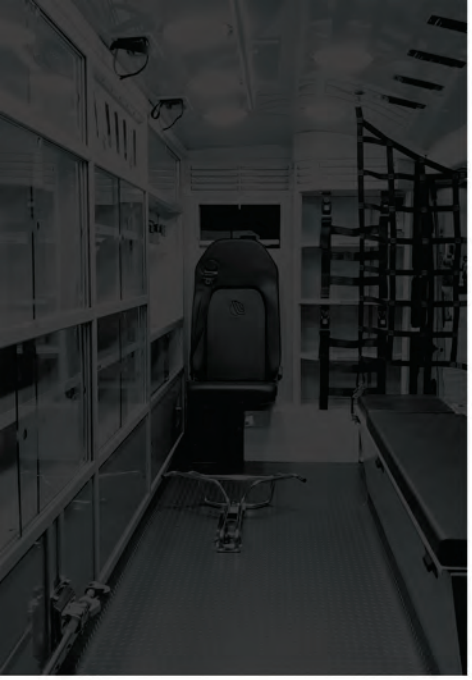

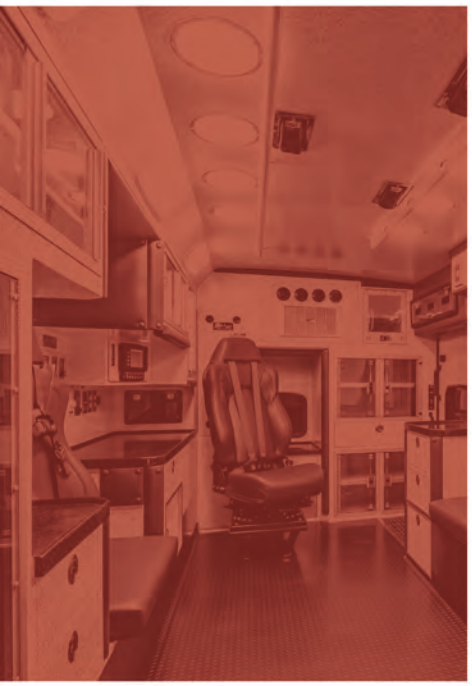

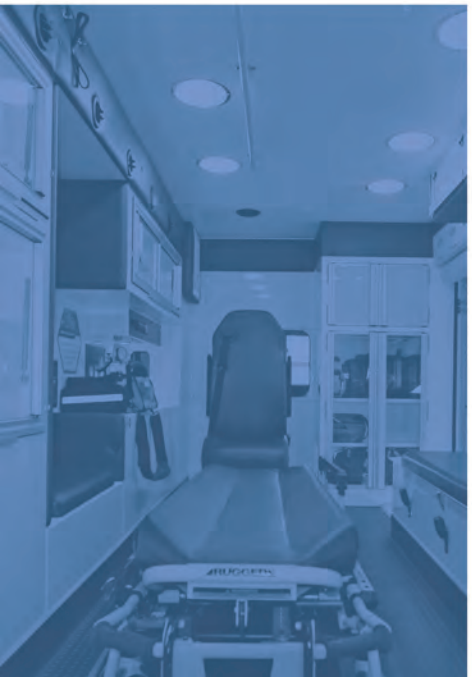

AMBULANCE DECONTAMINATION

Information, Resources,
& Considerations for
High-Risk Infection Control
in an **Ambulance**

This document was developed by Demers-Braun-Crestline

FOREWORD

Demers-Braun-Crestline has been one of the leaders in our industry for over 100 years, presenting customers with innovations, special design and safety features, and options. This white paper is another example of their thought leadership – focusing on management and the elimination of infectious diseases in ambulances.

As the worldwide emergency response community is being confronted with the challenges presented by the COVID-19 pandemic, Demers-Braun-Crestline dedicated engineering resources and expertise across their three brands to develop this special white paper. It offers information, advice, resources, recommendations, and products that can help you and your personnel stay safe and perform ambulance decontamination efficiently and effectively.

Infectious diseases have always posed a threat to EMS personnel and their patients, but COVID-19 is a unique and unpredictable virus. It demands special attention to the decontamination and restoration of ambulances to continue in service safely.

