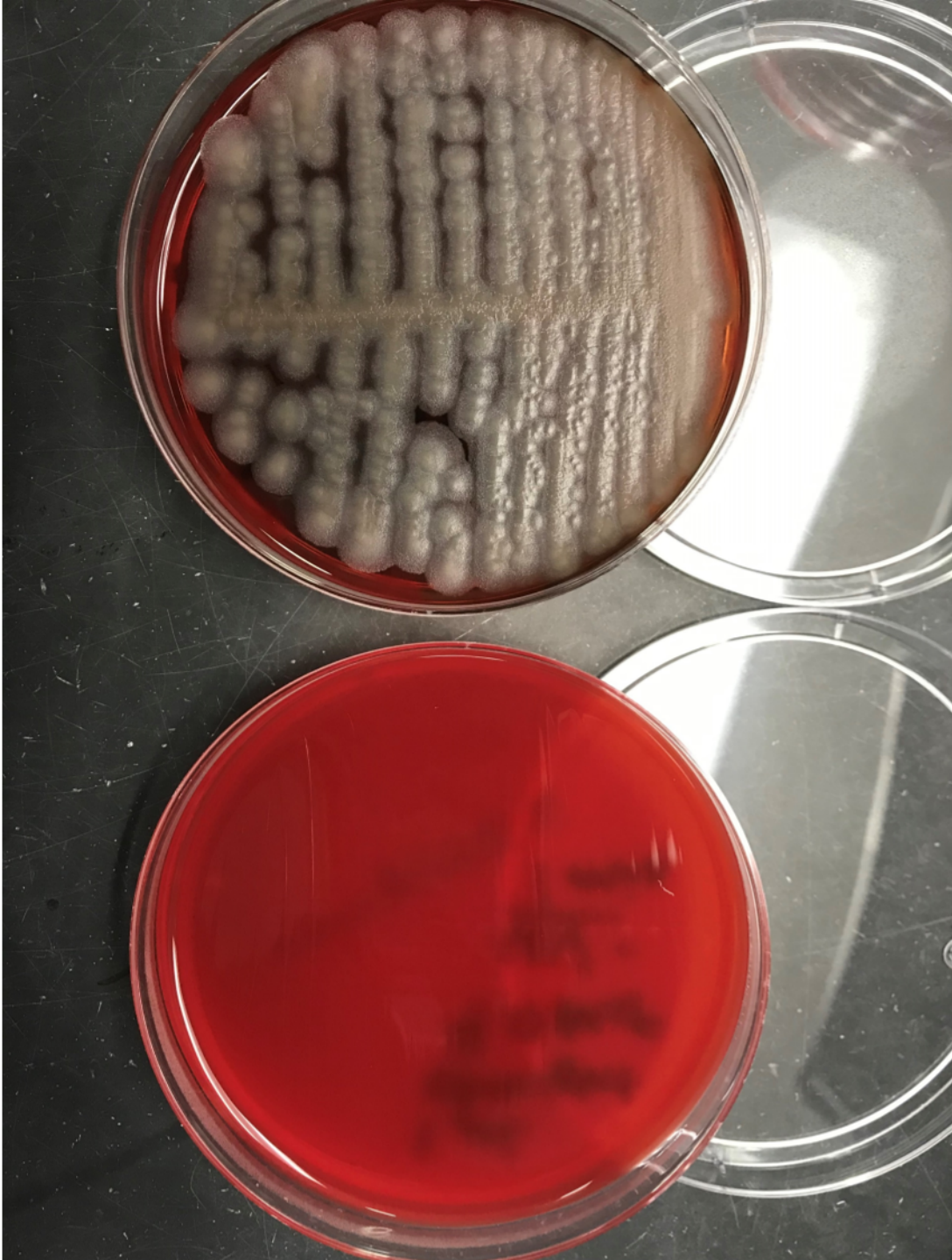


# DYI PPE Disinfectant Methods

*Andrea Armani*

*This webinar will be recorded  
and shared after.*



# Research Group Members

## Post-docs/Graduate Students



## Undergrad Students



## Collaborators

Jerry Lee  
David Agus  
Mary Galinski  
Qiming Wang  
George Hatch  
Yuji Zhao  
Rosemary She  
SMP Engineering  
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## More info



