

## Article

# Interactive, Hands-On Training for Hospital Workers Increases Level of Special Pathogen Preparedness

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**Abstract:** The purpose of this evaluation was to determine the effect of intensive, interactive training on hospital workers' preparedness for special pathogen cases by utilizing the Frontline Facility Special Pathogens Training Course created by the Systemwide Special Pathogens Program at New York City Health + Hospitals (NYC H+H). An 8 h course was offered in 2018 and 2019 to healthcare employees throughout the Department of Health and Human Services Region 2, mostly from NYC H+H. Evaluation included multiple-choice pre and post exams, a 26-question survey about level of preparedness before and after the training, and follow-up interviews focused on changes in facility protocols. As a result, 61% of survey respondents indicated that they had never previously attended a hospital-sponsored special pathogen training. After the training, there was a 53.3% report rate of feeling "very prepared," compared to 14.6% before the training. Additionally, there was an 11% improvement in test scores. Furthermore, 77% of respondents reported that their facility had changed protocols relating to topics of the course after their training date. Survey participants reported general satisfaction with the course, as well as an increased level of preparedness for special pathogen cases. Together, the results of the exams, survey, and interviews suggest that this interactive, mixed-method training increases special pathogen preparedness across different healthcare sectors. With the ongoing threat of special pathogens, the need for continued training and maintaining a state of readiness is paramount in healthcare.

**Keywords:** preparedness; special pathogens; EBOLA; PPE



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## 1. Introduction

Special pathogens are classified as highly infectious and easily transmissible microorganisms capable of causing life-threatening illnesses in humans and posing a major threat to the general public and in the healthcare setting [1]. They are associated with high morbidity and/or mortality, have a high likelihood of secondary cases (person-to-person spread), may lack an effective vaccine, prophylaxis, or treatment, and might prompt the use of a biocontainment unit due to clinical or public health concerns [2]. Examples of special pathogens include viral hemorrhagic fevers, such as Ebola and Lassa Fever, as well as severe respiratory special pathogens, such as Middle East respiratory syndrome and severe acute respiratory syndrome.

The World Health Organization (WHO) has reported that infectious diseases are growing faster than ever before, which is unsurprising given how technological investments have made travel nearly universally accessible among other contributing factors [3]. There have been numerous outbreaks of special pathogens around the world requiring prompt healthcare response for identification, isolation, and treatment [4]. This includes at least five outbreaks of Ebola virus disease since 2014 in West Africa, ongoing and sporadic cases of Middle East respiratory syndrome (MERS) reported in 12 countries in the Eastern Mediterranean Region since April 2012, and ongoing and sporadic cases of Crimean-Congo Hemorrhagic fever (CCHF) in countries within Asia, Africa, and Europe [5,6].

While many of these special pathogen outbreaks disproportionately affect lower-resource countries with inadequate public health systems, high-income countries are also not spared. There is often a paradox of low patient count but high resource demand. This was seen in the 2014 Ebola outbreak. In March of 2014, the WHO reported Ebola cases in rural Guinea. The next 2 years represented the largest Ebola epidemic in history, including numerous cases in Liberia, Sierra Leone, Mali, Nigeria, Senegal, Spain, the United Kingdom, and the United States. During the outbreak, many public health experts and academics expressed concerns about the United States' ability to properly manage patients with suspected and confirmed Ebola or other special pathogens [7]. These concerns became a reality in September 2014 when a Liberian national visiting the United States was admitted to Texas Health Presbyterian Hospital in Dallas, Texas, where he was diagnosed with Ebola virus disease (EVD) shortly after. During his time as a patient, two nurses were exposed to the virus and both were diagnosed with EVD in October 2014. Within the same month, a healthcare worker who was working overseas in West Africa for Ebola response returned to the United States and was diagnosed with EVD in New York and treated in NYC H+H's Bellevue Hospital. In April of 2015, the CDC contacted 55 Ebola treatment centers (ETCs) in the US and determined that only three had adequate preexisting biocontainment units and the other 52 needed to undertake extensive changes, including "development of plans, recruitment of facility leadership, recruitment and training of a multidisciplinary team of volunteers, and purchase of specialized supplies and equipment" [8]. These developments cost the ETCs nearly 54 million USD.

Following the outbreak, numerous evaluations of public health policies and hospital preparedness highlighted the need for increased training and education among healthcare workers. A 2014–2015 national survey of internists concluded that practitioners had widely different understandings of the risk of Ebola and required better risk communication [9]. Lack of preparedness education was not limited to the United States. Incorrect information about the risks and treatment of Ebola spread within West Africa at the beginning of the outbreak, making effective containment of the disease more difficult [10]. Internationally, many hospitals were unable to quickly implement procedures for diagnosing and caring for Ebola patients, putting healthcare workers also at risk [11,12]. The outbreak also highlighted the importance of training other members of hospital staff in special pathogen preparedness, as waste removal and patient transportation put numerous employees at risk [13,14].