To protect patients and crew from infectious diseases inside an ambulance, the White Paper focuses on five areas to help you understand options and features that can assist you in limiting the spread of viruses, bacteria, parasites, and fungi in your ambulances:

1. Separation needs and recommendations (With special consideration to safety in a collision, ergonomics, and airflow);
2. Air Flow & Filtration (Consideration of adding HEPA filter air filtration system to your existing HVAC systems; having a rear exhaust vent from the module to outside the improve particle clearance and venting air outside of the unit and away from EMS personnel);
3. Decontamination & Disinfection Systems (The benefits of “far-UVC” light disinfection, Air sanitation systems, EPA registered surface disinfectants for chemical-based fogging systems that can decontaminate the air and surfaces in an ambulance, and the hazards of Ozone generators, are discussed);
4. Surface Treatments that should be considered (Use of biocide disinfectants proven to kill the COVID-19 virus and self-disinfecting surface that produce their own anti-bacterial [built-in] effect);
5. Interior Materials that offer best results for safety and decontamination (For things such as one-piece upholstery; non-porous cabinetry, rounded corners and handles that do not require holes; and vinyl flooring)

Read each section of this white paper carefully and reach out to Demers-Braun-Crestline for more information on the recommendations, design and modification options, and equipment and supplies referenced.

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Adjunct Instructor of Clinical Research and Leadership at
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INTRODUCTION

Demers Ambulances, Braun Ambulances, and Crestline Coach are three distinct brands owned by Demers-Braun, creating the second largest ambulance manufacturing organization in North America. Backed by 100 years of rich history in serving the emergency medical services community, Demers-Braun-Crestline is recognized for leadership in innovative design, quality products, and their commitment to safety.

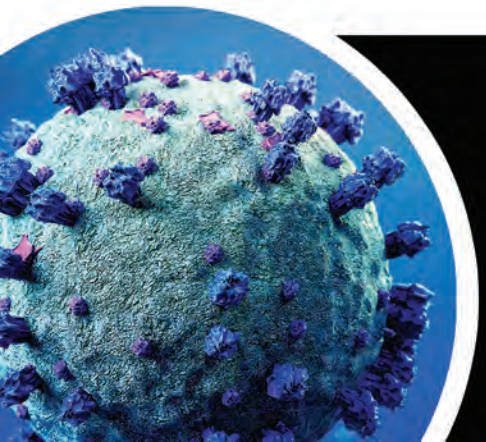
As the worldwide emergency response community grapples with the COVID-19 pandemic, Demers-Braun-Crestline is dedicating engineering resources across the three brands to enhance our offerings on ambulance decontamination and infectious controls. This white paper is a collection of information, resources, and recommendations on ambulance infectious disease control measures. It should serve as an introductory guide for organizations overwhelmed by where to start and encourage readers to seek personalized, expert advice on products, methods, and procedures applicable to their service.

HOW DO YOU PROTECT PATIENTS & PERSONNEL FROM INFECTIOUS DISEASES IN AN AMBULANCE?

COVID-19 is the present-day challenge facing our first responders, but infectious diseases have always posed a threat to EMS personnel and their patients. The World Health Organization defines infectious diseases as those "caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi; the diseases can be spread, directly or indirectly, from one person to another." (World Health Organization, 2020)

In modern history, the world has battled the Spanish flu, Asian Flu, HIV/AIDS, H1N1 Swine Flu, SARS coronavirus, and now COVID-19. While these pandemics received international notice, everyday infectious diseases like MRSA, Hepatitis, Tuberculosis, influenza, and the common cold, also deserve our attention.

EMS practitioners adhere to a code of ethics to protect others, provide care, and "first, do no harm." (Charles B.Gillespie, 1978) To best protect their patients and themselves, EMS practitioners have a responsibility to understand infectious diseases so as to reduce the spread and mitigate risk during ambulatory care.



AN IN-DEPTH LOOK AT COVID-19: HOW DOES IT SPREAD?

COVID-19 can be transmitted to others who are in close contact of respiratory droplets from symptomatic [and even asymptomatic] persons, by direct contact with infected persons, or by contact with contaminated objects and surfaces. (World Health Organization, 2020) This means that ambulance decontamination for both air and surface is critical.

WHAT ROLE DOES EMS PLAY IN INFECTIOUS DISEASE TRANSMISSION?

EMS practitioners are on the front lines of defense against infectious diseases. Not only are they often the first to provide medical care to infected persons, they also help identify and prevent the spread of infectious diseases through detailed patient evaluations and thorough protocols for care and decontamination.

