 2023). The instructor also disseminated the video on social media, viewed over 30,000 times. Students completed the knowledge test again at two-months follow-up into the course.

In-Class COVID-19 Precautions

In-classroom COVID-19 mitigation was substantial. High-quality masks (N95, KN95, or KF94) were required to be worn correctly in the classroom at all times. Students were requested to leave the classroom at any time if needing a food or beverage break, and the instructor provided universal breaks. The instructor noted only three lapses in masking, with one student sipping water once and one student twice having their nose outside their N95. On the first day of class, the instructor provided each student with a sample pack of five models of N95 masks. From largest to smallest, these include the 3M VFlex 9105, Aegle flat-fold, 3M Aura 9210, Vitacore CAN99, and 3M VFlex 9105S (see Fig. 2a). At the time, the

purchase price of the masks ranged from approximately $0.60-$2.00 USD per mask (about $5 total per pack), though comparable versions of the 3M VFlex models (specifically, the VFLex 1804 and 1804S) have dropped in price recently to as little as $0.07 USD. The instructor provided students with more N95 masks throughout the course for free as desired. Students could also obtain their own masks. The instructor selected a classroom in the engineering building that he tested and knew to have excellent ventilation and was oversized to allow distancing. As a class project the first day, students built four DIY air cleaners, variously referred to as Corsi-Rosenthal Boxes or SAFE air purifiers (Dal Porto et al., 2022; Dodson et al., 2022; Srikrishna, 2022) using box fans, duct tape, and MERV-13 HVAC filters, provided by the instructor (see Fig. 2b). Students assisted the instructor in calculating the air cleaning rate in the classroom, estimated at 15 air changes per hour (ACH), approximately equivalent to the minimum standard of a U.S. operating room (Centers for Disease Control and Prevention (CDC), 2022). Air quality was also monitored periodically throughout the course using an Aranet4 monitor (see Fig. 2c), which assesses outdoor air ventilation from the HVAC system to ensure it is functioning correctly. Students were requested to attend remotely if exposed to COVID-19, ill for any reason, or simply being health cautious. Policies related to personal illness, family illness, and bereavement were flexible.

Participants

Eleven students were enrolled in the course and completed the evaluation outcome measures.

Measures

COVID-19 Safety Knowledge

Students completed a test of COVID-19 safety knowledge at baseline (pre-test), after watching the COVID-19 safety video (post-test), and two months later (follow-up). The test included 10 multiple-choice questions, each with 3 response options. Responses were scored dichotomously as correct or incorrect. Possible scores ranged from 0-100% correct.

Attitudes and Behavior

At two months follow-up, participants answered 14 questions about their COVID-19 safety attitudes and behavior. Questions examined whether students 1) changed masking behavior (trying different types of N95s in the variety pack, talking to someone else about N95s, wearing an N95 for the first time, or switching N95s for better fit), 2) promoted indoor air quality to reduce COVID-19 transmission (talking to someone about Corsi-Rosenthal Boxes, giving information on how to build them, talking to someone about HEPA filters, buying a HEPA filter, or buying an air quality monitor), 3) changed testing behavior (helping someone decide what to do about testing, changing personal testing protocols), 4) helped others handle high-risk situations (being safer in high-risk contexts, or reducing in-home transmission when someone is ill), and 5) helped others to understand Long COVID.

Perceptions of Inclusivity

At two months follow-up, students answered four questions about the health-inclusivity of the course. They rated (0-100%) the chances they believed COVID-19 was transmitted in the current course versus in other typical courses during the current and prior semester (fall 2022 and spring 2023). They also rated (0-100%) the chances they believed a student who was immunocompromised or chronically ill would be comfortable in the current course versus a typical course in the current or prior semester.

Course Evaluations

Each student completed a course evaluation survey with 11 ratings on a scale from 1 (strongly disagree) to 5 (strongly agree). For example, “Overall, I would recommend this course.” The relevance of each rating varies by course, so the instructor also conducted analyses of 5 target questions selected *a priori* as most relevant to this methodology course: recommending the course, recommending the instructor, meaningfulness of feedback, perceived learning, and perceived knowledge gain.