All told, the 2014–2016 Ebola outbreak exposed the numerous cracks that exist in the United States preparedness toward special pathogens. As we know all too well, "special pathogens pose a significant risk to healthcare personnel and require specific healthcare facility processes to ensure early identification and isolation of infected patients and the use of effective infection control practices to prevent disease transmission while the patient is further evaluated" [2].

NYC H+H is the largest public healthcare system in the United States, with one of its acute care facilities, NYC Health + Hospitals/Bellevue, designated as one of 10 regional treatment centers in the country capable of treating Ebola patients and the remaining 10 acute facilities as frontline hospitals tasked with identification, isolation, and transferring suspected patients with Ebola or other special pathogens to the treatment center [15]. With 24 large facilities, NYC H+H is an important first line of defense for any outbreak in the city and, as such, the development of the Region 2 Frontline Facility Special Pathogens Course was started.

As a hub for both national and international travel, New York City plays a vital role in protecting the United States against transmission of special pathogens [16]. However, from a sample of 73 administrators, physicians, and nurses in Region 2 which includes NY, NJ, PR, and VI, 85.4% rated their facility as somewhat prepared or unprepared to combat an outbreak of a special pathogen in 2018 [17]. This highlights the need to provide ongoing training and education for special pathogen events including appropriate processes and procedures within healthcare systems.

Primary healthcare providers in HHS Region 2 expressed concern with the seemingly too narrowed focus on identification. When it comes to the goal in special pathogen preparation to “Identify, Isolate, Inform”, one physician commented, “We’re good at identifying, but if we are strong in just one area, we will fail.” Staff rarely work in the level of PPE that would be required for special pathogens. An outbreak would also place staff in an environment of much higher stress and less preparation than they are accustomed. Training in these unusual conditions is necessary to prepare for the real-life conditions of a special pathogen case [18]. The Frontline Facility Special Pathogens Training Course, created by the hospital systems’ Systemwide Special Pathogens Program, was an 8 h course offered throughout 2018–2019 to healthcare workers throughout the NYC H + H healthcare delivery system and Health and Human Services Region 2. The course mixed presentations, simulations, and discussions in an attempt to better prepare healthcare employees for an unexpected special pathogen case. The goal was to equip administrators and healthcare providers with centralized skills in order to effectively identify, isolate, preliminary manage, and inform appropriate stakeholders in the event of a special pathogen case and transfer of the patient to a treatment facility.

## 2. Materials and Methods

The 8 h course, offered in NYC between 2018 and 2019 as 20 courses, included three modules and culminated in group analysis of the participants’ performance and discussion of special considerations, such as pediatric, geriatric, and behavioral health. It did so through presenting decision support tools and resources, discussing best practices and basic infection control strategies, and providing immersive live scenarios. The course covered the practice of donning/doffing PPE and other clinical stations, including Middle East respiratory syndrome (MERS-CoV) workup on a mid-fidelity mannequin, immediate spill remediation of a bodily fluid spill, removal of contaminated PPE, and how to properly transfer and transport patients while wearing the high-level PPE attire. Module 1 covered “Identify, Isolate, Inform”, module 2 covered working in Level 1 PPE, and module 3 covered working in Level 2 PPE.

The course was open to all healthcare professionals but targeted frontline healthcare workers. Participants of this course included healthcare workers such as physicians, nurses, infection preventionists, and physician assistants who would be directly involved with the identification, assessment, or preliminary treatment of patients with suspected special pathogen disease (e.g., Ebola, MERS). Other allied healthcare professionals also participated in the course including patient care technicians, emergency management coordinators, hospital police, administration staff, triage staff, respiratory therapists, social workers, and others. According to a post-course follow up survey of participants who took the training, (Table A1, Appendix A), the majority of the respondents worked in a hospital, while the others either worked in healthcare management, such as a government agency, or in a non-hospital healthcare facility, such as a nursing home. Their employment included healthcare practitioners (46%), public servants (21%), and other nontraditional healthcare vocations, including educators (9%), sanitation workers (4%), and hospital administrators (20%). The instructors of the course included an infectious disease epidemiologist, infection preventionist, emergency management coordinator, and emergency medical services commanding officer.