THREE IMPORTANT AREAS OF FOCUS INCLUDE:

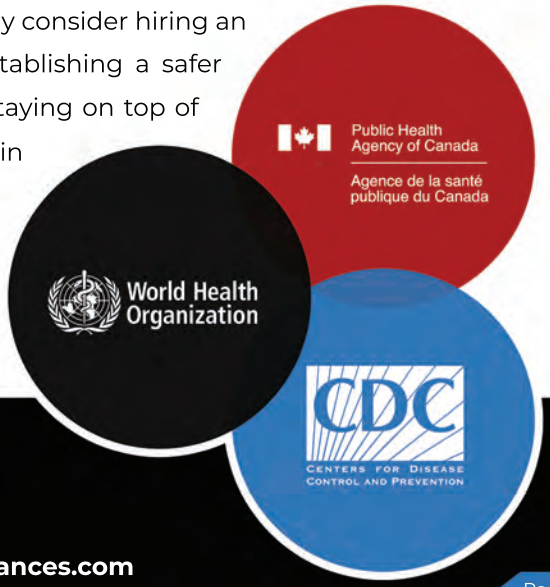
1. **What protocols should be considered outside of the ambulance?**
2. **What feature and design considerations should be reviewed inside the ambulance?**
3. **What attention should be given to equipment and supplies inside the ambulance?**

WHAT PROTOCOLS SHOULD BE CONSIDERED OUTSIDE OF THE AMBULANCE?

Protocols change over time in the natural evolution of prehospital care; EMS is always improving to enhance care and safety. Best practices also adapt based on the infectious disease. What EMS professionals do to protect themselves and their patients from the spread of COVID-19 is not the same as Ebola, and similar highly infectious diseases. Changes will be made as technology advances and new threats are identified.

It is important to stay on top of emerging infectious diseases and the latest recommendations from credible health sources. The World Health Organization, US Centers of Disease Control and Prevention, and The Public Health Agency of Canada are all experts on disease control.

Following thought leaders and connecting with manufacturers for more detailed information specific to the type of service and ambulance model(s) is also recommneded. Organizations may consider hiring an Infection Prevention and Control (IPAC) Specialist to assist them in establishing a safer environment for staff and patients during this pandemic and beyond. Staying on top of editorial features from EMS publications and well-known educators in Fire/EMS may also offer new insight. As manufacturers pivot to meet the latest needs of EMS, new features are likely to be introduced and product updates released. Networking with industry peers and reaching out to trusted suppliers is encouraged.



WE ARE HERE TO ANSWER YOUR QUESTIONS

United States
866-636-0415

Canada
866-667-0856

International
514-971-4509

DBCAmbulances.com

WHAT FEATURE AND DESIGN CONSIDERATIONS SHOULD BE REVIEWED INSIDE AN AMBULANCE?

The inside of the ambulance is where EMS personnel spend most of their time. Unlike the controlled, spacious environment of a healthcare facility, providing care in an ambulance presents unique challenges. Most apparent of these is providing care in an enclosed space while the ambulance is in motion. Additionally, evolving levels of protection or practices may be needed, even with the same patient.

How can you protect patients and crew from infectious diseases inside an ambulance? Focus on these five areas to understand options and features that assist in limiting the spread of viruses, bacteria, parasites, and fungi.

1. PHYSICAL SEPARATION

There are two areas in an ambulance to consider implementing physical separation. First is the forward chassis cabin, the space in the cab between the driver and passenger. Second is the access area, the area between the front cab and the ambulance module.

THE IMPORTANCE OF PHYSICAL DISTANCING & COVID-19

The World Health Organization recommends maintaining at least 1-meter (3 feet) distance between yourself and others for COVID-19. (World Health Organization, 2020) In the United States, the CDC has been more aggressive, suggesting 6 feet (2 meters) as the minimum distance. (Centers for Disease Control and Prevention, 2020) The primary mode of transmission for the virus is respiratory droplets. It is possible to expose yourself to COVID-19 by inhaling droplets containing the virus from someone else who has coughed, sneezed, or spoken too closely.

