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RESEARCH ARTICLE

Evaluation of a Contact Tracing Training Program and Field Experience

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Introduction: The study objective was to evaluate a contact tracing training program and the role of contact tracing on volunteers' professional development.

Methods: A COVID-19 contact tracing program was conducted at an urban academic medical center, in collaboration with the local health department, between March 2020 and May 2021. Contact tracers, most of whom were health professions students, completed pretraining and post-training surveys to assess knowledge and self-efficacy to conduct contact tracing, plus an 18-month follow-up survey regarding career impacts.

Results: We observed statistically significant post-training increases in knowledge and self-efficacy to conduct contact tracing. Contact tracers described benefiting from training regarding cultural humility, empathy, and trauma-informed interviewing. They also expressed a deeper understanding of COVID-19 inequities and their structural causes and reported that the work was emotionally demanding.

Conclusions: Key to pandemic preparedness is having a trained and supported workforce. This study showed how contact tracing training and field experience strengthened students' education in the health professions by sharpening interpersonal skills and structural competency and by generating insights regarding current gaps in both public health infrastructure and support for vulnerable populations.

INTRODUCTION

Contact tracing is a longstanding epidemic-mitigation approach that has been used successfully to control outbreaks of many infectious diseases, including Ebola,[1] smallpox,[2] and measles.[3] One study of a large-scale natural experiment in which 20% of nationwide coronavirus disease 2019 (COVID-19)-positive cases in England were accidentally not interviewed in a timely manner revealed that contact tracing reduced COVID-19 infections by 63% and deaths by 66%.[4] In a financial model from October 2020 evaluating the U.S. costs of the COVID-19 crisis

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2773-0654/$36.00
https://doi.org/10.1016/j.focus.2022.100017

because of reduced economic output and health loss (morbidity and mortality), the benefit of increased investment in testing and contact tracing was estimated to be 30 times greater than the cost of the investment itself.[5]

Nonetheless, the U.S. entered the COVID-19 pandemic with sparse infrastructure to conduct contact tracing, reflecting decades of declining investment in public health. Nationwide, only 2,200 contact tracers were employed at state and local health departments (LHDs) at the beginning of 2020.[6] This workforce fell short of the estimated 100,000 contact tracers required to address COVID-19, which would have required an additional $3.6 billion in emergency funding from Congress.[7] By the end of 2020, the U.S. contact tracing workforce had increased nearly 23-fold to an estimated 50,000 workers, but this still fell short of the 30 contact tracers per 100,000 people models suggested would be needed to control viral transmission.[8]

When the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic reached the U.S., LHDs mobilized to build contact tracing capacity quickly. Communities variably reassigned public health employees, activated National Guard troops, partnered with private firms and academic institutions, relied on volunteers, or implemented a combination of approaches.[9–13] Further complicating early contact tracing efforts was the lack of a national standard for training or skills and preparation required to conduct contact tracing,[14] along with the absence of a unified platform or protocol for data collection and sharing across programs and jurisdictions. Each program thus adopted its own training, standards, protocols, and processes, resulting in a heterogeneous array of programs all called contact tracing. To optimize future contact tracing efforts, the public health field must review and critique the varied programmatic responses to COVID-19, including the training received by contact tracers.

Between March 2020 and May 2021, we collaborated with the Philadelphia Department of Public Health to establish a volunteer-led contact tracing initiative at an urban academic medical center. We report an evaluation of a virtual training program for volunteer contact tracers, most of whom were students of the health professions. These findings should inform the building of a more robust and sustainable public health workforce, better prepared to address epidemic threats.

METHODS

Study Sample

The Contact Tracing Program. In response to the first wave of COVID-19 in Philadelphia, we built a contact tracing effort in partnership with the Philadelphia Department of Public Health. Volunteers were trained to investigate COVID-19 cases newly identified among health system patients, ascertain close contacts, and deliver isolation and infection control guidance. Contacts were then called to deliver quarantine guidance and answer testing questions. Contact tracing volunteers worked in tandem with a health system Social Needs Response Team (SNRT) to connect patients with supports (e.g., food and medication delivery, transport, primary care referral). These SNRT needs were identified through an optional set of SNRT screener questions at the end of each interview. Optional demographic questions, including race, ethnicity, gender identity, and age, were also included.

Volunteers were recruited through university listservs reaching students in medicine, nursing, public health, and social-work programs, for whom fieldwork credit was arranged where relevant. From March 28 to June 1, 2020, information from potential volunteers was collected through an electronic survey administered through Google Forms survey (Alphabet Inc., Mountain View, CA), including desired roles, time commitment, and a distress thermometer, to roughly approximate candidate resilience (Appendix A, available online). Select candidates were then interviewed to screen for responsibility, maturity, resilience, and empathy (Appendix B, available online). During the program, a total of 160 volunteers were trained: 130 contact tracing volunteers and 30 program operations volunteers. The 30 program operations volunteers are not discussed in this paper, given that they were not making contact tracing calls.