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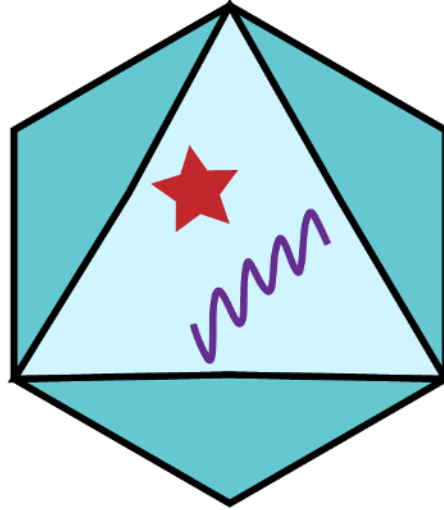
armanilab



**NORTHROP GRUMMAN**

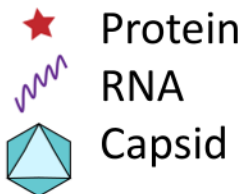


# What is viral disinfection?

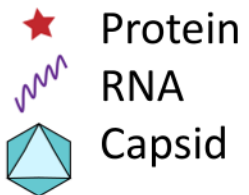
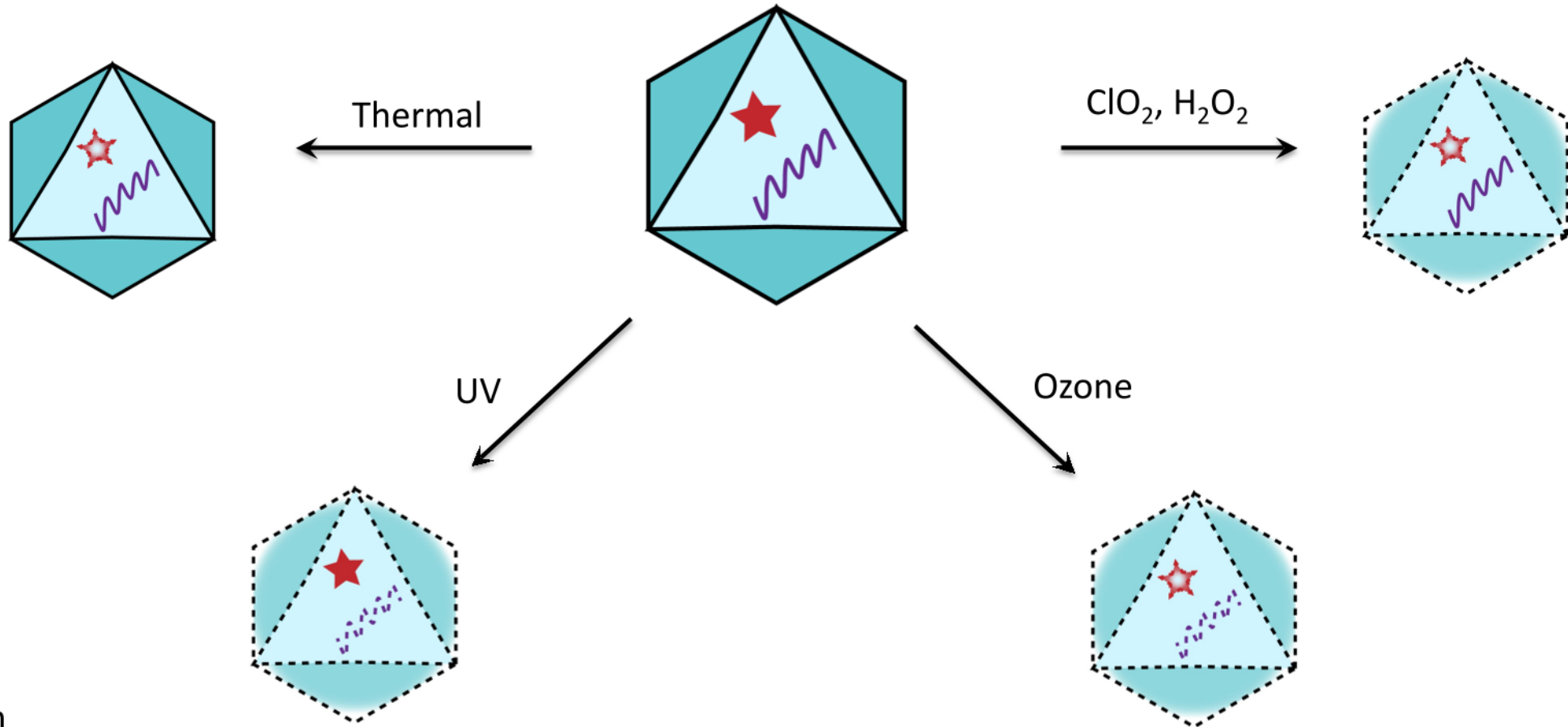