The success and impact of the course were evaluated by a subsequent cohort analysis, involving pre- and post-course examinations the day of the training, a course evaluation survey, post-course interviews of select course participants (Figure A1a–d, Appendix A), and a post-course survey. The post-course survey, distributed electronically no less than 2 weeks after completion of the course, evaluated participants’ prior preparation for and awareness of special pathogen cases, the course’s ability to meet expectations, and how the course changed their knowledge and or practices. Questions were written primarily in a multiple-choice format, with optional write-ins. The selected questions focused on the participants’ experience with special pathogen preparedness before the training, asking

about both subjective feelings of preparedness and accounts of previous trainings at the hospital.

In addition to a written, survey-based approach, in-depth interviews were conducted with 10 participants 1–2 weeks after completion of the survey, centered around the following topics: personal feelings of preparedness, evaluations of others and team dynamics, facility protocols, and facility preparedness/equipment (Figure A2, Appendix A).

Lastly, multiple-choice quizzes covering knowledge of special pathogen preparedness were given on the day of training immediately before and after the course. They were completed by 200 participants, scored out of 20 questions, and evaluated for quantitative improvement in knowledge. The questions were based on the following core competencies covered in the course:

- Healthcare worker safety when caring for a highly infectious disease patient,
- PPE donning and doffing technique,
- Rapid identification and isolation of high-risk patient through triage,
- Importance of early recognition and isolation,
- Safe patient care and management simulations,
- Enhanced infection control precautions,
- Drawing of routine (basic) labs on a suspected high-risk patient,
- Bodily fluid clean up and containment simulation,
- Special consideration for behavioral support,
- Special consideration for pediatric patient,
- Special consideration for geriatric patient,
- Appropriate internal and external contacts,
- Patient transport and transfer technique.

The end result of these surveys and interviews was a mixed-methods report, combining quantitative analysis of the participants' changes in knowledge and their reported (survey-based) preparedness levels, as well as a qualitative discussion based on interviews.

### 3. Results

#### 3.1. Evaluation on Training Day

Preliminary data from pre and post exams on all 200 participants showed an overall increase in knowledge, with an average improvement of 20% between tests (Figure 1). The improvement varied greatly across the first 20 classes, with class 14 showing a 26.5% improvement and class 3 showing a 1.30% improvement.

Class Number	Pre Test Scores		Post Test Scores		Improvement Between Each Test
	Participant #	Total Average	Participant #	Total Average	
Class One	7	81.4%	7	88.6%	7.2%
Class Two	4	70.0%	4	90.0%	20.0%
Class Three	9	76.7%	10	78.0%	1.3%
Class Four	11	69.0%	11	85.0%	16.0%
Class Five	13	67.7%	18	80.6%	12.9%
Class Six	10	76.0%	11	81.0%	5.0%
Class Seven	10	80.0%	13	83.0%	3.0%
Class Eight	10	77.0%	11	87.3%	10.3%
Class Nine	12	77.0%	12	87.3%	10.3%
Class Eleven	12	78.4%	12	91.0%	12.6%
Class Ten	12	79.2%	12	82.0%	2.8%
Class Twelve	9	77.8%	9	90.0%	12.2%
Class Thirteen	6	76.7%	6	68.0%	-8.7%
Class Fourteen	13	61.5%	13	88.0%	26.5%
Class Fifteen	16	71.9%	14	88.0%	16.1%
Class Sixteen	14	70.7%	16	93.0%	22.3%
Class Seventeen	4	62.5%	5	88.0%	25.5%
Class Eighteen	6	78.0%	6	90.0%	12.0%
Class Nineteen	7	77.1%	6	93.0%	15.9%
Class Twenty	6	71.1%	4	88.0%	16.9%
Total	191	74.0%	200	86%	12%

**Figure 1.** Test results from the first 20 courses, showing percentage correct immediately before and immediately after the 20 questions exams. The questions were different, but they covered the same topics. The average improvement across tests for all classes was 20%.

When surveyed about their prior experience with training, the majority of participants (66.6%) indicated that their facility tested for competency in special pathogen preparedness every year or 6 months, while only five reported that their facility did not test for competency. Most (83.7%) also indicated they “often” stayed updated with news about special pathogens (Table 1). Additionally, 61% of the participants reported that they had never previously attended a hospital-sponsored special pathogens training course. Only half of the remaining 39% reported attending a course not presented by the NYC H&H Special Pathogens Team (Figure 1).