Physical barriers have been recommended by the Public Health Agency of Canada, the United States CDC, and the World Health Organization in response to the COVID-19 pandemic. According to the National Collaborating Centre for Environmental Health, they serve three important functions: "1) intercepting the respiratory droplets that are thought to transmit the virus, 2) re-enforcing physical distancing requirements, even when users are unwilling or forgetful; and 3) reducing reliance on masks, both due to the shortage of these items and user comfort." (Eykelbosh, 2020)

TIPS FOR SELECTING THE RIGHT PARTITION

The National Collaborating Centre for Environmental Health published the following five tips:
1.) "Choose dimensions that protect the breathing zone of the tallest person using the partition. The breathing zone can be thought of as bubble with a radius of 30 cm extending out from the mouth and nose.
2.) Pass-throughs or openings should be as small as possible and not located in the breathing zone of either user; do not include speaking ports or grates.
3.) Install the partition securely, such that it cannot tip or fall; do not block or impede emergency egress.
4.) Surface-mounted partitions with small openings and wings/surrounds are preferred over hanging partitions that can swing or waft air.
5.) Clean the partition at least daily with mild soap and water or a compatible disinfectant; discard or launder the cloths used for cleaning." (Eykelbosh, 2020)

FORWARD CHASSIS CABIN DIVIDER

In the forward chassis cabin, physical separation would create a barrier between the driver and passenger. A barrier could be implemented as a fixed thermoplastic divider, such as Lexan or Plexiglass, or a flexible plastic curtain. However, it is important that consideration also be given to safety in a collision, ergonomics, and airflow.

- Will the divider of choice allow for proper airbag deployment?
- Is it secure, or could it become a projectile?
- Will it allow for occupant extraction in the event of an accident?
- Does it maintain full visibility?
- Does it impede functionality?
- Is there a quantifiable reduction in air flow between driver and passenger?

SEALING OFF MODULE ACCESS FROM THE CAB

The chassis cab is separated from the ambulance module by either a full wall, a pass-through window, or a door. In the case of a full wall, no additional consideration is needed. However, with a pass-through window or door access, which is common on Type I and Type III ambulance configurations, sealing off the module from the cab is an important factor in limiting the spread of disease. It is desirable for a sliding window pass-through to open electronically, allowing it to fully seal on closure. An electronically controlled window also eliminates the need for a finger hole or handle to open and close it, which serves as an open hole for air transmission and another surface touch point to decontaminate.

In modules with door access to the cab, fully sealing off the module presents more of a challenge due to the size of the opening. Implementing a positive pressure system in the cab may assist with this issue; airborne contaminants are likely not to go against the flow that such a system creates. More information on this is included under Air Flow & Filtration.

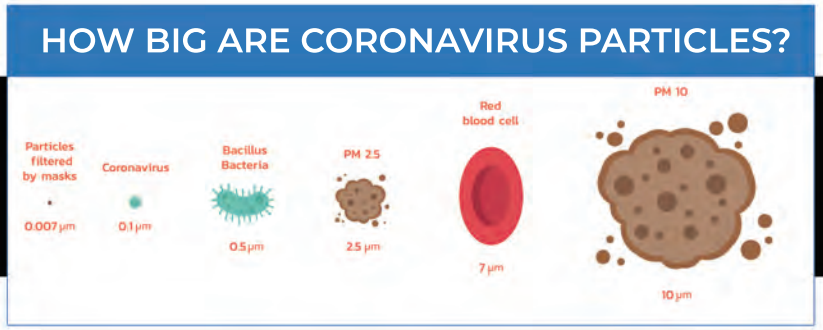
HOW DO YOU ENHANCE COMMUNICATION AND MAINTAIN AWARENESS WHILE IMPLEMENTING PHYSICAL SEPARATION?

Technology can help improve communication and visibility. The driver and EMS practitioner need to communicate with each other, dispatch, and the hospital. Adding an ambulance intercom system can offer two or three-way communication. A hands-free, wireless option is preferred.

2. AIR FLOW & FILTRATION

As COVID-19 spreads mainly through respiratory droplets and air flow, filtration has become an important area of focus. It is especially critical in an ambulance, which by design is a small, enclosed space that frequently transports infected persons with acute symptoms.