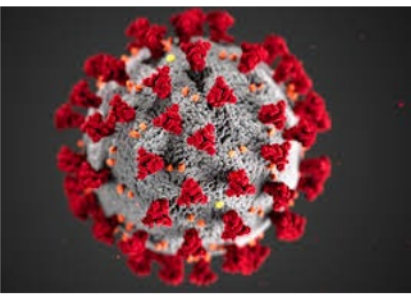
## Key features for viral function:

- Protein for “target” identification
- RNA (or DNA, if bacteria) for replication
- Capsid for protection



# Approaches for (viral) disinfection





# Looking past COVID-19

28% fewer deaths from antibiotic resistance in hospitals (since 2013 CDC AR Threats Report); however, community spread has increased.

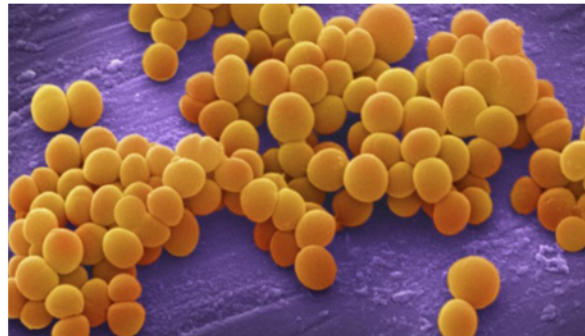
**“More action is needed across settings, industries and countries to fully protect people from antibiotic resistance threats.” – 2019 AR Threat Report, CDC**



E. coli



Pseudomonas aeruginosa



Staph



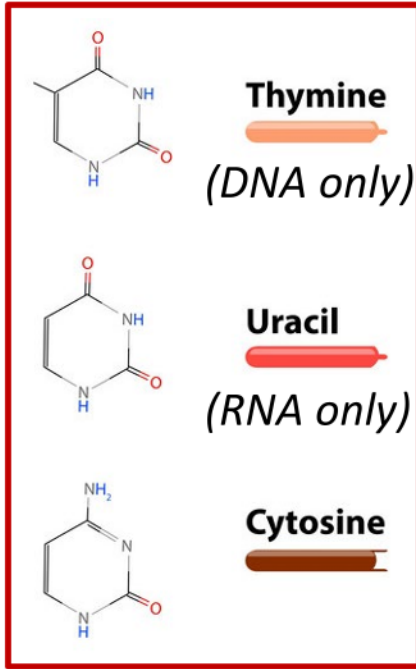
Salmonella

# Why does UV-C work? Biology

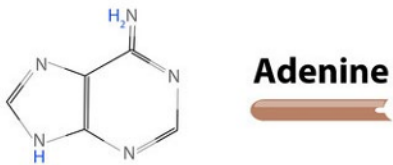
**DNA**  
(bacteria)



