

DISINFECTION IN A FLASH

# Smart Disinfection for Schools and Universities



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# Introduction

Every year, millions of school days are missed by students due to colds and the flu. Excessive student illnesses and high rates of absenteeism have led to schools being closed for facility-wide disinfection. Entire school systems and college campuses nationwide have had to shut down due to the COVID-19 pandemic, and in the past, even Norovirus outbreaks.

While exposure to infectious diseases often occurs through person-to-person contact, there is extensive evidence that environmental exposure to pathogens can also transmit illnesses. Many bacteria and viruses can remain viable on surfaces in classrooms, gyms or fitness centers, cafeterias, and health service centers/clinics for hours, weeks or even months, placing students and staff at risk for exposure.

This white paper, written by PURO Lighting's technology partner Violet Defense, lays out the challenges that schools and universities face in helping keep their campuses, students, educators and staff safe from harmful germs, and how advancements in UV disinfection technology will change the way they think about protecting their environments.

## The Cost of Student Illnesses



The average American child has 6-10 colds a year.<sup>3</sup>

The 2017-2018 flu season was among the deadliest in decades, taking the lives of 80,000 Americans last winter,<sup>1</sup> including 185 children.<sup>2</sup> Amidst the news of widespread outbreaks, there were frequent reports of schools or entire districts having to shut down when more than 20% of students and staff became ill. In 2020, amidst the COVID-19 pandemic, the chance of students, teachers and staff could spread the disease throughout their schools, families and communities was clearly evident.

Stopping the spread of illnesses in a school environment is a challenge throughout the year. The average American child has 6-10 colds a year.<sup>3</sup> Colds are often caused by rhinoviruses, infectious organisms that can survive on surfaces for hours. Another threat to students and staff is gastroenteritis, often referred to as the “stomach flu,” which is commonly caused by norovirus.

As a result, students miss nearly 22 million school days each year due to colds and 38 million due to the flu.<sup>4</sup> However, this may be a conservative estimate, as a study conducted after the 2012-2013 flu season, which at the time was one of the most severe in a decade, found children missed more than 90 million school days.<sup>5</sup>

Missing even a little bit of school can have a huge impact on student learning as “lost learning time, particularly in the younger grades, translates into weaker math and reading skills that become long-term deficits for students even years down the road.”<sup>6</sup>

Furthermore, student absences can have budgetary implications for certain schools. Several states rely on average daily attendance, either in whole or in part, to determine a school or district’s budget. With rates reported as high as \$40 per student per day, districts risk losing hundreds, thousands, or even millions to high absenteeism.<sup>7</sup>

With these types of high stakes — children’s health, long-term academic success, and the financial wealth of school districts to meet the needs of all of their students — schools should deploy every means necessary to keep students healthy and in the classroom.

In addition to primary and secondary schools, higher education institutions also face risks due to illness outbreaks. In February 2018, over 40 students at the University of Wisconsin-Oshkosh contracted norovirus.<sup>8</sup> Two months later, Western Connecticut State University shut down classes after over 100 students fell ill to the same virus.<sup>9</sup>

College campuses have numerous areas that can be vectors for the transmission of diseases, ranging from classrooms and student centers to gymnasiums, cafeterias, and the student health centers. Enhanced sanitation of these spaces is typically included as a part of the efforts to stop outbreaks from spreading further, as well as increased education and encouragement of hand-washing and personal hygiene.

## Areas to target for enhanced disinfection



Gyms &  
Locker Rooms



Bathrooms



Classrooms



Kitchens &  
Dining Areas



Nurse's Clinic or  
Health Centers



# The Threat to Student Athletes

Another health threat that many schools and universities face is keeping athletes safe from infections, including those caused by MRSA, an antibiotic-resistant strain of *Staphylococcus aureus* that causes skin infections. Due to the difficulty in treating MRSA, it can easily lead to serious complications, including pneumonia, sepsis, or even death.

There are not currently requirements to report all “community-acquired” skin infections, making reliable statistics about the actual scale of this threat hard to come by, though experts claim that cases have become more common in recent years.<sup>10</sup> Often times, schools implement intensive disinfection after a single case is reported, helping prevent further spread. However, there have been schools with over a dozen students affected by Staph infections at a time before the outbreak could be stopped.