The virus particles that cause the disease COVID-19 are spheres with diameters of :0.125 microns (125 nm). (Robertson, 2020)



In this document, we will explore:

- **HEPA Filters**
- **Negative/Positive Air Pressure Systems**
- **Air Flow Management**

HEPA FILTERS

HEPA stands for High-Efficiency Particulate Air and is an efficiency standard for air filtration. Common standards require a HEPA filter to remove 99.97% of particles whose diameter is equal to 0.3 micron. (Wikipedia, 2020)

Scientific data supports HEPA filtration as an effective method for capturing airborne viruses. NASA conducted a detailed study on the topic and published their findings in a 2016 report titled, *Submicron and Nanoparticulate Matter Removal by HEPA-Rated Media Filters and Packed Beds of Granular Materials*. The document concludes that HEPA filters are most efficient for capturing ultrafine particles below the 0.3 micron HEPA test standard. (Heffernan, 2020)

Using a supplemental HEPA filter for infectious disease control in an ambulance is strongly recommended. In a study titled "HETA 95-0031-2601" conducted by University of Medicine and Dentistry of New Jersey, University Hospital, Newark, New Jersey, it was determined that a supplemental HEPA filtration system cleared particles faster than an ambulance without. (Seitz TA; Decker, 2016) A more recent publication titled, *Could air filtration reduce COVID-19 severity and spread?* also proposed air filtration to decrease the number of viral particles present in transit vehicles, including ambulances. (Bar-Yam, 2020)

HEPA filters can be applied to an existing HVAC system or implemented through a portable air purifier. Retrofitting an existing HVAC system, or purchasing a special HVAC system to accommodate such filters on a new build could be a costly investment. HEPA filters can impact airflow and performance, meaning not all HVAC systems can accommodate HEPA filters successfully. Implementing a filter through a portable air purifier is a sound option for new and existing ambulances, It is also an affordable way to implement a HEPA filter, without adding the overhead of tying it into the HVAC system.

DID YOU KNOW? An N95 mask is 95% efficient at removing coronavirus COVID-19 sized particulates. A HEPA filter is 99.97% efficient for the same sized particles. (University of Iowa Health Care, 2020) This means, if there were 10,000 virus particles floating in the air, a HEPA filter would remove 9,997 on the first pass. An N95 mask would only remove 9,500.

Demers-Braun-Crestline now offers an Air Filtration System with HEPA technology that can be retrofitted to an ambulance's HVAC system. It utilizes a HEPA H14 classified filter with a high air exchange rate to remove 99.995% of airborne contaminants. The product meets WHO, CDC, and ECDC air filter guidelines. Reach out to us to learn more about this new system.

NEGATIVE/POSITIVE AIR PRESSURE SYSTEMS

Negative or positive air pressure applies to the pressure difference between two places. A positive pressure room maintains a higher pressure inside an area than its surrounding environment. This means that air can leave an area without circulating back in. A negative pressure room uses lower air pressure than outside air. This traps particles within the negative pressure area, preventing them from leaving the space. (Air Innovations, 2020) Inside an emergency vehicle, an air pressure system could be used to seal the cab off from the module.

Successfully implementing a negative or positive air pressure system inside an ambulance module presents several challenges. Most challenging, it requires that the pressurized area be sealed off fully from the outside to maintain proper air levels. It also requires multiple air changes per hour and the use of a powerful HEPA filter and HVAC system.

As the nature of EMS can require multiple runs per hour and/or no notice for a call response, an air pressure system does not appear to be the best method for removing airborne contaminants from a vehicle. However, there may be some application for the ambulance chassis, where driver and passenger could remain sealed off from the module and protected against potential airborne contaminants inside the box. It is preferred in infectious disease control to protect the driver compartment from the patient compartment.

AIR FLOW MANAGEMENT

Strong consideration should be given to how air moves throughout the ambulance. It is recommended that air move from front to back to outside the module. Implementing a rear exhaust vent from the module to outside the ambulance has been proven to improve particle clearance, as cited in the same University Hospital study on HEPA filters mentioned previously. (Seitz TA; Decker, 2016) Venting air outside of the unit and safely away from EMS personnel is preferred as well.

3. DECON & DISINFECTION SYSTEMS

Decontamination and disinfection systems get much of the focus in healthcare when it comes to infectious disease control. Often self-contained, they can be built in a new ambulance, retrofitted to an existing one, or utilized across multiple units as a portable device. They are available for air disinfection or surface decontamination, making them a sought-after feature for reducing the spread of infectious diseases.

