

Submission ID #: 69913

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Project Page Link: <https://review.jove.com/account/file-uploader?src=21323513>

Title: Automated Hospital Room Disinfection Utilizing a Novel Aerosolized Hydrogen Peroxide Microdroplet Disbursing Technology

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Author Questionnaire

1. Microscopy: Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

2. Software: Does the part of your protocol being filmed include step-by-step descriptions of software usage? **Yes**

Authors: Please create screen capture videos of the shots labeled as SCREEN, create a screenshot summary, and upload the files to your project page as soon as possible:
<https://review.jove.com/account/file-uploader?src=21323513>

Videographer: Please film the computer screen for 3.11.1 and 3.11.2 as a backup

3. Filming location: Will the filming need to take place in multiple locations? **No**

4. Testimonials (optional): Would you be open to filming two short testimonial statements **live during your JoVE shoot**? These will **not appear in your JoVE video** but may be used in JoVE's promotional materials. **Yes**

Current Protocol Length

Number of Steps: 19

Number of Shots: 33

Introduction

Videographer: Obtain headshots for all authors available at the filming location.

INTRODUCTION:

~~REQUIRED: Summarize your research focus and the main questions it aims to answer.~~

- 1.1. **Meghan Johnson:** The focus of this work is to describe the use and impact of an innovative automated aerosolized hydrogen peroxide dry fogging technology.
 - 1.1.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B roll: 2.14.1.*

~~Describe the research contexts or systems in which this protocol can be applied.~~

- 1.2. **Kathy Warye:** The protocol is applicable across the healthcare continuum, anywhere there is risk of transmission of infection, from isolation to patient rooms to ambulance transport.
 - 1.2.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

CONCLUSION:

~~What does this protocol allow researchers to study or measure?~~

- 1.3. **Cate Lazarus:** This protocol allows researchers to measure the effects of aerosolized hydrogen peroxide dry fogging technology on reducing healthcare-associated infections.
 - 1.3.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

~~Are there any additional methods or analyses that can be performed following this procedure?~~

- 1.4. **Ranya Sikka:** Additional analyses that can be performed include quantification of the economic impact on the healthcare system and comparison of this impact to alternative methods.

- 1.4.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

~~How can future studies build on this work? Describe the questions or research directions that can be investigated next.~~

- 1.5. **Tyler Short:** Research directions that can be investigated next include the effects on specific pathogens and the performance of the technology on hard-to-reach areas, such as curtains.

- 1.5.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Videographer: Obtain headshots for all authors available at the filming location.

Testimonial Questions (OPTIONAL):

Videographer: Please capture all testimonial shots in a wide-angle format with sufficient headspace, as the final videos will be rendered in a 1:1 aspect ratio. Testimonial statements will be presented live by the authors, sharing their spontaneous perspectives.

- Testimonial statements will **not appear in the video** but may be featured in the journal's promotional materials.
- **Provide the full name and position** (e.g., Director of [Institute Name], Senior Researcher [University Name], etc.) of the author delivering the testimonial.
- Please **answer the testimonial question live during the shoot**, speaking naturally and in your own words in **complete sentences**.

What value do you expect this video article to have for other researchers working in your field?

- 1.6. **Erik Kulstad, Adjunct Professor**: (authors will present their testimonial statements live)
 - 1.6.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

How does the video format of your article help you to share your work with the broader scientific community?

- 1.7. **Erik Kulstad, Adjunct Professor**: (authors will present their testimonial statements live)
 - 1.7.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Protocol

2. Aerosolized Hydrogen Peroxide Disinfecting Fogger Setup

Demonstrator: ~~Dana Shock, RN~~ Rosa Estrada, Perspective Legal Nurse Consulting, Albuquerque and Emma Jean Damon, Infection Control Nurse Isleta Health Center

NOTE: LAB MEDIA for protocol was added at the postshoot stage. Please contact the postshoot note integrator (Sri Lakshmi Priya) for queries regarding lab media.

