Notes for PPP

Slide 1: Why is Sterilization or Sanitization important?

- Helps reduce hospital opportunistic infection
- Stop spread of bacterial and viral diseases
- Deodorizing
- Control fungi… mold and fungus

Notes: Add graphics of hospital or school class room, or a metro transit station

Slide 2: Quantify the numbers:

1) CDC estimates one in 20 patients will contract an HAI (Healthcare Associated Infection) every day – Economic burden of HAI reached $35.7B a year.
2) 6-8 times for a child in elementary school, 3-4 times for a teen
3) Grocery store shopping carts have 138,000 total bacteria per sq. inch, more bacteria than a public rest room.
4) Cell phones have 10 times more bacteria than public toilet seats
5) Every 60 sec, a working adult touches as many as 30 objects which may be contaminated by bacteria or virus causing infectious disease.
6) Office toilet seats, desktops, and phones have **49,21000** and 25,000 germs per square inch respectively

Notes:

References:

School – CNN

Grocery Store: University of Arizona http://www.foodprotection.org/files/food-protection-trends/Dec-12-Maxwell.pdf

Cell Phone: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5719508/

https://cals.arizona.edu/news/why-your-cellphone-has-more-germs-toilet

Slide 3: Why is UV important?

1) No residue: Eco-friendly
2) CDC, FDA listed strong disinfectant agent
3) Proven technology in US and Europe
4) Air and surface purification
5) Safe, easy and cost effective

6) Less human exposure to bacteria and virus

Slide 4: How does it work?

- Break the DNA of bacteria, virus and spores
- Damage the nuclei and therefore prevent further cell replication or growth

Notes: Get pics

Slide 6: Importance of Ozone along with UV

1) Ozone is a strong oxidizing agent that can kill pathogens in air and on surfaces.
2) Reaches every part of the room where UV cannot reach

	UV	**Ozone**
Standard?	UV kill rate at least 99.9% on the first pass as per NSF/ANSI under Std 50, Chapter 14	UV kill rate at least 99.9% on the first pass as per NSF/ANSI under Std 50, Chapter 13
How does it work?	Photolysis: Breaking the molecular bonds and rearranging them.	Oxidation: Ripping electrons in pathogens and breaking their cellular walls *Ozone destroys viruses by diffusing through the protein coat into the nucleic acid core, resulting in damage of the viral RNA. At higher concentrations, ozone destroys the capsid or exterior protein shell by oxidation*
Wavelength range	254 nm is proven germicidal while other wavelengths (185nm-450nm) are needed to kill certain kinds of bacteria, virus, and fungi	100-200nm, specifically 185nm ionizing energy efficiently generates ozone converting O2 to O3
Time taken	Depending on the line of sight, surface, distance from the source and the pathogen kill rate	Depending on the humidity and temperature
Recovery time to re-enter	Instantaneous	30 sec to dissipate the Ozone to safer limits (under 0.5 ppm)
Limitations	Cannot reach the hidden areas where light cannot reach	Ozone doesn’t accumulate, so the kill rate doesn’t necessarily depend on the running time of the lamp

Human Exposure	Do not look at the source directly without protective eyewear	FDA regulation is 0.5ppm for more than 5 hours of exposure
Recommended Operation	No human presence when in operation	No human presence when in operation

Notes: Ozone is a strong oxidation agent that rips electrons in the pathogens and break their cellular walls. Ozone destroys viruses by diffusing through the protein coat into the nucleic acid core, resulting in damage of the viral RNA. At higher concentrations, ozone destroys the capsid or exterior protein shell by oxidation

Slide 7: UV + Ozone Vs traditional chemical agents (Generic information, Optional Slide)

	Chemical Agents	UV + Ozone
Advantages	- Easy to use - Relatively inexpensive - Not a lot of training for standard agents like Lysol®	- Less human interaction - No residue, eco-friendly - Advanced, and proven - Can disinfect both air and surfaces - Low maintenance cost (low power bills) - No refills needed, less expensive to operate - Deodorizes while disinfecting
Disadvantages	- Limited reachability - More labor and more time - Lung issues for prolonged exposure - Need refills	- Initial capital cost - No human presence when in operation unless protective gear is used

Notes: The energy of germicidal UV photons at 254 nm wavelength is 470 kJ/mol and is higher than the average chemical bond energy (bond enthalpies) of all of the chemical compositions in keratin and cysteine.

Slide 8: Side Effects of UV and Ozone

1) Prolonged exposure causes skin irritation and, in rare instances possibly cancer
2) Temporary or permanent damage to eye when looked at the source with naked eye
3) Prolonged exposure to Ozone causes respiratory issues.

Notes: FDA regulation is 0.5ppm Ozone in the air, which can be attained after 40sec from the Sterile-Bright™ lamp in a 20’ x 20’ x 9’ space without ventilation after being turned off.

Slide 9: Sterile-Bright™

1) STERILE-BRIGHT™ is a full-range UV/Ozone generator, capable of neutralizing bacteria, viruses, fungi, and spores
2) Ionizing UV-C below 200nm to 181nm .

Slide 10: Sterile-Bright™ vs Competition (UV-C solutions)

	Sterile-Bright™	**Competition**
Range	UV-A, UV-B, UV-C and Vacuum UV (181nm-200nm wide range)	UV-C (254 nm) only
Sterilization	Yes	Yes but partial
Oxidation	Yes	No
Spores, Mold, Algae	Easy to achieve at 100mJ/cm2 in less than few mins @ 254nm and under 60 seconds with ionizing energy under 200nm	Hard to attain 100mJ/cm2 that can kill spores and other hard-to-kill pathogens; insufficient energy
Ozone	Yes	No
Longevity	100,000 working hours	10-10,000 working hours
Intensity/Irradiation	30mW/cm2 at 254nm, other board range intensity + Ozone	Maximum 30mW/cm2
Degradation	10% in 11 years	30% in 3 months
Time Taken	Less than 3 mins for a 12x12x10ft room	15 mins for a 12x12x10ft room
Side Effects	None	Decay of polymers
Capital investment	Less number of units with better kill rate and faster times to disinfectant a facility	More number of units and personnel needed to disinfectant a facility due to its slow operation
Cost	Modest	Expensive

Slide 11: Test Results

1) Wash U
2) RPI Lighting Research Institute
3) Naveen Home results
4) USA ambulance test data

Slide 12: Safety Features and Precautions needed

1) Occupancy sensors
2) Ozone detection and control
3) Exposure control
4) Protective gear

Slide 13: Applications and Product Line

Applications:

1) Healthcare, Hotels, Cruises
2) Airlines, public transportation, public restrooms
3) Shopping malls, restaurants
4) Warehouses, manufacturing facilities

Product Line:

1) Portable cage
2) Troffer
3) HVAC
4) Mobile

Slide 14: References

1) Science magazines
2) Medical journals