We have identified three of the most common systems for ambulance decontamination:

- **Ultraviolet Light Disinfection**
- **Chemical-Based Fogging Systems**
- **Ozone Generators**

ULTRAVIOLET LIGHT DISINFECTION

Often shortened to UV light, a very specific type of ultraviolet light is needed for disinfection. According to a PubMed Central article titled, "The History of Ultraviolet Germicidal Irradiation for Air Disinfection" published in the US National Library of Medicine National Institutes of Health:

> "Ultraviolet germicidal irradiation (UVGI) is an established means of disinfection and can be used to prevent the spread of certain infectious diseases. Low-pressure mercury (Hg) discharge lamps are commonly used in UVGI applications and emit shortwave ultraviolet-C (UV-C, 100–280 nanometer [nm]) radiation, primarily at 254 nm. UV-C radiation kills or inactivates microbes by damaging their deoxyribonucleic acid (DNA)." (Reed, 2010)

Conventional germicidal UVC light (254 nm wavelength) has been used in traditional healthcare settings for years to disinfect unoccupied spaces. However, direct exposure to conventional germicidal UVC light is a human health hazard; it can produce sunburn, skin cancer, inflammation of the cornea, damage to the retina, and even permanent vision impairment. (American Cancer Society, 2019) With little downtime for ambulances, and constant traffic of EMS personnel in and out of the module, it is not practical to leave a module unattended for disinfection through UVGI light.

Recent studies and new disinfection products have focused on UVC light for decontamination. "Far UVC light cannot penetrate the tear layer of the eye or the outer dead-cell layer of the skin so it cannot reach or damage living cells in the body." (Columbia University Irving Medical Center , 2020) This makes it safer for humans to be around and ideal for applications like ambulance decontamination. A unit can be decontaminated with UVC light without clearing the module of EMS personnel or decommissioning it for a period of time.

Researchers at Columbia University Irving Medical Center recently completed a study looking at far-UVC light and two common coronaviruses. Their results (broken down into timed exposures) showed continuous exposure to far-UVC light to be an effective method in killing airborne viruses, such as COVID-19.

- 8 minutes continuous exposure of far-UVC light = 90% of airborne viruses killed
- 11 minutes continuous exposure of far-UVC light = 95% of airborne viruses killed
- 16 minutes continuous exposure of far-UVC light = 99% of airborne viruses killed
- 25 minutes continuous exposure of far-UVC light = 99.9% airborne viruses killed

(Columbia University Irving Medical Center , 2020)

UV light disinfection systems utilizing UV-C light are available as a portable device for periodic disinfection, a fixed recirculating add-on, or a duct mounted retrofit. The effectiveness of UV-C light varies based on wavelength, distance to target, duration of exposure, and more. Selecting the right system will depend on the ambulance module and use requirements.

Lumalier offers fixed and portable UV-C light systems for emergency vehicles.
Their ADU unit disinfects the air and all line-of-sight surfaces for use in medical transport disinfection. If you are interested in how Demers-Braun-Crestline can assist you in retrofitting Lumalier with the assurance of continued functionality, warranty, and certification, we encourage you to contact us.

Sanuvox also offers an air disinfection unit, the VP 900 Interceptor, that can be mounted in the ambulance interior. It uses germicidal UV to disinfect the air. If you are interested in learning how Demers-Braun-Crestline can assist you in retrofitting a module with a Sanuvox unit, with the assurance of continued functionality, warranty, and certification, we encourage you to contact us.

CHEMICAL-BASED FOGGING SYSTEMS

Another option for ambulance decontamination is a chemical-based fogging system. These can provide whole vehicle disinfection and are available in a variety of options. They can be built into the module for hands-free ambulance decontamination, compartmentalized into a portable device to hand-spray a space, or combined to offer the best of both worlds. They can decontaminate the air, as well as surfaces.

The core function of any chemical-based fogging system is to take a disinfectant solution and aerosol it into a mist. Once aerosolized, the fine particles of disinfectant can reach and sanitize even the smallest open spaces of an ambulance interior.

The US Environmental Protection Agency has curated a list of EPA-registered surface disinfectants proven to be effective against the SARS-CoV-2, the virus that causes COVID-19. You can view the full list of products on their website:
https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2-covid-19

Such products already have proven efficacy and wide adoption rate for infectious disease control in ambulances. In addition, they generally offer a low cost of ownership and operation, and fast turnaround time to run a cycle and get a unit back into service. This makes them a strong consideration for EMS organizations.

AeroClave and **Curis Decontamination** are two well-known manufacturers of chemical-based fogging systems for ambulances. AeroClave offers both portable and patented fixed port systems that provide automated, no-touch decon that are OSHA and NFPA approved. CURIS Decontamination offers touchless portable systems which combine EPA approved hydrogen peroxide fogging, wireless treatment tracking, and remote operation. If you are interested in learning how Demers-Braun-Crestline can assist you in retrofitting either of these options with the assurance of continued functionality, warranty, and certification, we encourage you to contact us.