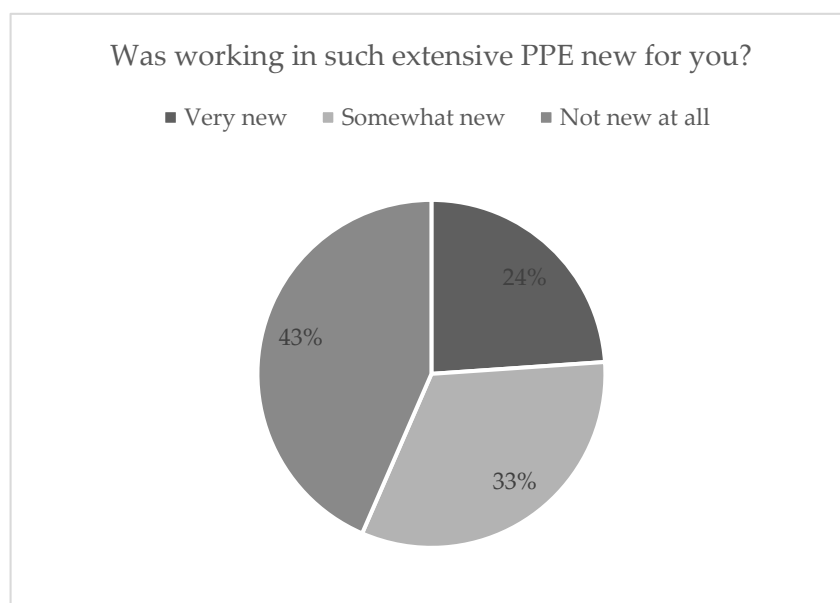
**Table 1.** The majority of respondents indicated that their facility tested for special pathogen preparedness competency every year or every 6 months and kept updated with relevant news and information somewhat to very often. The majority of participants had never previously attended a hospital-sponsored special pathogens training course; of those who did, 11 of 19 had previously attended the Frontline Facilities Special Pathogens Training Course.

How Often Does Your Facility Test for Competency in Special Pathogens Preparedness? <i>n</i> = 48				
Every year	Every 6/few months	Every month	I don't know	My facility doesn't test for competency
20 (0.42)	12 (0.25)	1 (0.02)	9 (0.19)	6 (0.12)
How often are you updated with news and information about special pathogens? <i>n</i> = 48				
Very often	Somewhat often	Not very often		Never
23 (0.48)	17 (0.35)	8 (0.17)		0 (0.00)
Had you already attended a hospital-sponsored special pathogens training course? <i>n</i> = 48				
No	Yes (this one)		Yes (another one)	
29 (0.61)	11 (0.23)		8 (0.16)	

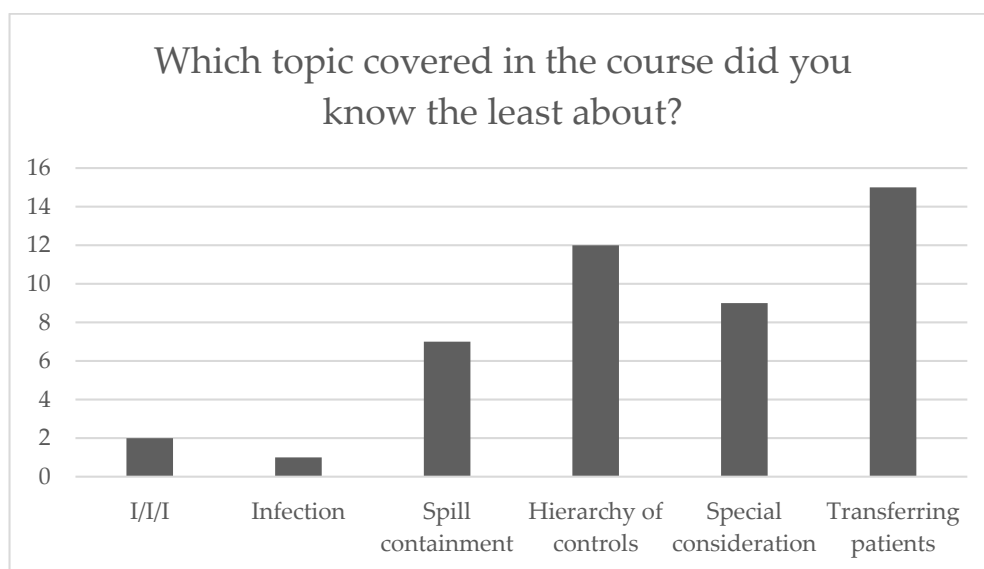
### 3.2. Post-Training Evaluation

After participating in the 8 h training, a post-course survey was sent to all 200 course participants within 2 weeks of their training date to assess any changes to their respective healthcare facilities in terms of Ebola and other special pathogen protocols, processes, and

plans based on learnings from the course. Of the 200 participants surveyed post course, 50 (20%) responded. Since much of the Frontline Special Pathogens training course involves learning to work in PPE specific to special pathogens, the post-course survey asked about how the course compared to participants' prior experience. Accordingly, 33% reported that working in such extensive PPE was somewhat new and 24% reported that it was very new (Figure 2). In addition to PPE, patient transfer was the topic that most respondents reported being least comfortable with (Figure 3).