Thus, this program relied on essential academic resources. These resouces included access to academic and health system professionals, trainees, legal and bioethics consultants, and data management tools (e.g., REDCap).

This research study was conducted under a Quality Assurance protocol approved by the IRB of the University of Pennsylvania.

Measures

Contact Tracer Trainings. Training sessions were developed and ready for implementation within 2 weeks of the LHD's request for volunteers, with input from the U.S. and international public health organizations. These training sessions were developed to prepare volunteers to navigate the workflow, interview cases or contacts, and communicate infection control guidance, with the goals of increased knowledge and self-efficacy to conduct contact tracing. In April and May 2020, 109 contact

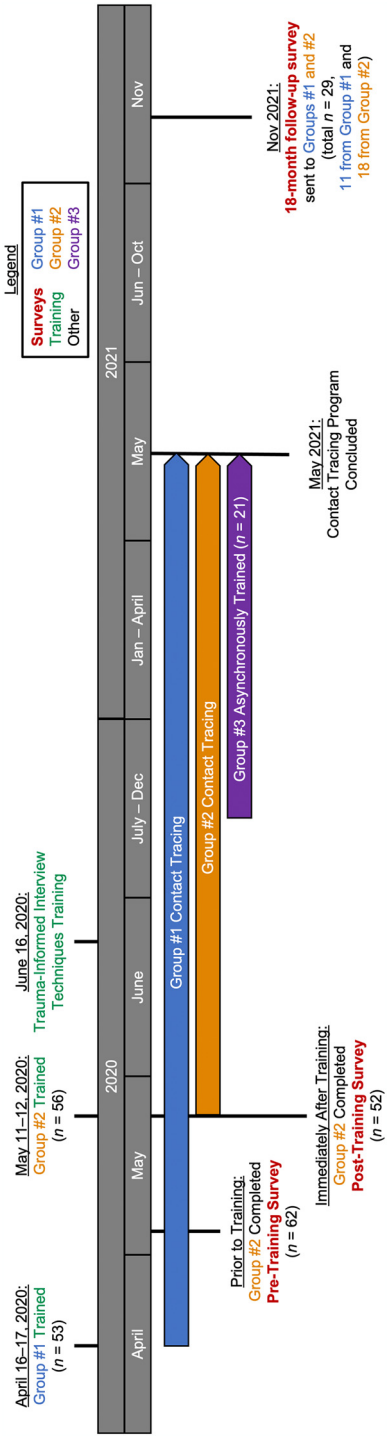

Figure 1. Visual timeline of contact tracing training sessions, events, and surveys. Note that the timeline is not to scale.
#, number; Dec, December; Jan, January; Jun, June; Nov, November; Oct, October.

tracers participated in virtual synchronous training sessions administered through Zoom (Zoom Video Communications, San Jose, CA) in 2 separate groups (Figure 1). Details regarding the structure and composition of the training sessions are available in Table 1 and Appendix C (available online). All volunteers role-played before initiating calls and completed asynchronous training on the protection of human subjects. A shared Google folder (Alphabet Inc., Mountain View, CA) included a regularly updated frequently asked questions guide and sample scripts.

Although 62 contact tracers from the second training group completed the pretraining survey, only 56 of them went on to work with us after training. Owing to the anonymous nature of the survey, it is not possible to exclude the 6 pretraining survey responses from participants who did not work with us after training.

Recognizing stresses caused by both the pandemic and systemic racism in local communities, a trauma-informed interview techniques training was added in June 2020 (Table 1). All contact tracers making calls were required to attend this training.

Team leaders held optional twice-weekly office hours to virtually answer questions and monitor volunteer wellbeing. Team managers and volunteers communicated frequently by e-mail and Slack (Salesforce, San Francisco, CA), with at least 1 manager always on call to address time-sensitive concerns.

Pre-training, Post-training, and 18-Month Follow-Up Surveys. The contact tracing initiative described in this study was launched as an emergency response to a public health crisis. The focus, especially initially, was on establishing the foundation of a contact tracing workforce. After rapidly implementing and designing the program, we realized, through discussions regarding continuous quality improvement, the need for evaluation data regarding the training program. Consequently, only the second group of contact tracers trained was invited to complete the pretraining and post-training surveys (Figure 1) by e-mail and in the training itself.

The pretraining and post-training surveys were administered through the REDCap secure data collection platform. These surveys assessed knowledge and self-efficacy to conduct contact tracing, measured on a 5-point Likert scale ranging from completely agree to completely disagree. In November 2021, an 18-month follow-up survey was deployed through REDCap to assess the personal and career impacts of working as a contact tracer and to solicit training feedback (Figure 1). Both the first and second training groups of contact tracers were invited to participate. Because the third group was trained asynchronously (owing to rolling recruitment and onboarding), contact tracers in this group were not invited to participate in the evaluation surveys. Figure 1 summarizes the timeline of events, and Table 2 summarizes the breakdown of volunteers across the 3 groups.