Analyses

Analyses were conducted in Excel and IBM SPSS Statistics 27.0. Descriptive statistics were used to summarize each variable. For knowledge, between-group *t*-tests were used to compare the percentage correct at baseline versus post-test or follow-up; repeated-measures *t*-test could not be used, as student-level data were not linked longitudinally, so the analysis was conservative. For course evaluations, analyses reported means and the percentage of ratings that were at least 4 out of 5, both for the 11 total questions and the 5 target questions; a sign test was used to test whether the proportion of ratings of ≥ 4 differed from the proportion of ratings that were ≤ 3. Inferential analyses used a two-tailed alpha level of .05. The underlying data are available from the corresponding author upon request.

Results

Students ($n = 11$) enrolled in the course and completed the outcome measures. They included four PhD students (36.4%), five terminal Master’s students (45.5%), and two advanced undergraduates planning to enter the terminal Master’s program (18.2%). Nine were female (81.8%). Race and ethnicity were as follows: white non-Latino/a (54.5%), white Latino/a (9.1%), African American (18.2%), and Asian (18.2%).

Students experienced a sustained increase in knowledge of COVID-19 safety, saw changes in COVID-19 safety-related attitudes and behaviors, and evaluated the course as health-inclusive. As shown in Fig. 3, student knowledge of COVID-19 safety increased from 55.5% correct at baseline to 93.6% at post-test and 87.3% at 2-months follow-up, ps $< .001$. As shown in Table 1, 72.7% of students changed their masking behavior, 90.9% promoted improved indoor air quality in some way, 45.5% changed their testing behavior or helped others with testing, 27.3% helped others better manage risky contexts, and 54.5% helped others to understand Long COVID. As shown in Table 2, 100% of students believed the current course was safer

than typical recent courses regarding COVID-19 transmission, and 100% believed the course was more health-inclusive than typical recent courses in supporting students with medical vulnerabilities.

Students evaluated the course favorably. Across all ratings (11 questions x 11 students = 121 ratings), students rated the course as a mean of 4.32 on the 1–5 scale, including at least 4 out of 5 on 89.3% of ratings (108/121), sign test $p < .001$. On the five target questions (55 total ratings), students rated the course as a mean of 4.47 on the 1–5 scale and at least a 4 out of 5 on 96.4% of ratings (53/55), sign test $p < .001$.

Discussion

Key Findings

This article documents how instructors can teach in ways that are effective, safe, and health-inclusive during a highly-contagious airborne infectious disease pandemic. The course exercised transparency in COVID-19 precautions through email, the syllabus, and discussion. A video empowered students with COVID-19 safety knowledge, which increased by 38.1% and was mainly retained at 2-months follow-up. The course led students to have more proactive COVID-19 attitudes and behaviors, such as 72.7% changing masking behavior, 90.9% taking action on indoor air quality, and 54.5% helping others understand Long COVID. Moreover, 100% of students indicated that the course was more health-inclusive than their typical courses in the current and prior semester. Students evaluated the course favorably in course evaluations. Findings have implications for teaching safely during public health crises.

Many of the safety precautions emphasized here can be implemented in other university classrooms. Any instructor can provide helpful and frank information on COVID-19 safety by reviewing the studies cited in this article or watching the video used in this course (available upon request, though it should be updated to reflect new information beyond December 2022). Instructors can also seek classrooms in buildings that commonly have better ventilation (e.g., engineering buildings, newer buildings) or operable windows. Unless forbidden, instructors can encourage students to stay home when ill and provide flexible policies. Moreover, students and instructors can build DIY air cleaners, an engaging, fun, and pro-safety activity. One potential sticking point is masking. Some universities do not allow instructors to require masks. Similarly, where allowable, fixed-term and pre-tenured faculty may be reluctant to implement precautions for fear of retaliation. Instructors may wish to consider other options, such as simple and low-cost DIY mask fit-testing (Hoerger, 2022) if they will be the only one masked or, alternatively, teaching outdoors. Nonetheless, where universal masking is allowed, cost remains a barrier in large classes. Two of the five N95 options the instructor provided students (the biggest and smallest options, the 3M VFlex and VFlex small) have recently sold for as little as $0.07 USD per mask. This cost may be viable, even in larger classes. Moreover, where collective bargaining agreements are present, faculty may wish to negotiate for free personal protective equipment for students, staff, and faculty, as well as other precautions outlined in this article. The author is pleased to assist other faculty in these endeavors. The hope is that this article