- 2.1. To begin, insert the smart controller in the controller holder located on the handle of the cart [1]. Install the controller cap using the two screws provided with the setup [2].
 - 2.1.1. WIDE: Talent placing the smart controller into the holder mounted on the handle of the mobile cart supporting the fogging unit.
 - 2.1.2. Talent installing the controller cap using two screws.
- 2.2. Plug the controller cable into the controller charge port [1]. Then, insert the other end of the cable into the USB receptacle on the mobile cart [2].
 - 2.2.1. Talent inserting the controller cable into the charge port of the smart controller.
 - 2.2.2. Talent connecting the other end of the cable into the universal serial bus receptacle on the mobile cart.
- 2.3. Now, use the supplied cable clips to secure the cable along the cart handle [1].
 - 2.3.1. Talent fastening the cable neatly along the cart handle using the supplied cable clips.
- 2.4. Power on the controller by pressing and holding the ON and OFF keys until the controller vibrates [1].
 - 2.4.1. Talent presses the ON/OFF key until the controller vibrates and shows the phone splash screen.
- 2.5. Now plug the power cable included on the mobile cart into the receptacle at the bottom of the aerosolized hydrogen peroxide disinfecting fogger [1]. Install the fogger in the designated depression in the mobile cart while tucking the excess cord into the rear of the cart base [2].
 - 2.5.1. Talent inserting the power cable into the receptacle at the bottom of the aerosolized hydrogen peroxide disinfecting fogger.
 - 2.5.2. Talent placing the fogger securely into the molded depression of the mobile cart and feeding the excess cord into the rear pocket of the cart

2.6. Fill the tank of the aerosolized hydrogen peroxide disinfecting fogger with 1 gallon of 5 to 7 percent hydrogen peroxide solution [1]. Then, screw the cap back onto the tank securely [2].

2.6.1. Talent pouring 1 gallon of hydrogen peroxide solution into the tank.

2.6.2. Talent is tightening the cap back onto the tank.

2.7. Plug the cart power cord into a wall outlet in the room to be disinfected [1].

2.7.1. Talent plugging the cart cord into a wall outlet.

3. Dashboard Initiation and Initial Configuration of the aHP Disinfecting Fogger

3.1. For locations with an existing Breezy Cloud site, invite new users through the Breezy Cloud website as the site administrator [1].

3.1.1. SCREEN: 69913_screenshot_1.mp4: 00:20-00:36.

3.2. If a new user needs to be added to an existing site and the site administrator is unknown, email Breezy Med for further assistance [1]. Use the invitation email link to set up the Breezy Cloud account [2].

3.2.1. SCREEN: 69913_screenshot_2.mp4: 00:40-00:42, 00:47-00:50

3.2.2. SCREEN: 69913_screenshot_3.mp4: 00:13-00:15, 01:10-01:17

3.3. A verification code sent to the user's email is necessary to complete the account setup [1]. Then, use the account and password that were just created to log in to the Controller [2].

3.3.1. SCREEN: 69913_screenshot_3.mp4: 01:23-01:24, 01:34-01:35, 01:45-01:47, 01:58—2:00

3.3.2. SCREEN: 69913_screenshot_4.mp4: 00:35-00:37, 01:11-01:15.

3.4. Alternatively, if the location does not already have a site, create an account on the controller [1]. A verification code sent to the user's email is necessary to complete the account setup [2]. Finally, create a site using the controller [3].

3.4.1. 69913_screenshot_5.mp4: 00:06-00:08, 00:45-00:50

3.4.2. 69913_screenshot_5.mp4: 00:56-00:58, 01:14-01:19

3.4.3. 69913_screenshot_5.mp4: 01:27-01:29, 01:44-01:46, 02:25-02:27

3.5. To prepare for fogging, verify that the Breezy Blue on the cart appears in the scanning list [1]. The fogging list displays the Breezy Blue serial number, which can be found on the bottom label of the fogger [2].

3.5.1. SCREEN: 69913_screenshot_6.mp4: 00:00-00:07

3.5.2. Talent tips the Breezy Blue on the cart to show the label on the bottom of the device *Video editor: Post-edit video to circle the serial number on the label if*

possible) Videographers' NOTE: DCS05611 and DCS05612.