Table 1. Summary of Contact Tracing Training Sessions Structure and Composition

Training session	Training topic	Topic details	Topic goals and benchmarks
Initial training (April/May 2020)	Introduction: who are we, and what are we doing?	• Mission • Objectives • Organizational structure	• Provide contact tracers with knowledge regarding how they fit into the broad program's goals and structure
	COVID-19 Science and CDC Guidelines	• Virus versus disease • Symptoms, infectious period, incubation period, treatments (or lack thereof at the time) • Importance of flattening the curve • Current rates in Philadelphia	• Ensure that contact tracers understand key scientific background and implications related to the work, to help them make decisions on the job and interact with interviewees
	Case investigation and contact tracing processes	• What is contact tracing? • Definition of "case" and "contact" • Operational workflow	• Ensure that contact tracers have foundational knowledge of the work they are doing, as well as how and why the information is being collected
	Contact tracing operational workflow	• How to use REDCap data collection system • How to use other management tools (e.g., Slack, Google Drive, Doximity)	• Ensure that contact tracers have the knowledge and self-efficacy to use the essential tools on the job
	Consent and interviewing techniques	• Important considerations before, during, and after the interview • Role-play script before making calls • Role-play challenging situations (See Appendix C, available online, for example scenarios)	• Ensure contact tracers have the knowledge, self-efficacy, and interpersonal skills to navigate all aspects of the interview process, including potential difficult situations
Trauma-informed interview techniques training (June 16, 2020)	Trauma-informed interviewing approaches	• Disproportionate impact of COVID-19 on Black communities • Social needs among cases and contacts within our system • SAMHSA's concept of trauma • Six key principles of a trauma-informed approach • Crisis intervention theory: "Starting where the patient is at" • Principles of empathetic inquiry: motivational interviewing, communication skill building, cultural humility • When a case needs to be escalated/referred to a specialist and how to conduct escalation	• Provide contact tracers with a contextual understanding of the pandemic- and systemic racism-induced stress experienced within local communities to possess the interpersonal skills required show respect, empathy, and cultural humility toward all persons being interviewed • Note: this training was not evaluated on the pre- and post-training surveys

For each training session (either the initial training session in April/May 2020 or the Trauma-Informed Interview Techniques training session on June 16, 2020), the training topic, topic details, and topic goals and benchmarks is listed.
CDC, Centers for Disease Control and Prevention; SAMHSA, Substance Abuse and Mental Health Services Administration.

The pretraining survey was completed before the volunteer's training session on either May 11 or 12 and included 44 questions on demographics, COVID-19 experiences, and knowledge/self-efficacy to conduct contact tracing. The post-training survey was completed immediately after the training session (before any contact tracing experience) and included 21 questions on knowledge/self-efficacy to conduct contact tracing. The 18-month follow-up survey was completed in November 2021 (regardless of when the contact tracer began/finished their work) and included 40 questions on COVID-19 experiences, impacts of contact tracing work, and knowledge/self-efficacy to conduct contact tracing. All surveys were provided through a link to an online REDCap form to be completed on the contact tracer's own time. All surveys are available in Appendix D (available online).

Statistical Analysis

All statistical tests were performed in R, Version 4.0.2. Bar graphs were generated in PRISM, Version 9.3.1. To calculate the approximate number of calls and duration of volunteering for each volunteer, timestamp and call

Table 2. Summary of Self-Reported and REDCap-Calculated Participant Characteristics (N = 62, Unless Otherwise Noted)

Characteristics	Statistics
Contact Tracing Program	
Total contact tracers	130 contact tracers
Total calls assigned	9,191 calls
Pretraining survey participants	62 contact tracers
Post-training survey participants	52 contact tracers
18-month follow-up survey participants	29 contact tracers
Age	
Mean	27.7 years
Median	26.5 years
Range	18–68 years
Standard deviation	6.8 years
Call number per volunteer (n = 130)[a]	
Mean	70 calls
Median	43 calls
Range	1–487 calls
Standard deviation	79.8 calls
Estimated Elapsed Time per Volunteer (n = 122)[b]	
Mean	172 days
Median	162 days
Range	17–369 days
Standard deviation	117.6 days
	***n* (%)**
Race[c]	
White	52 (83.9)
Asian	6 (9.7)
Other	4 (6.5)
Black or African American	2 (3.2)
Decline to answer	2 (3.2)
American Indian or Alaskan native	0 (0)
Native Hawaiian or Pacific Islander	0 (0)
Gender identity	
Female	57 (91.9)
Male	5 (8.1)
Another identity	0 (0)
Decline to answer	0 (0)
Student/retiree status	
Currently a student	52 (83.9)
Currently retired	1 (1.6)
Current field of work[c]	
Nursing	36 (58.1)
Research Scientist	13 (21.0)
Other	12 (19.4)
Medicine	3 (4.8)
Social work	1 (1.6)
Language(s) spoken[c]	
English	61 (98.4)
Spanish	5 (8.1)
French	3 (4.8)
Portuguese	2 (3.2)
Hebrew	1 (1.6)
Creole	1 (1.6)
Russian	1 (1.6)
Telugu	1 (1.6)
Arabic	1 (1.6)
Volunteer location during contact tracing work[d]	
PA	65 (81.3)
NJ	6 (7.5)
NY	2 (2.5)
MA	2 (2.5)
CA	1 (1.3)
MD	1 (1.3)
MN	1 (1.3)
TN	1 (1.3)
TX	1 (1.3)
Group distribution (n = 130)[a]	
Group One	53 (40.8)
Group Two	56 (43.1)
Group Three	21 (16.2)