provides a starting point for instructors to create safe and health-inclusive classroom spaces while acknowledging local constraints.

Strengths, Limitations, and Constraints on Generality

The study was balanced by strengths and limitations. A key strength was the innovation of the safety precautions. High-level COVID-19 mitigation has typically been implemented at the university level rather than by individual instructors. When university-level precautions are limited, individual instructors often wear high-quality masks themselves, but the author is unaware of examples of an individual instructor taking such a comprehensive approach using multiple layers of universal precautions. The primary limitation was the sample size, 11 students. This example is illustrative. It shows how to run a COVID-19 cautious course. Moreover, despite the small number of students, no “red flags” were observed in the data, as students learned and changed as one might hope and without obvious penalties to course evaluations. The study was constrained in that it involved students at a research-intensive private university completing a graduate-level course in the U.S. Deep South in 2023. Implementing health and safety precautions without retaliation may be more challenging at public universities, especially in states with governors or legislators who have argued against COVID-19 mitigation. Moreover, such precautions could be viewed as more acceptable during hypothetical future surges and more difficult during periods of lower illness transmission.

Broader Implications

Although this article was designed to assist instructors with practical advice for teaching safely in high-risk contexts, it may have implications for future legal proceedings. This illustrative example shows that by January 2023 the scientific literature was clear to science faculty on how to mitigate in-classroom risk of COVID-19. Courts could conceivably find that universities are liable if they should have also been clear on this evidence, if they ignored this evidence when offered by faculty, or if they blocked faculty from implementing reasonable precautions, particularly if an instructor or student has a known medical vulnerability. Of course, many states passed shield laws to protect schools and universities from COVID-19-related litigation (Lieberman, 2021). Yet, these shield laws were often tied to the U.S. federal COVID-19 public health emergency declaration, which ended on May 11, 2013, even though COVID-19 continues to transmit at higher levels today than during 43% of the pandemic (BioBot Analytics, 2023; Institute for Health Metrics and Evaluation, 2023). Recent court rulings (Supreme Court of California, 2023) have affirmed the rights of employees to pursue claims when infected because of employer negligence, though at present infected family members have limited legal options due to challenges with accurately tracing the transmission chain. As legal battles undoubtedly unfold, it may be helpful for readers to present this article to university administrators to improve COVID-19 safety policies, allow instructor-specific safety precautions, or reduce the risk of legal liability.

Conclusion

This article provides an illustrative example of how to implement an effective, safe, and health-inclusive learning environment in a university classroom during the spring 2023 semester of the ongoing COVID-19 airborne infectious disease pandemic. Students experienced improved knowledge of COVID-19 safety, had more proactive safety attitudes and behaviors, found the class to be more inclusive than others, and evaluated the course favorably. Findings have implications for instructors wishing to improve classroom safety, collective bargaining negotiations, and future legal cases.

Declarations

Author Note

Author Contributions: The sole author conceptualized, analyzed, drafted, and revised the manuscript.

Biography: Michael Hoerger, PhD, MSCR, MBA, is an associate professor of psychology and director of the Health Psychology PhD program at Tulane University. He completed his doctorate from Central Michigan University, clinical internship at the University of Rochester Medical Center, MSCR in clinical research at the Tulane University School of Medicine, and MBA at the Tulane University A. B. Freeman School of Business. He is a licensed psychologist in Louisiana and New York. His research and professional interests include using psychological science to reduce the emotional and physical burden of serious illness. He has a long-standing interest in psychosocial oncology and during the past several years has developed a secondary focus on reducing the burden of the COVID-19 pandemic.