- 3.6. Make the Breezy Blue device a favorite to keep it at the top of the screen [1]. Select the Breezy Blue device that is marked as a favorite [2].
 - 3.6.1. SCREEN: 69913_screenshot_6.mp4: 00:08-00:18
 - 3.6.2. SCREEN: 69913_screenshot_6.mp4: 00:24-00:30
- 3.7. Press pair to accept the pairing request. It is not necessary to allow access to contacts and call history [1].
 - 3.7.1. SCREEN: 69913_screenshot_6.mp4: 00:32-00:35
- 3.8. To view details for each fogging button, hold the button until a window appears. Press OK to return to the fogging screen [1]. Disinfect the room by selecting the appropriate room size button on the fogging screen [2].
 - 3.8.1. Talent holds a button until a window pops up, then presses OK after reviewing.
 - 3.8.2. Talent presses the button appropriate for the room size on the set and begins a fogging countdown.
- 3.9. After fogging and settling are complete, as indicated by a blue waistband on Breezy Blue, re-enter the room [1]. Unplug the cart from the wall outlet, wrap the cord around the handle, and proceed to the next area for disinfection [2].
 - 3.9.1. Talent enters the room.
 - 3.9.2. Talent unplugs the cart from the wall, wraps the cord around the breezy blue handle and exits the room with the cart.
- 3.10. To review the details of the disinfection events, log in to Breezy Cloud [1]. Then navigate to the fogging logs by pressing the VIEW LOGS button [2]. To view the devices on the site, select Devices on the left side of the screen [3].
 - 3.10.1. SCREEN: 69913_screenshot_7.mp4: 00:19-00:23
 - 3.10.2. SCREEN: 69913_screenshot_7.mp4: 00:30-00:37
 - 3.10.3. SCREEN: 69913_screenshot_7.mp4: 00:55-00:57
- 3.11. Use commercial software COMSOL (*Com-sol*) Multiphysics version 6.3 with computational fluid dynamics and particle tracing modules to perform code verification [1]. ~~Access the verification and validation models on the COMSOL website to review the available verification models [2].~~
 - 3.11.1. SCREEN: Show the COMSOL Multiphysics version 6.3 interface with computational fluid dynamics and particle tracing modules enabled.
 - 3.11.2. ~~SCREEN: Display the COMSOL verification and validation models webpage with available verification models listed.~~ Author's NOTE: Remove it.
- 3.12. NOTE: Authors requested to add shots of device fogging.

- 3.13. NOTE: Authors requested to add shots of device fogging.
- 3.14. NOTE: Authors requested to add shots of device fogging.

Results

4. Results

4.1. The standardized room geometry was defined as 11 feet by 12 feet with an 8-foot ceiling in the mathematical model [1].

4.1.1. LAB MEDIA: Figure 4.

4.2. The model showed that aerosolized hydrogen peroxide particle velocity ranged from 0.2 meters per second to over 25 meters per second [1].

4.2.1. LAB MEDIA: Figure 5.

4.3. Room coverage from surface contact with hydrogen peroxide was completed at 1 minute into the treatment course [1].

4.3.1. LAB MEDIA: Breezy-Blue-Droplet-Spraying---Section-3.3.1.gif *Video editor: Show the full animation.*

4.4. Over the 24-month timeframe from January 2023 to July 2025, 24 patients known to be colonized or infected with carbapenem-resistant organisms were admitted [1].

4.4.1. LAB MEDIA: Figure 7.

4.5. Only 2 cases were detected after admission during this period [1]. Compared to the expected 9.6 in-facility transmissions based on a per-admission reproduction number of 0.40, the observed transmissions represented a significant reduction [2].