(*continued*)

(*continued*)

These data come from the responses provided by the 62 contact tracers who completed the pretraining survey.
[a]Statistics were calculated using data from REDCap records, so all 130 volunteers are included in this calculation.
[b]Statistics was calculated using data from REDCap, but an estimated end date could not be determined for 8 of the 130 total volunteers, so n = 122.
[c]Survey participants could select more than one response, so total will be >100%.
[d]Survey participants could enter multiple ZIP codes.
CA, California; MA, Massachusetts; MD, Maryland; MN, Minnesota; NJ, New Jersey; NY, New York; PA, Pennsylvania; TN, Tennessee; TX, Texas.

assignment data from REDCap data collection projects were used.

Survey responses were dichotomized for both knowledge (i.e., correct, incorrect) and self-efficacy ("Agree" or "Completely Agree" versus "Unsure," "Disagree," or "Completely Disagree") questions. To assess within-subject changes between the pre- and post-training surveys on individual knowledge questions, McNemar's test was performed. To assess changes for each self-efficacy question, Wilcoxon's signed rank test was performed, which analyzed changes in proportion of respondents who endorsed the specific self-efficacy question before and after training. All open-response questions were coded for content by 2 investigators, who iteratively reviewed and discussed the data to agree on classification (Appendix E, available online).