**Figure 2.** Of the 46 participants who answered this question, 57% indicated that working in SP Level 1 and Level 2 was new, with 24% labeling it as very new.

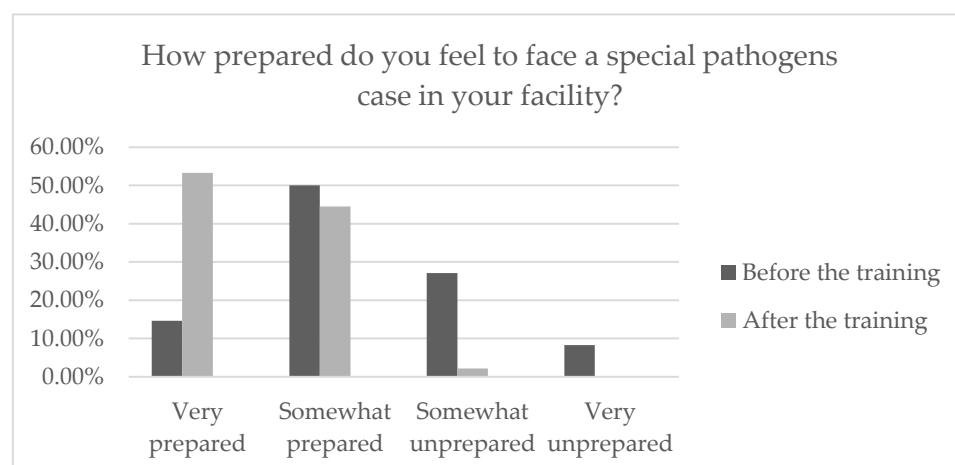


**Figure 3.** Of the 46 participants who answered this question, the topics most indicated as being new to participants were hierarchy of control (12), special consideration (9), and patient transfer (15). I/I/I represents the topic of “Identify, Isolate, Inform”.

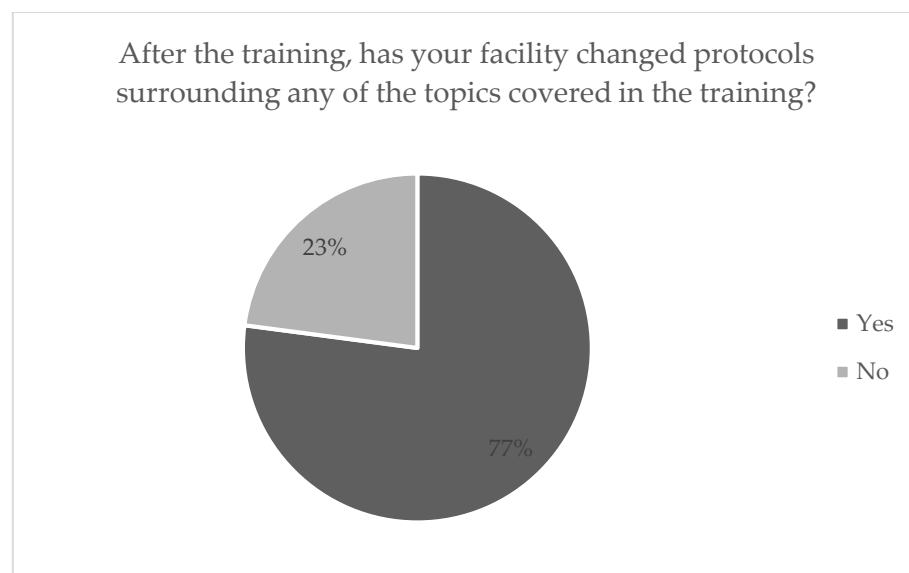
In addition to the changes seen in exam scores on the day of training, self-reported levels of preparedness shifted after taking the Frontline Facility Special Pathogen Course, with 53.3% respondents feeling “very prepared” after the training, compared to the initial 14.6%



with the same response (Figure 4). Almost the entirety of the remaining responses after the training were of feeling “somewhat prepared”, with only one participant selecting “somewhat unprepared”. In addition to personal feelings of preparedness, most participants (77%) reported that their facility changed their protocols surrounding special pathogen preparedness after the course (Figure 5). Most reported protocol changes involved special consideration, such as geriatric or prenatal issues, or Special Pathogen PPE Level 1 and 2. These changes were followed up in depth during the interviews.



**Figure 4.** Of the 45–48 participants, most reported feeling somewhat prepared or somewhat unprepared before the training, with some feeling very prepared or unprepared. After the training, almost every participant reported feeling prepared, with the majority feeling very prepared.



**Figure 5.** Of the 48 respondents, 77% reported that their facility changed their special pathogen protocols after they had taken the training.