4.5.1. LAB MEDIA: Figure 7. *Video editor: Highlight the bar labeled “With Intervention”*

4.5.2. LAB MEDIA: Figure 7. *Video editor: Highlight the “Without Intervention” bar*

Pronunciation guides:

1. Aerosolized

Pronunciation link: <https://www.merriam-webster.com/dictionary/aerosolized>

IPA: /'er.ə'sɑ:l.aɪzd/

Phonetic Spelling: air·uh·saa·lized

2. Hydrogen

Pronunciation link: <https://www.merriam-webster.com/dictionary/hydrogen>

IPA: /'haɪ.drə.dʒən/

Phonetic Spelling: hy·druh·juhn

3. Peroxide
Pronunciation link: <https://www.merriam-webster.com/dictionary/peroxide>
IPA: /pəˈrɒːk.səɪd/
Phonetic Spelling: puh·raak·side
4. Disinfecting
Pronunciation link: <https://www.merriam-webster.com/dictionary/disinfect>
IPA: /ˌdɪs.ɪnˈfekt/
Phonetic Spelling: dis·in·fekt
5. Receptacle
Pronunciation link: <https://www.merriam-webster.com/dictionary/receptacle>
IPA: /rɪˈsep.tə.kəl/
Phonetic Spelling: ruh·sep·tuh·kuhl
6. Verification
Pronunciation link: <https://www.merriam-webster.com/dictionary/verification>
IPA: /ˌver.ə.fəˈkeɪ.jən/
Phonetic Spelling: veh·ruh·fuh·kay·shuhn
7. Configuration
Pronunciation link: <https://www.merriam-webster.com/dictionary/configuration>
IPA: /kənˌfɪɡ.jəˈreɪ.jən/
Phonetic Spelling: kuhn·fig·yuh·ray·shuhn
8. Administrator
Pronunciation link: <https://www.merriam-webster.com/dictionary/administrator>
IPA: /ədˈmɪn.əˌstreɪ.tə/
Phonetic Spelling: uh·min·uh·stray·ter
9. Computational
Pronunciation link: <https://www.merriam-webster.com/dictionary/computational>
IPA: /ˌkɑːm.pjuˈteɪ.jən.əl/
Phonetic Spelling: kaam·pyoo·tay·shuh·nuhl
10. Multiphysics
Pronunciation link: <https://www.merriam-webster.com/dictionary/multiphysics>
IPA: /ˌmʌl.tiˈfɪz.ɪks/
Phonetic Spelling: mul·tee·fiz·iks
11. Dynamics
Pronunciation link: <https://www.merriam-webster.com/dictionary/dynamics>

IPA: /daɪˈnæm.ɪks/
Phonetic Spelling: dye·nam·iks

12. Particle

Pronunciation link: <https://www.merriam-webster.com/dictionary/particle>
IPA: /ˈpɑːr.tɪ.kəl/
Phonetic Spelling: paar·tuh·kuhl

13. Validation

Pronunciation link: <https://www.merriam-webster.com/dictionary/validation>
IPA: /ˌvæl.əˈdeɪ.ʃən/
Phonetic Spelling: val·uh·day·shuhn

14. Geometry

Pronunciation link: <https://www.merriam-webster.com/dictionary/geometry>
IPA: /dʒiˈɑː.mə.tri/
Phonetic Spelling: jee·aa·muh·tree

15. Velocity

Pronunciation link: <https://www.merriam-webster.com/dictionary/velocity>
IPA: /vəˈlɑː.sə.ti/
Phonetic Spelling: vuh·laa·suh·tee

16. Colonized

Pronunciation link: <https://www.merriam-webster.com/dictionary/colonized>
IPA: /ˈkɑː.lə.naɪzd/
Phonetic Spelling: kaa·luh·nized

17. Carbapenem-resistant

Pronunciation link: <https://www.merriam-webster.com/dictionary/carbapenem>
IPA: /ˌkɑːr.bəˈpiː.nəm/
Phonetic Spelling: kaar·buh·pee·nem

18. Reproduction

Pronunciation link: <https://www.merriam-webster.com/dictionary/reproduction>
IPA: /ˌriː.prəˈdʌk.ʃən/
Phonetic Spelling: ree·pruh·duk·shuhn