OZONE GENERATORS

Ozone generators are a specific type of chemical-based fogging system. They intentionally produce the gas Ozone, which is a molecule composed of three oxygen atoms (O_3). Basic Oxygen(O_2) is made up of two oxygen atoms. It is the most stable form of oxygen and makes up one-fifth of air; it is the type of oxygen humans can breathe in. (Ball, 2001)

The third atom of oxygen found in Ozone is unstable. As it degrades, one atom of oxygen breaks off, leaving stable Oxygen (O_2) behind. This creates free oxygen atoms or free radicals in the air. "The free oxygen atoms or radicals are highly reactive and they will oxidize almost anything (including viruses, bacteria, organic and inorganic compounds)..." (LAM, 2020)

While Ozone generators may be an effective solution for deactivating bacteria, viruses, and even spores, they are likely not a good choice for ambulance decontamination. Ozone generators should not be used in occupied spaces. Ozone can cause discomfort and irritate mucous membranes when it reaches a certain concentration level. (Muzhi, 2020) Therefore, they should be used in an unmanned environment; this is not feasible in EMS transport.

SURFACE TREATMENTS

Treating a surface inside an ambulance is another form of infectious disease control. "Biocides are chemical substances or microorganisms which can deter, render harmless, and kill living organisms. They are used to control and kill harmful and unwanted organisms such as mould [*sic*], bacteria, algae, insects, and rodents." (Schmitz-Felten, 2017) There are self-disinfecting surfaces that mimic biocidal effects, as well as traditional biocidal treatments applied to surfaces.

"The biocidal effect demonstrated by AGAT Laboratories (ISO 22196)
AGAT Laboratories has undertaken to evaluate the antibacterial activity anodized aluminum surface treated with UmanProtek under the standard ISO 22196. To this end, some anodized aluminum surfaces treated by UmanProtek has *[sic]* been put into contact with two types of pathogens bacteria: staphylococcus aureus and E. coli. After 10 minutes, viable bacteria level by cm2, which use to start around 7000 and 10 000, has dropped by 99%. There were literally no remaining bacteria colonies while control surfaces were showing stagnant or increased viable bacteria level by cm2." (A3 Surfaces, 2019)

Since many biocide disinfectants are non-specific and kill a wide range of microorganisms, they should be used with caution. It is important to know exactly what viruses and bacteria a disinfectant can kill, and ensure the proper solution is selected for the right application.

Self-disinfecting surfaces, such as those made with an antimicrobial coating of anodized aluminum, copper, or silver nanoparticles, produce their own anti-bacterial effect. Antimicrobial additives can also be added to powder coat paint finishes, helping to prevent and protect surfaces against bacteria growth and destructive microorganisms. As these surface treatments are "built-in" and offer ongoing protection, they are the preferred option for use in ambulances.

There are quite a few surface treatment options that are helpful in infectious disease control. **CrestClean** is an antimicrobial coating proprietary to Crestline that prevents and protects interior surfaces from growth of bacteria and destructive microorganisms. **UmanProtek** is an antimicrobial anodized aluminum surface treatment that is self-disinfecting. **Aegis®** is a surface protectant that creates an inhospitable environment for microbes and can be bonded to virtually any surface. **Lamilux Antibac** is a fibre-reinforced polymer with special silver nanoparticle surface that produces an anti-bacterial effect. **CuSalus** is an antimicrobial copper alloy for touch surfaces. If you are interested in applying any of these surface treatments to your ambulance with the assurance of continued functionality, warranty, and certification, we encourage you to contact us.

5. INTERIOR MATERIAL OPTIONS

An ambulance module contains a variety of materials, including upholstery, cabinetry, flooring, and more. Infectious disease control should be considered for each material used inside the module.

UPHOLSTERY

Upholstery for seats, trim work, padding, and other areas in an ambulance are a potential breeding ground for bacteria, viruses, and fungi. Incorporating one-piece upholstery with no stitching or Velcro is recommended. It is easier to clean and reduces the risk of bacteria growth. Vacuum formed seating is often a standard in ambulances for this reason.