The majority of respondents (80.4%) agreed that the course covered the expected topics (Table 2). Furthermore, 95.7% believed their colleagues would benefit from taking the same course, with the other respondents selecting “probably” or “maybe”. Lastly, 78.2% reported that they would be interested in taking a yearly refresher course; 19.6% reported maybe and 2.2% reported no (Table 2).

**Table 2.** A total of 42 participants answered questions about overall satisfaction with the training course. The majority reported that the course covered what they expected (81.0%), that their colleagues could benefit from it (73.8%), and that they would be interested in taking a yearly refresher course (76.2%).

Did the Course Go over All the Topics You Expected/Hoped? <i>n</i> = 46							
Yes		No		Had no expectations			
37 (0.81)		1 (0.02)		8 (0.17)			
Do you think colleagues would benefit from taking this course? <i>n</i> = 46							
Very much		Probably		Maybe		No, it's unnecessary	
34 (0.74)		10 (0.22)		2 (0.04)		0	
Would you be interested in taking a shorter, refresher course every year? <i>n</i> = 42							
Yes		Maybe			No		
36 (0.78)		9 (0.20)			1 (0.02)		

#### 4. Discussion

Survey participants reported not only general satisfaction with the course, but also an increased level of preparation for a special pathogen case. Specifically, greatest improvements in preparation were made in the areas of special considerations and special pathogen-specific PPE. Interview responses elaborated on the course's ability to increase participants' confidence and the course's ability to affect change in facility protocol. Together, these results suggest that this interactive, mixed-method training increased special pathogen preparedness across different healthcare sectors.

The demographic data collected from the survey indicate that many of those that self-selected the course were hospital workers, but not necessarily nurses and physicians. Follow-up interviews with administrators and managers revealed that many of these professionals felt excluded from normal hospital preparedness trainings and were worried about their role in the event of a special pathogens outbreak. Environmental service employees found it especially important to take this course as they would also be expected to work in the relevant PPE and patient care environment.

Questions about prior preparedness interventions indicated that both hospital workers and the hospital administrators were already taking active steps to be prepared. Most facilities were testing regularly for competency and the employees themselves self-reported staying up to date with relevant news and information; however, most reported never previously attending a hospital-sponsored special pathogens training course, indicating that facilities may be testing for preparedness without offering the necessary education beforehand.

Respondent reports of inexperience working in PPE and patient transfer reinforced the need for this course, as the second and third module focused heavily on moving the patient and performing procedures in the restrictive special pathogen PPE.

##### 4.1. Effectiveness of the Training Course

Self-assessments of preparedness before and after the training suggested a dramatic shift from the majority of participants feeling somewhat prepared and somewhat unprepared before the training to almost the entirety of the respondents indicating feelings of preparedness, with the majority feeling "very prepared". Although this result was self-reported, we find it to be incredibly promising because it indicates that the workers left the training feeling more confident in their abilities, which would help them work better as a team member in the case of a special pathogens emergency. Only one participant noted a feeling of "somewhat unprepared" after the course; however, reported feeling "very unprepared" before the course; hence, this finding still shows improvement.

Results from the pre and post examinations also indicate that there was objective improvement in knowledge surrounding special pathogen preparedness. It is important to note, however, that the rates varied greatly between each class and that definitive



conclusions cannot be made about any improvement in knowledge until more data are gathered.

Some of the most unexpected but most promising results from this survey were the questions involving changes in facility protocol. The majority of respondents indicated that their facility changed their special pathogen protocol, most often those involving special consideration and special pathogen-specific PPE after they had taken this training. This suggests that there may be a ripple effect due to increased training, i.e., the idea that those who are trained will train others and inspire change in their facilities.

Follow-up interviews with physicians and administrators from multiple hospitals were conducted to more deeply evaluate how hospitals instated changes in protocol after their employees attended the class. Most hospital staff reported that the largest protocol change was in PPE training and equipment availability. Although all interviews reported having prior training with PPE, all reported that these preparations consisted of online training courses and demonstrations; one described the state of PPE protocol as “woefully underdeveloped”. Reported changes after the Frontline course included more accessibility to the equipment detailed in the training course and instituting active donning and doffing training drills, rather than relying on online modules.

#### 4.2. Satisfaction with the Training Course

The majority of 200 respondents indicated that the course was what they expected, that it would benefit their colleagues, and that they would be interested in taking a yearly refresher course. This finding is significant given the need to maintain a state of readiness on an ongoing basis. Preparedness is not a state; rather, it is an active process that requires continuous training and education in the form of refreshers.

Follow-up interviews reported no dissatisfaction with the course. When prompted for recommendations for alternations, only one interviewee spoke up, noting the importance of including a degree of “applicable honesty”, a discussion of what is realistic for clinicians, and making sure not to undermine the existing knowledge and experience they already have about the subject.