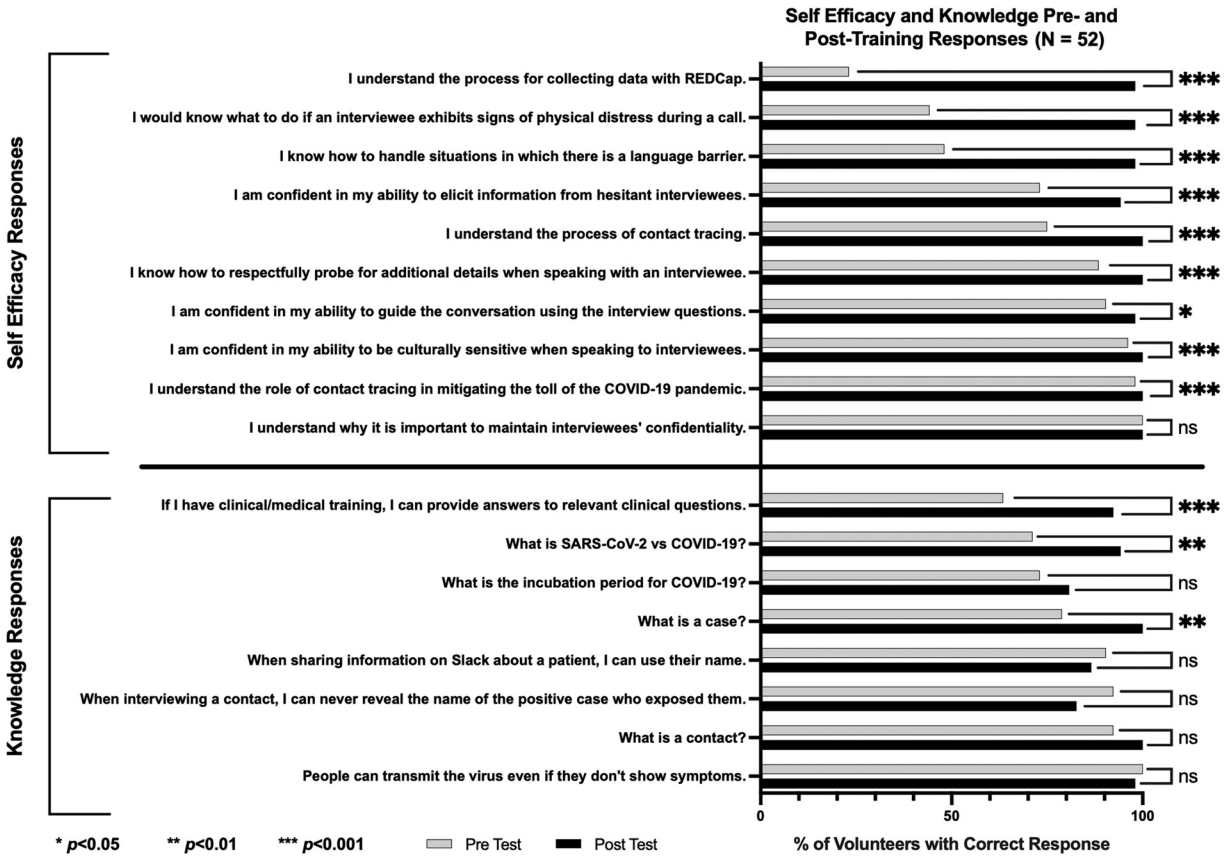

Figure 2. Evaluation of pretraining and post-training survey results reveals overall efficacy of training. Top: A significant improvement between the pre- and post-training surveys was observed on 8 of the 10 self-efficacy questions. Wilcoxon signed rank tests, N = 52. Bottom: A significant improvement between the pre- and post-training surveys was observed for 3 of the 8 knowledge questions. McNemar tests, N = 52.

RESULTS

Descriptive statistics for the 62 participants who completed the pretraining survey (out of approximately 100 invitees) are reported. Most contact tracers were current students aged in their late 20s, white, female, and specializing in a health-related field (Table 2).

A total of 9 languages were spoken among the contact tracers (Table 2). Most contact tracers conducted calls from Pennsylvania, and 15 (19%) reported working from other states including New Jersey, New York, Texas, and Californai. Across all 130 volunteers, the contact tracers volunteered an average of 172 days, and each was assigned an average of 70 calls, with a range of 1 −487 calls (Table 2).

Pre- and post-training surveys were administered to volunteers to assess their knowledge and self-efficacy for conducting contact tracing (Figure 2). Of the 62 volunteers who completed the pretraining survey, 52 (83.9%) also completed post-surveys.

Volunteers' responses varied on the pretraining survey, and responses significantly improved on 9 of 10 measures of self-efficacy after training ($p<0.05$). (Figure 2, top). Participants also demonstrated significant improvements for 3 of 8 knowledge questions (Figure 2, bottom). These questions related to answering interviewees' clinical questions ($p<0.001$), the difference between SARS-CoV-2 and COVID-19 ($p<0.01$), and the definition of a case ($p<0.01$).

In both pre- and post-training surveys, contact tracers described via open response what they anticipated to be the most challenging aspect(s) of their forthcoming contact tracing work. Anticipated challenges included *supporting the interviewee*, e.g., when the interviewee was emotionally distressed. After completing the training, a smaller proportion of contact tracers reported concern regarding how to support interviewees ($p<0.01$). Other anticipated challenges included *logistic* (e.g., data entry, script familiarity), *personal aspects of the work* (e.g.,

emotional/mental toll, personal time management), and *eliciting information from reluctant interviewees*.

In the 18-month follow-up survey, open-ended questions were asked regarding what ultimately the most challenging aspect of the contact tracing work was. One unanticipated challenge was *establishing trust with the interviewee*. One contact tracer described how "it was challenging getting people to divulge their contacts… particularly for marginalized patients who do not have good relationships with the healthcare system." Another challenge was striking the *balance* between collecting necessary information, meeting the interviewee's needs, and maintaining boundaries. One contact tracer wrote, "A big part of contact tracing is the emotional side of it. It was often difficult to provide comfort to people on the other side of the phone… to balance being supportive but not getting too emotionally invested." Volunteers described the *personal impacts* as the most difficult part of the work (e.g., the "emotional" or "psychological" impacts). Two contact tracers reported that "not knowing follow-up on social needs - whether loops were closed [for the interviewee]," was challenging, especially because it was "taxing to talk to people who are scared and/or in need of food, shelter, or medical assistance without being able to offer an immediate solution [beyond a referral to the Social Needs Response Team]."

In the 18-month follow-up survey participants were asked to describe their most difficult experiences as contact tracers, which included delivering COVID-19 −related news when someone was at work or calling when the interviewee had been hospitalized or passed away. Other difficult experiences included working with people who had extreme social needs, such as elderly individuals experiencing disrupted services and individuals experiencing homelessness. One contact tracer remarked: "I spoke to the mother of a homeless man who was unable to locate her son [after] he had been discharged from the hospital."

Open responses on the 18-month follow-up surveys provided additional insight into the training evaluation (Table 3). Nearly 1 in 3 volunteers recalled finding aspects of training related to *cultural humility, empathy, and trauma-informed interviewing* most helpful in their contact tracing work (Table 3). Eight (40%) of the survey participants indicated that they would have benefited from *training in additional areas* that were not covered, such as contact tracing-specific language training (e.g., in Spanish) and how to tailor broad infection control guidance to individuals' specific circumstances (Table 3). Three (15%) reported that the *training was sufficient* (Table 3).