Researchers have specifically investigated the level of MRSA colonization in athletic facilities. The University of Central Missouri took 108 samples from the football locker room and weight room and found that 26 (24%) contained *methicillin-susceptible S aureus* (MSSA) and 33 (31%) contained *methicillin-resistant S aureus* (MRSA).<sup>11</sup>

According to the CDC, MRSA cases are more likely when the “5 Cs” occur: crowding; skin-to-skin contact; compromised skin (cuts or abrasions); contaminated items and surfaces; and lack of cleanliness.<sup>12</sup>



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As skin-to-skin contact is one of these key factors, athletes participating in contact sports are even more likely to carry MRSA than non-contact sport athletes. Vanderbilt University found that contact-sport athletes had a *S. aureus* colonization rate range of 32%-62%, as compared to the lower occurrence range in non-contact sport athletes (18% and 53%).<sup>13</sup>

In general, fitness equipment is known to have significant amounts of bacteria. Exercise bikes and treadmills have been tested to have over 1.3 million colony forming units (CFU) of bacteria, and free weights had as many as 1.2 million CFU, which is 362 times the CFU found on a public toilet. Of the bacteria found on exercise equipment, 70% was determined to be harmful to humans.<sup>14</sup>

# Traditional Environmental Disinfection

Historically, the role of the environment in the transmission of diseases was underplayed or at least not well understood. However, ample evidence now exists that demonstrates the contributory role that environments can play in the transmission of illnesses.

One critical factor to the transmission of pathogens via the environment is that many of them can persist on surfaces for hours, weeks, months, and even some reports of years. For example, the survival time for MRSA has been documented to range from 7 days to 12 months, and up to 46 months for VRE.<sup>15</sup>

“It is now recognized that the environment can facilitate transmission of several important health care-associated pathogens.”

Stephanie Dancer  
Department of Microbiology  
Hairmyres Hospital

Given the nature of their business, hospitals have extensive experience cleaning and/or disinfecting environmental surfaces. Their policies dictate the frequency and type of cleaning conducted based on clinical risk, patient turnover, contact surfaces, and other factors. Additional measures may be taken if the patient was known to be colonized or infected with a specific pathogen, such as *C. diff* or MRSA.

Despite the awareness of the importance of proper disinfection, hospitals (and other settings) often do not achieve the levels of cleanliness necessary to protect patients or staff. Carling conducted a study in acute-care hospitals and found that only 49% of evaluated surfaces had reached the desired compliance with the cleaning standards.<sup>16</sup>

This is a result of several challenges that exist with manual cleaning processes. Regardless of what environment is being cleaned, staff face a significant challenge of complying with the saturation requirements of most chemical disinfectants. To achieve the effective kill rates claimed by chemicals or disinfectant wipes, many of them must be applied such that the surfaces are visibly wet for extended periods of time. In fact, many EPA-registered disinfectants for hospital use require a contact time of 10 minutes to be effective.<sup>17</sup>

Many household consumer products, such as disinfecting wipes require 3-4 minutes or more of remaining wet on the surface for effective kills, which few people know or follow.

Furthermore, chemical disinfectants pose health risks to those using them and can potentially contribute to microbial resistance. In 2016, the U.S. Food and Drug Administration issued its final ruling related to over-the-counter consumer antiseptic wash products containing certain active ingredients. The ruling stated that manufacturers were unable to demonstrate that their ingredients were safe for long-term daily use, nor that they were more effective than plain soap and water in preventing illness and the spread of certain infections.

The agency issued the ban after reviewing data that suggested that exposure to certain ingredients, including triclosan and triclocarban could pose health risks in humans, such as bacterial resistance and hormonal effects. The ban required these products to be pulled from the market.<sup>18</sup>

## Benefits of UV Disinfection

One thing nearly all illnesses have in common is that they can be spread by touching contaminated surfaces, from toys, shared supplies, door handles, or other high touch areas.

While extensive disinfection becomes part of the response to widespread illnesses or infections, it is not standard protocol for most campuses. However, there have been increasing number of schools that are taking a more preventive approach. Vineland Public Schools in New Jersey conduct high-level disinfection on a daily basis, versus other area districts that typically only deploy more stringent cleaning protocols after an outbreak occurs.<sup>19</sup>

However, additional manual cleaning can be a very labor-intensive effort given the number of classrooms, surfaces, and objects within a school. Given the health risks of chemicals, as well as the inability to consistently achieve the necessary disinfection levels, many hospitals and other healthcare settings have begun incorporating additional automated decontamination devices.