#### 4.3. Limitations

One limitation of the paper was the inability to evaluate actual preparedness without the occurrence of an actual special pathogen case. Simulating a special pathogen case or outbreak is difficult. We hope that incorporating a wide variety of questions surrounding factual knowledge, situational decision-making, simulation, and subjective experience of preparedness can help to qualify the complex subject of preparedness. The Frontline course itself is one of the best indicators for preparedness, as it most realistically mimics a high-risk case; therefore, the Special Pathogens team hopes to initiate an additional yearly refresher course to test competency.

Self-selection bias was a concern as it is possible that those who chose to attend the course were those who believed they were not prepared. Although this factor is important to consider, it should not affect the question to be addressed, i.e., that this course promoted a positive *change* in preparedness. Starting at a lower level of preparedness would not have altered our ability to study change.

All 200 course participants completed the pre and post assessments. The interviews and follow-up survey were completed by a smaller number but offered to all. Given the busy schedules of healthcare workers and competing priorities, not all participants were able to devote additional time for post-training evaluation.

### 5. Conclusions and Future Directions

As infectious diseases continue to proliferate with many factors responsible for the rise and spread of diseases including human ecological and environmental changes, agricultural development, travel and commerce, human demographic changes and behavior, microbial adaptation, and breakdown and poor public health infrastructure, it is increas-

ingly important for all healthcare workers to prepare for the nearly inevitable next outbreak. The Frontline Facility Special Pathogens Training Course creates a hands-on way for hospital staff to engage with the pressing reality of a special pathogens case or potential outbreak. The need to offer ongoing training and education to staff including having established protocols and processes is essential for preparedness and eventual response.

As a preventative measure, these trainings may be limited in their effectiveness due to technical, social, and financial constraints. The implementation of such a program within hospitals will rely on available funds, the willingness of administration to make the training mandatory, and the eagerness of employees to participate if voluntary. Funds will be necessary to both provide the training and allocate a day off for employees to participate. This may not be possible for all hospitals and highlights another larger issue in changing the way healthcare and public health infectious disease prevention and readiness is funded at the local, state, and national level.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Not applicable.

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**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

### General

1. What is your name?
2. When did you attend training?
  - a. Within the last 2 months
  - b. More than 2 months ago
  - c. I don't remember
3. Do you work at NYC H+H?
  - a. Yes
  - b. No (please specify where you work)
4. If yes, what category facility do you work at?
  - a. Acute
  - b. Post-acute
  - c. Gotham
  - d. Public health
  - e. Other (please specify)
5. What is your position?
  - a. Physician
  - b. Nurse
  - c. Administrator
  - d. Other (please specify)

### Experience Before the Training

6. How often does your facility test for competency in special pathogens preparedness?
  - a. My facility doesn't test for competency
  - b. Every few months
  - c. Every 6 months
  - d. Every year
  - e. Every 2 years
7. How does your facility test for competency? (if they don't, write N/A)
8. Had you already attended a hospital-sponsored special pathogens training course?
  - a. No
  - b. Yes (please describe what these courses entail)
9. How often are you updated with news and information about special pathogens?
  - a. Very often
  - b. Somewhat often
  - c. Not very often
  - d. Never
10. In the past 12 months, has your place of work run any special pathogens exercises?
  - a. Yes
  - b. no
11. Before this training, how prepared did you feel to face a special pathogens case in your facility?
  - a. Very prepared
  - b. Somewhat prepared
  - c. Somewhat unprepared
  - d. Very unprepared

(a)

**Figure A1.** *Cont.*

12. Before the training, how familiar were you with the travel screening screening questions?
  - a. Very familiar
  - b. Somewhat familiar
  - c. Not so familiar
  - d. Not at all familiar
13. Before the training, how frequently did your facility or team discuss how to handle special pathogens cases?
  - a. Very frequently
  - b. Somewhat frequently
  - c. Somewhat infrequently
  - d. Very infrequently
14. Before the training, how familiar were you with the waste management process (locations of waste receptacles, protocols, classifications) involving special pathogens?
  - a. Very familiar
  - b. Somewhat familiar
  - c. Not so familiar
  - d. Not at all familiar

#### Experience at the Training

15. What aspects of the training were new for you? (check all that apply)
  - a. Identify/isolate/inform
  - b. Infection control 101
  - c. Spill containment
  - d. Hierarchy of controls
  - e. Special considerations
  - f. Transferring a patient
16. Was working in such extensive PPE new for you?
  - a. Very new
  - b. Somewhat new
  - c. Not new at all
17. Did the course clearly cover the difference between Special Pathogens Level 1 and Level 2 PPE VHS ensemble?
  - a. Yes
  - b. Somewhat
  - c. No
18. Did the course go over all the topics you expected/hoped?
  - a. Yes
  - b. No
  - c. Had no expectations going in
19. Which topic covered in the course did you already know the *most* about (check all that apply)
  - a. Identify/isolate/inform
  - b. Infection control 101
  - c. Spill containment
  - d. Hierarchy of controls
  - e. Special considerations
  - f. Transferring a patient

(b)

Figure A1. Cont.