Positionality Statement: Given that one's identity can influence aspects of teaching, student evaluation, and interpretation of evidence, the author notes that he is a white male American, first-generation college student from a low-income family of origin, married parent of three children, and teaching at a research-intensive private university in the U.S. Deep South.

Citation Diversity Statement: Given biases in referencing, the author reviewed each reference cited and used a probabilistic database to predict the gender of the first and last author of each article: 25.0% woman first author / woman senior author, 25% man/woman, 41.7% woman/man, and 8.3% man/man. Only peer-reviewed publications that did not involve the author were included. Such methods are limited to probabilistic binary descriptions of gender.

Data Statement: The underlying data are available upon request to the corresponding author.

Conflicts of Interest. The author has no conflicts of interest.

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Tables

Table 1
Changes in Attitudes and Behavior During a COVID-19 Cautious Course

Variable	Percentage
Changed N95-masking Behavior	72.7%
Tried different types of N95s in the sample variety pack	63.6%
Talked to someone else about N95s	45.5%
Wore an N95 for the first time	45.5%
Switched from an initial N95 in the variety pack to one with better fit	18.2%
Promoted Indoor Air Quality	90.9%
Talked to someone about Corsi-Rosenthal Boxes	63.6%
Gave someone information on how to build a Corsi-Rosenthal Box	36.4%
Talked to someone about HEPA filters	27.3%
Bought a HEPA filter	9.1%
Bought an air quality monitor	9.1%
Changed COVID-19 Testing Behavior	45.5%
Helped someone with what to do about COVID-19 testing	36.4%
Changed personal protocols regarding COVID-19 testing	27.3%
Helped Others Handle High-Risk Settings	27.3%
Helped someone to be safer in a COVID-19 high-risk context	18.2%
Helped someone reduce in-home COVID-19 transmission	18.2%
Helped Someone Better Understand Long COVID	54.5%

Table 2
Perceptions of Inclusivity in a COVID-19 Cautious Course

Variable	Percentage
Believed the Course was Safer than Others	100.0%
Chances of in-class COVID-19 transmission in the current course	5.0%
Chances of COVID-19 transmission in other courses current/prior semester	31.9%
Believed the Course was More Inclusive than Others	100.0%
Chances a student who is immunocompromised or chronically ill would be comfortable in the current course	92.0%
Chances a student who is immunocompromised or chronically ill would be comfortable in other courses current/prior semester	32.1%