Seven contact tracers (43.8%) described in open-ended responses how the work showed them the disproportionate impact of COVID-19 on certain communities (*COVID-19 Disparities*; Table 3). In addition, 1 in 4 contact tracers noted that their work provided an expanded understanding of other peoples' experiences or perspectives regarding the pandemic (*Expanded Worldview*; Table 3). As one volunteer said, "[Contact tracing] broadened my perspective on how the pandemic was impacting low-income and minority communities particularly. A large number of the people being called needed additional resources such as food, water, and medication during their quarantine period." Other volunteers reported developing an appreciation for the *importance* (31.3%) and *difficulty* (12.5%) of contact tracing, while some described a new understanding of how *quickly the virus was spreading* through the community (12.5%) or their own increased likelihood of *adhering to public health guidelines* (12.5%) (Table 3). One contact tracer noted "how important it was to pursue public health interventions beyond clinical medicine," and another said the work "showed me just how broken our public health infrastructure is."

Nearly half (43.8%) of survey participants reported that their most uplifting or positive experience was receiving *gratitude* from the interviewee (Table 3). One volunteer wrote, "I once spoke with [someone] who sounded exhausted but had much gratitude to express. Paraphrasing her sentiments… the calls you are doing may be a thankless job… I couldn't emotionally do what you are doing. Thank you for caring about the strangers and seeing the stories behind the statistics." Other uplifting or positive experiences included a feeling of *connectedness* with the interviewee, *listening to the interviewee's stories*, and *providing guidance* to the interviewee in an empowering way (Table 3). *Addressing interviewees' social needs* was also rewarding, as one volunteer described how "being able to link people with rent, food, and clinical support was really meaningful."

Given that most (83.9%) contact tracers were current students (Table 2), this study explored how volunteering impacted their career development and/or trajectory. In the pretraining survey, participants reported their motivation for becoming a contact tracer, both in multiple choice and open response formats. Fifty-six (90.3%), 45 (72%), and 36 (58%) of the respondents indicated that they wanted to help mitigate the pandemic, had an applicable skillset, or were receiving academic credit for volunteering (Table 4). Ten motivation themes were identified when analyzing the open responses. In addition to the previously mentioned motivations, contact tracers reported that their interest in volunteering stemmed from being *unable to partake in normal work/school* and *having time* (Table 4).

Most (68.8%) of the respondents indicated that contact tracing was applicable to their *current or future*

Table 3. Contact Tracer Experiences Retrospectively Reveal Areas in Which the Training Was Both Successful and Could Be Improved

Retrospective training efficacy questions	*n* (%)
What part of the training was most helpful to you in your work as a contact tracer? (*n* = 21)[a]	
Cultural humility/empathy/trauma training	6 (28.6)
Interview techniques	4 (19)
Continuing communication and education	4 (19)
Practice calls	4 (19)
Script/REDCap walkthrough	4 (19)
Organizational structure	2 (9.5)
Other	2 (9.5)
What do you wish you had more training on before starting your work as a contact tracer? (*n* = 20)[a]	
Additional trainings (e.g., contact tracing-specific language training in Spanish, how to tailor broad infection control guidance to individuals' specific circumstances)	8 (40)
Training was sufficient	3 (15)
Handling difficult situations	3 (15)
Cultural humility/empathy/trauma training	2 (10)
Practice calls	2 (10)
Eliciting information	2 (10)
Organizational structure	1 (5)
Did your work as a contact tracer influence your perspectives on the COVID-19 pandemic? If so, how? (*n* = 16)[a]	
COVID-19 disparities	7 (43.8)
Importance of contact tracing	5 (31.3)
Expanded worldview	4 (25)
Fast viral spread	2 (12.5)
Guidance adherence	2 (12.5)
Difficulty of contact tracing	2 (12.5)
Broken public health infrastructure	1 (6.3)
Connectedness	1 (6.3)
No	1 (6.3)
Can you please describe your most uplifting or positive experience while working as a contact tracer? (*n* = 16)[a]	
Gratitude	7 (43.8)
Connectedness	5 (31.3)
Listening to stories	4 (25)
Providing guidance	4 (25)
Addressing social needs	3 (18.8)
Speaking with elderly persons	3 (18.8)
Helping someone get to a hospital	1 (6.3)
Interviewee wanted to help	1 (6.3)

Note: These data come from the 18-month follow-up survey.
[a]Survey participants could provide more than one response to the question, so total will be >100%.

work in healthcare or public health (Table 4). One volunteer described, "Hearing about the journeys of patients leading up to showing symptoms and their experience with the virus has been very helpful for personalizing how this virus has impacted patients I might work with." Finally, while only 9.7% of the survey participants initially described *skill development* as a motivating factor for volunteering, this proportion increased to 37.5% in the 18-month follow-up survey when additional participants reported that this was one of the ways in which the work ultimately impacted their career (Table 4). These skills included expressing empathy, balancing information-seeking and infection control with provision of support, and rapid relationship building.

DISCUSSION

This article describes how a volunteer contact tracing program contributed to pandemic response and health profession career development through training and field experience. These results may inform contact tracing and pandemic responses in 3 key ways.