20. Which topic covered in the course did you already know the *least* about (check all that apply)
- a. Identify/isolate/inform
  - b. Infection control 101
  - c. Spill containment
  - d. Hierarchy of controls
  - e. Special considerations
  - f. Transferring a patient

#### Experience After the Training

21. After this training, how prepared do you feel to face a special pathogens case in your facility?
- a. Very prepared
  - b. Somewhat prepared
  - c. Somewhat unprepared
  - d. Very unprepared
22. After the training, has your facility changed protocols surrounding any of the following topics? (check all that apply)
- a. Identify/isolate/inform
  - b. Infection control 101
  - c. Spill containment
  - d. Hierarchy of controls
  - e. Special considerations
  - f. Transferring a patient
  - g. SP1
  - h. SP2
23. Which of these topics do you feel more knowledgeable of after the course? (check all that apply)
- a. Identify/isolate/inform
  - b. Infection control 101
  - c. Spill containment
  - d. Hierarchy of controls
  - e. Special considerations
  - f. Transferring a patient
  - g. SP1
  - h. SP2
24. Which of these topics do you think you still don't understand after the course? (check all that apply)
- a. Identify/isolate/inform
  - b. Infection control 101
  - c. Spill containment
  - d. Hierarchy of controls
  - e. Special considerations
  - f. Transferring a patient
  - g. SP1
  - h. SP2
25. Do you think colleagues would benefit from taking this course?
- a. Very much
- (c)
- b. Probably
  - c. Maybe
  - d. No, it's unnecessary
26. Would you be interested in taking a shorter, refresher course every year?
- a. Yes
  - b. Maybe
  - c. No
- (d)

**Figure A1.** Survey given to each participant 1 week before the course and 3 months after the course to assess any change in preparedness (a–d). Questions are divided into multiple-choice knowledge-based questions, scaled subjective questions, and free-response questions.

## Guiding Interview Questions

## Personal feelings of preparedness

1. Would you be prepared to tend to an outbreak today and to assist your colleagues?
2. Please list the locations of all the equipment necessary for a special pathogen outbreak:
3. What do you feel you understand most about identifying and treating special pathogens?
4. What do you feel you understand least about identifying and treating special pathogens?

## Evaluations of others and team dynamics

1. Do you have a designated team that you will work with in the event of an outbreak?
2. Describe your team's communication style:
3. Describe an incident, faced by your team, that involved high stress. How did you all handle it?
4. Do you feel you would trust your colleagues in the event of such a high-stakes situation?

## Facility protocols

1. Do you think that your facility would be a major hub of patient care in the event of a city-wide outbreak?
2. Does your facility have explicit rules and assigned roles in the event of an outbreak?
3. Is everyone aware of their roles?
4. In what areas do you think your facility would struggle during an outbreak?

## Facility preparedness/equipment

1. Has your facility run through outbreak scenarios?
2. Do you know where PPE equipment is held? Is it up to date?
3. Do you think that your facility has enough bed space and, in particular, isolation bed space to handle a large-scale outbreak?
4. If your facility were to run out of resource, is there a clear supply chain established?

**Figure A2.** List of questions that served as a guide for how to conduct further interviews with course participants; however, discussions were expected and encouraged to differ, given they covered one of the four main topics: personal feelings of preparedness, evaluations of others and team dynamics, facility protocols, and facility preparedness/equipment.

**Table A1.** Demographic information collected from the survey, indicating that the 44 respondents were primarily hospital workers, with a range of positions including primarily nurses, physicians, and management. There was an equal representation of people who attended training more than 2 months ago and less than 2 months ago.

When the Participant Attended Training, <i>n</i> = 44		
More than 2 months ago		Less than 2 months ago
22 (0.50)		22 (0.50)
Place of work, <i>n</i> = 44		
Hospital	Non-hospital healthcare facility	Healthcare management (govt/admin)
28 (0.64)	7 (0.16)	9 (0.20)
Employment Position, <i>n</i> = 44		
Nurse	Physician	Educator
11 (0.25)	9 (0.20)	4 (0.09)
Management	Police	Sanitation
7 (0.16)	1 (0.02)	2 (0.04)
EMT	Infection control	Administrator
3 (0.06)	6 (0.14)	2 (0.04)

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