With over 140 years of research behind it, UV light has been proven effective at killing bacteria, viruses, mold, and fungi.

While not a “new” disinfecting technology, UV light has rapidly been growing in use in hospital settings as it is a proven disinfectant for surfaces, instruments, and air. With over 140 years of research behind it, UV light has been proven effective at killing bacteria, viruses, mold, and fungi.

Ultraviolet light attacks microorganisms at the DNA and RNA level. Microbes are not able to develop resistance to ultraviolet light, compared to their ability to form resistance to certain types of chemical disinfectants.

Ultraviolet light has been repeatedly proven effective against pathogens, including *C. diff*, MRSA, *E. coli*, Salmonella, Norovirus, and many more. The ability of UV light to kill microorganisms is directly related to the energy dosage produced by the UV source as a function of spectrum, time and distance to the target.

UV light, particularly UV-C, has also been shown to have great benefits when combined with other cleaning methods for optimal results. Researchers at Duke University and the UNC Schools of Medicine found an additional 94% reduction in epidemiological-important pathogens when UV was added to the standard use of quaternary compound disinfectants.<sup>20</sup>

Another potential benefit is the ability to reduce the labor and/or cost of chemical cleaning. A study using pulsed UV for routine once-daily disinfection of hospital surfaces cut the number of housekeeping hours required in half, compared to using alcohol wipes in manual cleaning.<sup>16</sup>

Given its effectiveness and health benefits, UV technology has begun to expand beyond healthcare facilities. Advancements in the technology have made it more viable and cost-effective to deploy UV in everyday spaces. For example, the Jewish Academy of Orlando has installed germ-killing UV lights from PURO Lighting's technology partner, Violet Defense, throughout its school, including units in its nurse's clinic, classrooms, and other shared spaces on campus. These units automatically disinfect the school every night.

Using this technology, it is estimated that an average size classroom of 25 students could implement automatic disinfection with UV for approximately 57 cents a day per student (assuming a 180-day school year).



# Conclusion



Ultraviolet light has an extensive history of effectively killing microbes in the air and on surfaces,

Ultraviolet light has an extensive history of effectively killing microbes in the air and on surfaces, which has been proven to reduce the infection rates of MRSA, *C. diff*, VRE and other harmful pathogens.

As a result of the miniaturization of this technology, it is now possible to deploy UV disinfectant technology in dramatically more settings than ever before, thereby creating cost-effective deployments to fight off harmful germs, particularly when used in combination with existing cleaning protocols.

Given the variety of threats schools face with regard to illnesses, including cold, flu, and norovirus, as well as threats to their student athletes from superbugs like MRSA, ultraviolet light should become a key component of cleaning protocols throughout school campuses.

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## ABOUT PURO UV DISINFECTION LIGHTING

Launched in 2019 in Lakewood, Colorado, PURO™ Lighting products, powered by Violet Defense™ technology, have set out to take proven UV light disinfection technology to the next level by making it more powerful, more affordable and most importantly, smaller and easier to utilize. PURO Lighting products can rapidly disinfect any room of any size and at any time using the proprietary miniaturized, pulsed Xenon Light Engine System. Our high intensity broad-spectrum UV disinfection units rapidly kill up to 99.9% of viruses and bacteria and can significantly reduce the growth of fungi such as yeasts and molds. All in remarkably small, yet powerful fixed or mobile units designed for any sized space. For more information, visit [www.purolighting.com](http://www.purolighting.com).

## ABOUT VIOLET DEFENSE

Founded in 2012, Violet Defense is on a journey to find new ways to protect people from harmful germs that have grown resistant to traditional forms of cleaning and disinfecting. Its patented technology is the only known Pulsed Xenon UV solution that can be installed into a room full-time, creating continuous way to address disinfection needs of all types of settings, including healthcare and non-healthcare alike. Designed to bring hospital-grade disinfection to everyday spaces, Violet Defense has cost-effective solutions to kill up to 99.9% of bacteria and viruses, including *E. coli*, Salmonella, MRSA, Norovirus and *C. diff*. For more information, visit [www.violetdefense.com](http://www.violetdefense.com).



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