First, contact tracing programs require both infrastructure and skilled staff, and a volunteer-based system

Table 4. Contact Tracing Work Was Applicable to and Impacted Contact Tracers' Careers

Career impact and applicability questions	*n* (%)
What is your motivation for becoming a contact tracer? (multiple choice) (*n* = 62)[a]	
I want to help mitigate the pandemic	56 (90.3)
I have a skillset that applies to this work	45 (73)
I am receiving credit in some way for participating (e.g., clinical hours, field work)	36 (58)
Other	0 (0)
What is your motivation for becoming a contact tracer? (open response) (*n* =62)[a]	
Desire to help	52 (83.9)
Applicable to field of interest	16 (25.8)
Use applicable skills	15 (24.2)
Have time	15 (24.2)
Receive credit	8 (12.9)
Recognition of contact tracing importance	6 (9.7)
Develop applicable skills	6 (9.7)
Work from home	5 (8.1)
Feeling helpless	2 (3.2)
COVID-19 experience	1 (1.6)
How has your work as a contact tracer impacted or been applicable to your career? (*n* = 16)[a]	
Current or future healthcare/public health worker	11 (68.8)
Develop skills	6 (37.5)
Expanded worldview	3 (18.8)
Influenced job/career path	3 (18.8)
COVID-19 knowledge	2 (12.5)
Similar in nature to current work	2 (12.5)
Importance of public health/intersection with medicine	1 (6.3)
Balance urgency with support	1 (6.3)

Note: These data come from the pretraining survey and the 18-month follow-up survey.
[a]Survey participants could provide more than one response to the question, so total will be >100%.

is not a sustainable pandemic preparedness model. University faculty and staff managed this program alongside their normal job responsibilities, and all contact tracers were volunteers. The program also relied on academic health system professionals, trainees, legal and bioethics consultants, and data management tools (e.g., REDCap). These human and institutional resources supported rapid program development and implementation. However, these resources were tapped as an emergency adaptation to insufficient health department resources and cannot substitute for durable public health infrastructure, especially because of the nature of volunteerism. This program ultimately ended because both students and staff needed to return to their prepandemic responsibilities related to studying and paid work. The phenomenon of abandoning volunteer positions for paid work has been identified beyond the context of COVID-19.[15] Furthermore, it has been proposed that enlisting unpaid volunteers to conduct long-term, significantly beneficial work integral to an organization is problematic.[16] Consequently, this suggests that a robust, effectively maintained contact tracing program requires well-resourced public health infrastructure including funding for contact tracers to be compensated, rather than serving as volunteers. The study findings also demonstrated that effective contact tracing required refinement of interpersonal skills (e.g., empathy, communication under stress, ability to respectfully probe for additional details or guide the conversation during an interview) that should be selected for in recruitment and reinforced through training of contact tracers (Table 1 and Figure 2, top).

Second, contact tracers developed *structural competency*, defined as an understanding of how a patient's clinical presentation represents not only that person's individual decisions and actions, but also the consequence of upstream systemic health inequities embedded within the infrastructure of our society.[17] The call for improved structural competency in healthcare settings and health professions education resounds.[18–23] In the post-training survey, there was a significant improvement in volunteers' confidence in their ability to be culturally sensitive when speaking to interviewees ($p < 0.001$). Furthermore, although the development of

structural competency was not an explicit goal of this program, many contact tracers gave feedback consistent with an evolved understanding regarding structural determinants of health (provided as *COVID-19 Disparities* and *Expanded Worldview* in Table 3, and the codebook in Appendix E, available online). Volunteers described how interviewees' structural constraints and lack of social safety net put them at-risk for COVID-19 exposure, thus demonstrating structural competency. These study findings suggest the educational value of engagement and conversation with individuals regarding their pandemic lived experiences. Although this program was similar to other institution-based student-volunteer COVID-19 contact tracing programs, this training evaluation is the first among recent evaluations to identify the development of structural competency among volunteers, which has potential career benefits for health professions students.[24–26]

Finally, this work reinforced that the COVID-19 pandemic has been a collective trauma,[27–29] with a disproportionate impact on people with marginalized social positions and other vulnerabilities.[27,30,31] The contact tracers in this study observed that this was true for the community members with whom they interacted. They also described the emotional and mental impact of contact tracing as the most challenging aspect of the work. They recognized their limited personal and programmatic capacity to address *COVID-19 disparities*. While connecting interviewees to resources through the Social Needs Response Team referrals mitigated short-term difficulties, many interviewees were vulnerable in other systemic ways that our contact tracers could not address —sometimes leading to frustration and hopelessness. This recognition is related to the concept of moral injury, or the accumulation of distress individuals feel when external factors prevent them from accomplishing what they believe is right.[32] These data suggest that contact tracers, like other frontline workers, are vulnerable to moral injury, and consequently need training and support.[33–35] Support structures were provided in this program, such as team office hours, consultation with social work-trained team members, and trauma-informed training. Roycroft et al.[32] (2020) suggest additional approaches may be beneficial, such as consistent teams to foster an environment of reliable support and guidance, as well as the provision of time and space for workers to rest and process their experiences.