Figures

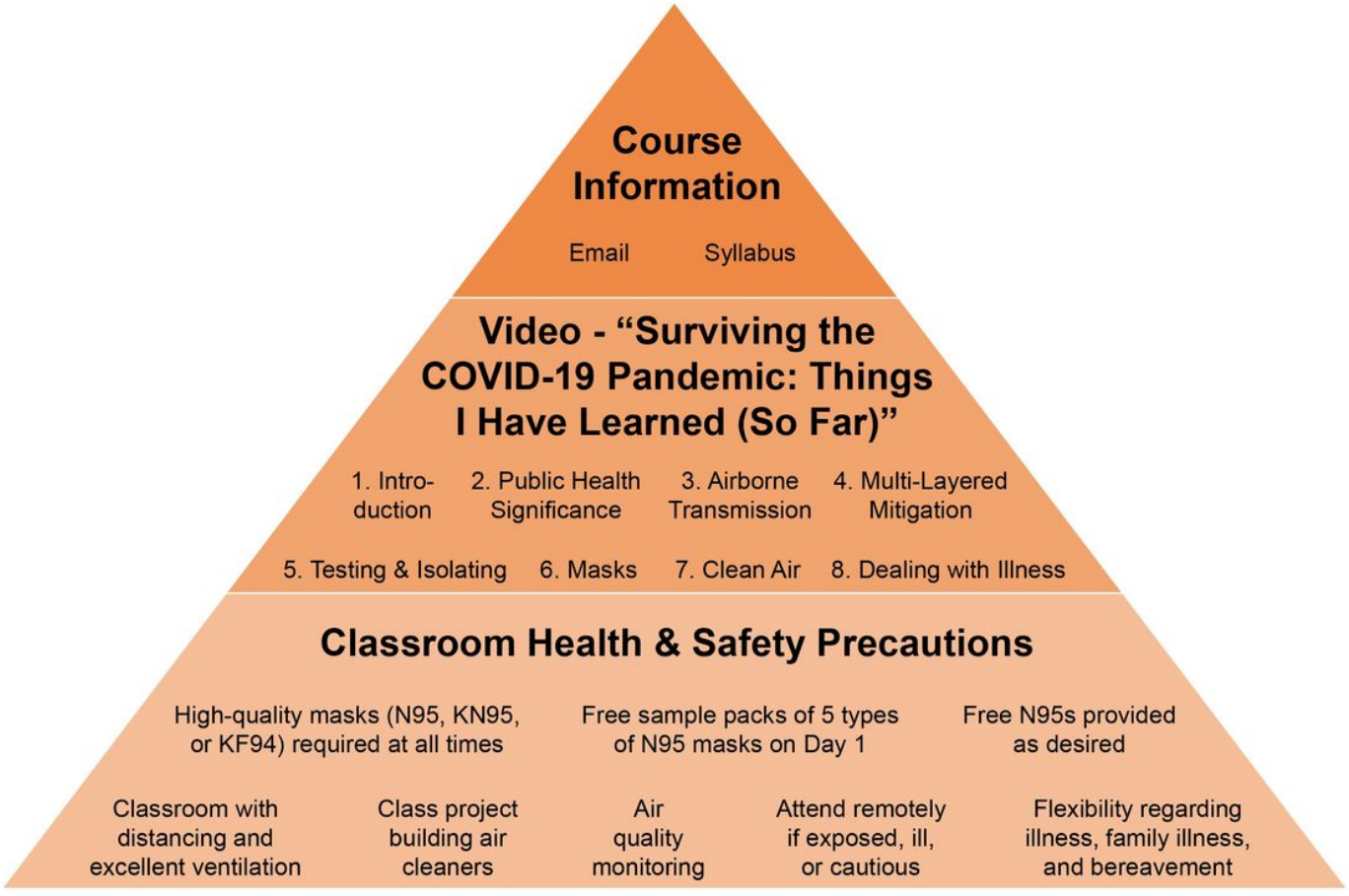

Figure 1

COVID-19 Precautions Implemented During the Course

Figure 2

Photographs of Selected COVID-19 Mitigation Tools. A) Safe Air Purifiers. Students built four air purifiers. Each involves a standard 20” by 20” box fan with a 4” thick 20” by 20” MERV-13 HVAC filter duct taped to the back. A cardboard shroud covers the corners of the front of the fan to reduce reverse airflow and improve efficiency. These DIY air purifiers compare well with >$400 commercially available HEPA filters in independent testing. B) N95 Masks. Each student received a five-pack of different N95 masks on the first day of class. They vary in size to provide an optimal fit for people with differing faces. Additional free N95s were available each session as desired. C) Ventilation monitor. An Aranet4 air quality monitor ensured the HVAC system cleaned the air as expected, rather than requiring maintenance. The masks reduce the risk of exhaling or inhaling COVID-19 viral-laden aerosol particles. The air purifiers and HVAC system reduce the number of COVID-19 viral-laden aerosol particles in the air that may be present due to lapses in masking or from unmasked students who just left the preceding class.