Vinyl is the preferred material choice. Vinyl is easy to clean. The nonporous material adds a significant benefit to infection control in healthcare settings. (Infection Control Today, 2000)

Valor First Responder offers vinyl, vacuum formed seating solutions for ambulances. In addition, they provide surface treatments using AEGIS® Microbe Shield, an antimicrobial surface treatment that renders surfaces inhospitable for germs and makes it easier to clean. If you are interested in learning more about this seating option, we encourage you to contact us.

CABINETRY

Ambulance cabinetry is another potential area that can harbor unwanted pathogens. Consider cabinetry material that is nonporous, such as aluminum, that can be easily sterilized. Rounded corners allow for a smoother surface to fully wipe down and disinfect. Hardware without holes creates less crevices for pathogens to collect. It also allows the cabinetry to fully seal, reducing viruses, bacteria, and bodily fluids from penetrating cabinets and contaminating supplies.

FLOORING

Vinyl flooring should strongly be considered inside an emergency vehicle. As with vinyl in other areas of the unit, the non-porous material is easier to clean. If it is affixed to the floor, a coved shape extending up the walls of the interior can enhance cleaning. A removable, roll-up floor is also an option, allowing EMS personnel easier access to the underlayer for full decontamination of the unit. As with rounded corners on the cabinetry, rounded corners on the floor enhance accessibility, making it easier to get to an area for cleaning.

WHAT CONSIDERATIONS SHOULD BE GIVEN FOR EQUIPMENT AND SUPPLIES INSIDE THE VEHICLE?

Sometimes referred to as a mobile hospital, an ambulance must contain a significant amount of equipment and supplies. Even on BLS (Basic Life Support) ambulances, there is ventilation and airway equipment, monitoring and defibrillation equipment, immobilization devices, bandages, communication tools, and more. (American College of Surgeons, 2009) There is a lot to keep clean and free of contamination in any emergency vehicle.

When possible, equipment and supplies should be stored inside fully sealed cabinetry and/or compartments. If vented outside the module, exterior compartments offer an acceptable storage location for equipment and supplies to be sealed off as well. Equipment that must remain in reach on countertops or mounted to the module should be wiped down often with approved disinfectants or protected with a covering that can be replaced between patients or cleaned.

WHERE TO STORE PPE IN AN AMBULANCE

During a pandemic like COVID-19, EMS personnel should be especially cautious about how they access and dispose PPE to avoid cross contamination. Consideration should be given to separating new PPE from used PPE; best practice recommends designating two unique storage areas within the ambulance. An exterior compartment is a great place to store used PPE until it can be disposed of properly.

Organizations may also consider purchasing equipment that has its own built-in infectious disease control elements. The COVID-19 pandemic has pushed many manufacturers to introduce new products and options for existing products that are welcome improvements for infection control. For example, stretchers can be fitted with a protective screen to reduce the spread of respiratory droplets during patient transport.

Techni-Shield Defender is a new product from LeSoleil, designed to attach to an existing stretcher to reduce the spread of droplets from a patient in transport. Manufacturers such as **Ferno** and **Stryker** are also offering similar solutions.

CONCLUSION

Modern EMS has a relatively short history, but one marked by an unwavering commitment to continuous improvement. Protocols, design and build standards, and other considerations are constantly evolving to enhance patient care and safety, along with the safety of EMS personnel.

Demers-Braun-Crestline has championed that history, leading the industry in innovation, design, and safety for over 100 years. Today, we are expanding that legacy to provide thought leadership for ambulances and infectious disease control. This document was intended to highlight information, resources, and considerations for high-risk infection control and ambulance decontamination. It should serve as an introductory guide for organizations overwhelmed by where to start with enhancing infectious disease control in an ambulance.

The content of this white paper, such as text, images, and other materials, are for informational purposes only, and does not constitute advice or an endorsement. Demers-Braun-Crestline does not make any statement or express opinion regarding the scientific positions and statements from organizations, agencies, corporations, or individuals. We encourage readers to seek personalized, expert advice on products, methods, and procedures mentioned in the enclosed.

Techni-Shield Defender est un nouveau produit de LeSoleil, conçu pour s'attacher à une civière existante afin de réduire la propagation des gouttelettes d'un patient pendant le transport. Des fabricants tels que **Ferno** et **Stryker** offrent également des solutions similaires.

Our mission is to provide effective, compliant, validated solutions that every emergency response organization should consider for protecting patients and personnel from infectious diseases. We are here to assist our customers in selecting the right technology to meet their needs.

For additional information, please review the cited resources in detail.

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