In response to the COVID-19 pandemic, academic institutions partnered with LHDs to aid in contact tracing initiatives.[9,25,26] However, to the best of our knowledge only one of these groups conducted a follow-up study investigating contact tracers' perspectives on the initiative. Shelby and colleagues[24] (2021) described a qualitative focus group study in which 36 volunteer contact tracers provided insight regarding "facilitators, barriers, and potential solutions for improving implementation of COVID-19 contact tracing." Our findings corroborate many of those described in Shelby et al.,[24] including contact tracers' motivations to volunteer (e.g., desire to help mitigate the pandemic and use an applicable skillset, as described in Table 4), difficulty in reaching/establishing trust with the interviewee, and appreciation for the provided interview script. Both studies also report sustainability barriers because of the volunteer nature of the work. However, our study contributes novel findings in terms of our detailed training session evaluation, exploration of health professions career benefits, the development of structural competency among student volunteers, and the need to provide supports to contact tracers to mitigate moral injury. These studies are complementary, with findings corroborated despite differing methodologic approaches (focus group conversations versus surveys) and different study goals (improving the program structure based on volunteer feedback versus evaluating training sessions and professional development impacts).

Limitations

The contact tracing initiative described here was launched as an emergency response to a public health crisis, and thus our primary responsibility was to rapidly establish a robust contact tracing workforce to stop the chain of SARS-CoV-2 transmission in Philadelphia. Consequently, the findings presented here are the result of a secondary analysis of the training sessions and evaluations that were designed for the field as opposed to research. This context explains key limitations of our work, including incomplete data regarding comprehensive contact tracer demographics, small survey sample sizes, and lack of a control group. The generalizability of these findings is consequently impacted. For example, this study cannot examine differences in experiences, knowledge, self-efficacy, or outcomes between responders and non-responders.

Contact tracer demographics could have also impacted responses on all 3 surveys, resulting in a lack of generalizability. Furthermore, both recall bias and differences in experience level (e.g., call assignments ranging from 1 to 487 and elapsed time ranging from 17 to 369 days; Table 2) among the contact tracers could have impacted survey responses on the 18-month follow-up survey. The results from this survey are also limited by low response rate, which could be because of the time delay between when the contact tracing program ended (May 2021) and when the survey was administered

(November 2021). Consequently, there was a lack of current contact information for all contact tracers, and the delay itself could have disincentivized contact tracers from completing the survey. This low response rate also impacts the generalizability of these findings. Finally, another limitation of this program is the low retention of volunteers over time, a common obstacle encountered by volunteer-led programs.[36–38]

Despite these limitations, this work provides valuable foundational insights into the training materials necessary to prepare volunteers for conducting contact tracing. A key strength of this work is the insights provided from the evaluation of both training and field experience for a large volunteer effort that assigned more than 9,000 calls between April 2020 and May 2021.

CONCLUSIONS

Through training sessions and field experience, our volunteer contact tracing program contributed to health profession education and career development for trainees. Our evaluation also reveals how preparation and support systems for contact tracers can be improved for future contact tracing programs.

ACKNOWLEDGMENTS

The authors thank our contact tracers and patients, as well as colleagues from the DrPH Coalition (Boston, MA), the Health Service Executive Ireland (Dublin, Ireland), University of Pennsylvania Campus Health (Philadelphia, PA), and the Washington State Department of Health (Olympia, WA), as well as Dr. Josh Sharfstein and Dr. Emily Gurley, for their insights in creating the contact tracing training sessions. The authors thank the WW Smith Foundation for their support of this work.

This work was supported by the WW Smith Foundation.

The authors have no conflicts of interest to report. Most staff effort was donated by volunteers, with philanthropic support from the WW Smith Foundation to partially offset salaries of 2 staff members who led the program (RFS and CCC). The university provided in-kind support, such as online tools for data collection. All research team members contributed to the writing of the manuscript. No disclosures were reported.

CREDIT AUTHOR STATEMENT

Katherine M Strelau: Conceptualization, Methodology, Software, Formal Analysis, Investigation, Data Curation, Visualization, Writing — Original Draft, Writing — Review & Editing. Nawar Naseer: Methodology, Validation, Formal Analysis, Writing — Original Draft, Writing — Review & Editing. Rachel Feuerstein-Simon: Conceptualization, Methodology, Data Curation, Project Administration, Writing — Original Draft, Writing — Review & Editing. Kierstyn Claycomb: Investigation, Writing — Review & Editing. Heather Klusaritz: Conceptualization, Resources, Writing — Review & Editing. Hillary Nelson: Conceptualization, Resources, Writing — Review & Editing. Carolyn Cannuscio: Conceptualization, Resources, Supervision, Funding Acquisition, Writing — Original Draft, Writing — Review & Editing.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.focus.2022.100017.

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