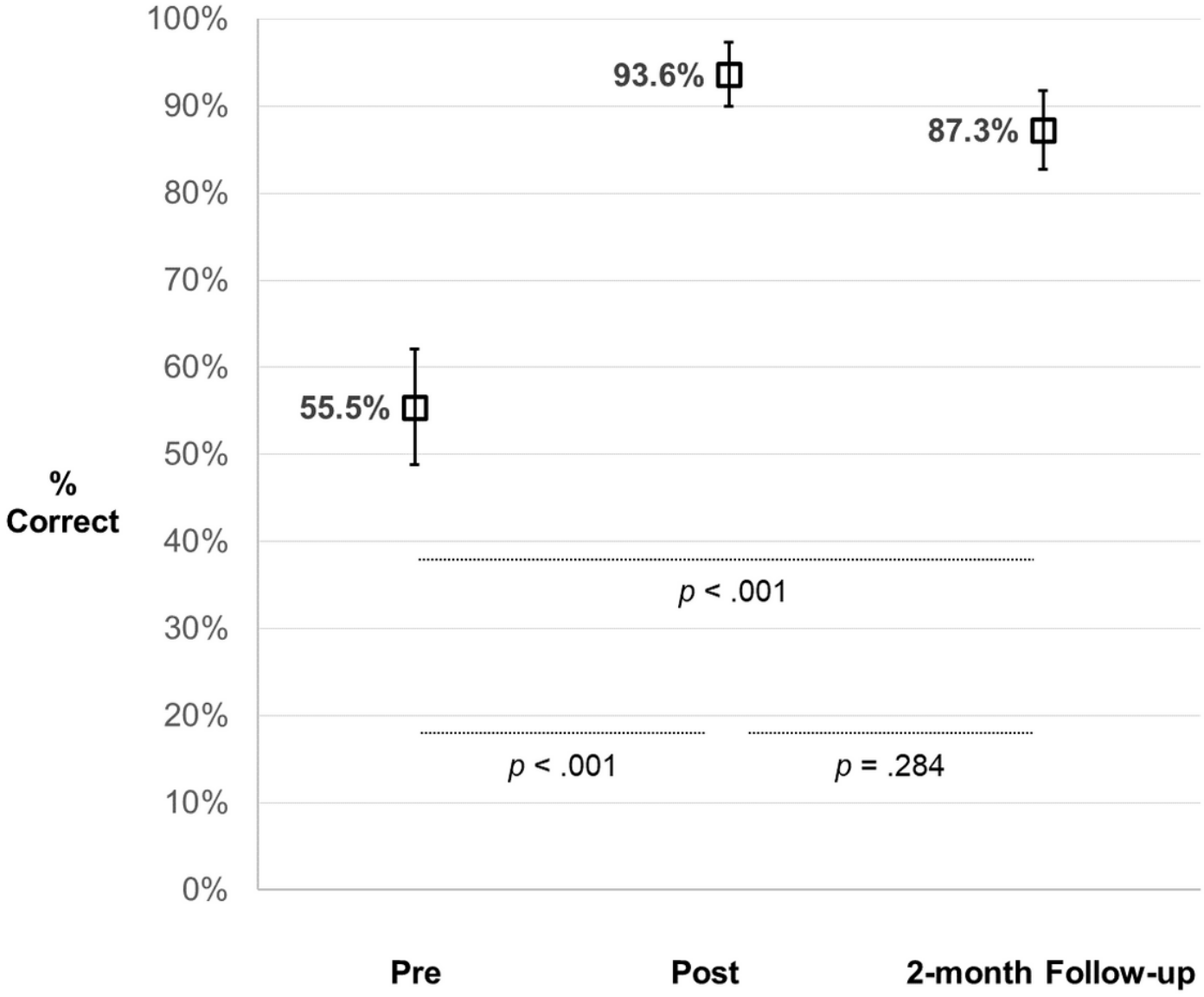

Figure 3

Changes in Students' Knowledge of the COVID-19 Safety During the Course. Students completed a measure of COVID-19 pandemic mitigation knowledge at three time points: a pre-test, a post-test immediately following an educational video developed by the instructor, and a follow-up test completed two months later. Relative to the pre-test, students were more knowledgeable at the post-test and follow-up (*p*s < .001).