**Pyrimidines**



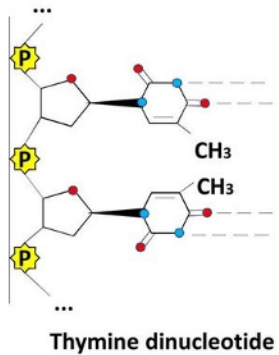
**RNA**  
(virus)



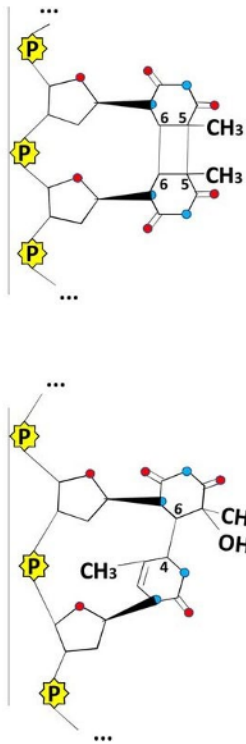
Pyrimidines are in both bacteria (DNA) and virus (RNA), so anything that impairs DNA or RNA will impact both.

# Why does UV-C work? Biology

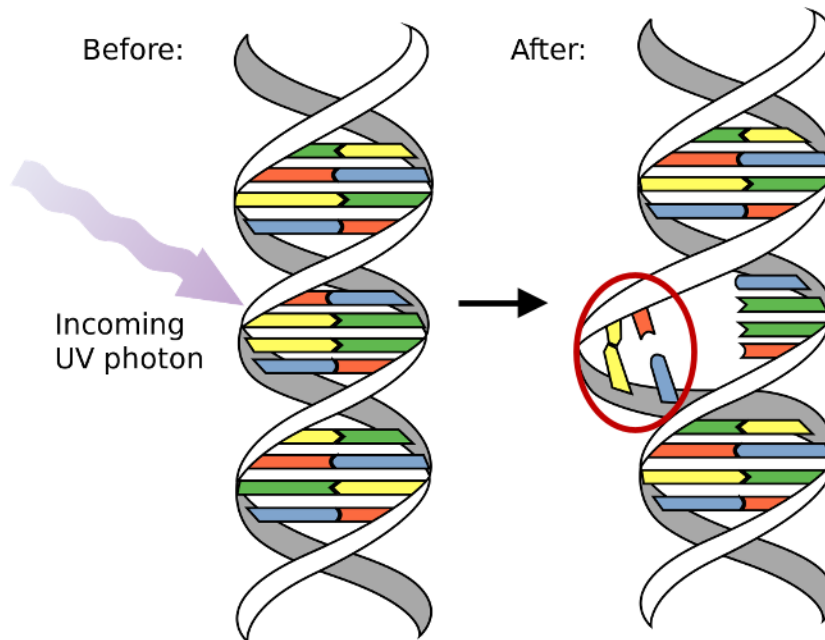
Expose either DNA or RNA to UV-C



UV light



Pyrimidine dimers form



UV-C works with both bacteria and viruses.

Dimers change the structure, causing transcription errors (and other things), ultimately resulting in death

# UV-C disinfection approaches



- Designed for small medical instruments
- Fixed source for replacement parts (e.g. sole supplier on UV-C bulbs)

Conventional UV-C disinfection system



Biosafety cabinet  
(research setting)

- Automated disinfection cycle built-in
- Larger chamber allows for larger items
- No safety precautions or shields



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## EPA/FDA guidelines:

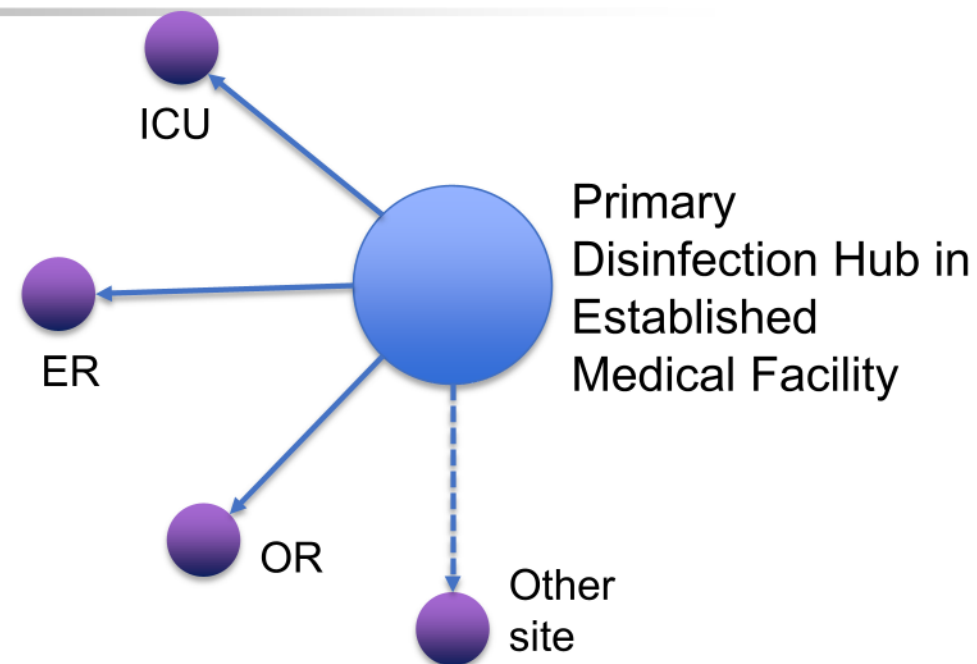
- Dose for virus:  $\sim 100\text{mJ}/\text{cm}^2$
- Dose for bacteria:  $\sim 10\text{mJ}/\text{cm}^2$

# Distributed UV-C disinfection

**Goal:** Create, lightweight, inexpensive, easily-manufacturable system that could be used to create a distributed network of “localized disinfection stations”.

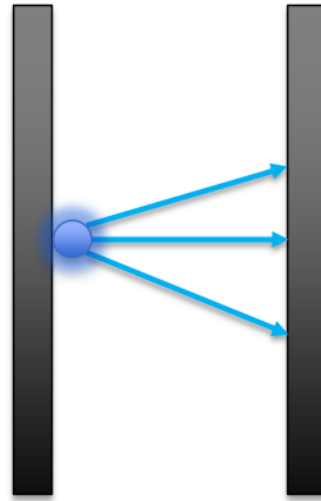
Key design criteria (FDA/others):

- Achieve  $>100\text{mJ}/\text{cm}^2$  of UV-C intensity
- Lightweight, inexpensive, portable
- 3 log reduction in growth (FDA standard)

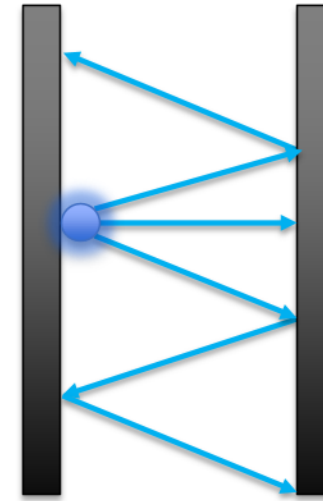


# Digging into the science a little: Why chrome?

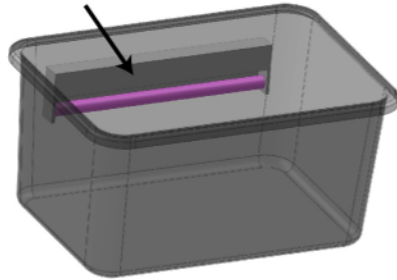
No interior coating  
(no reflection)



66% reflectivity



UV-C bulb and mount



Chrome (=Al) provides up to 90% at 260nm

# Test system



Used plastic petri dishes as mimic



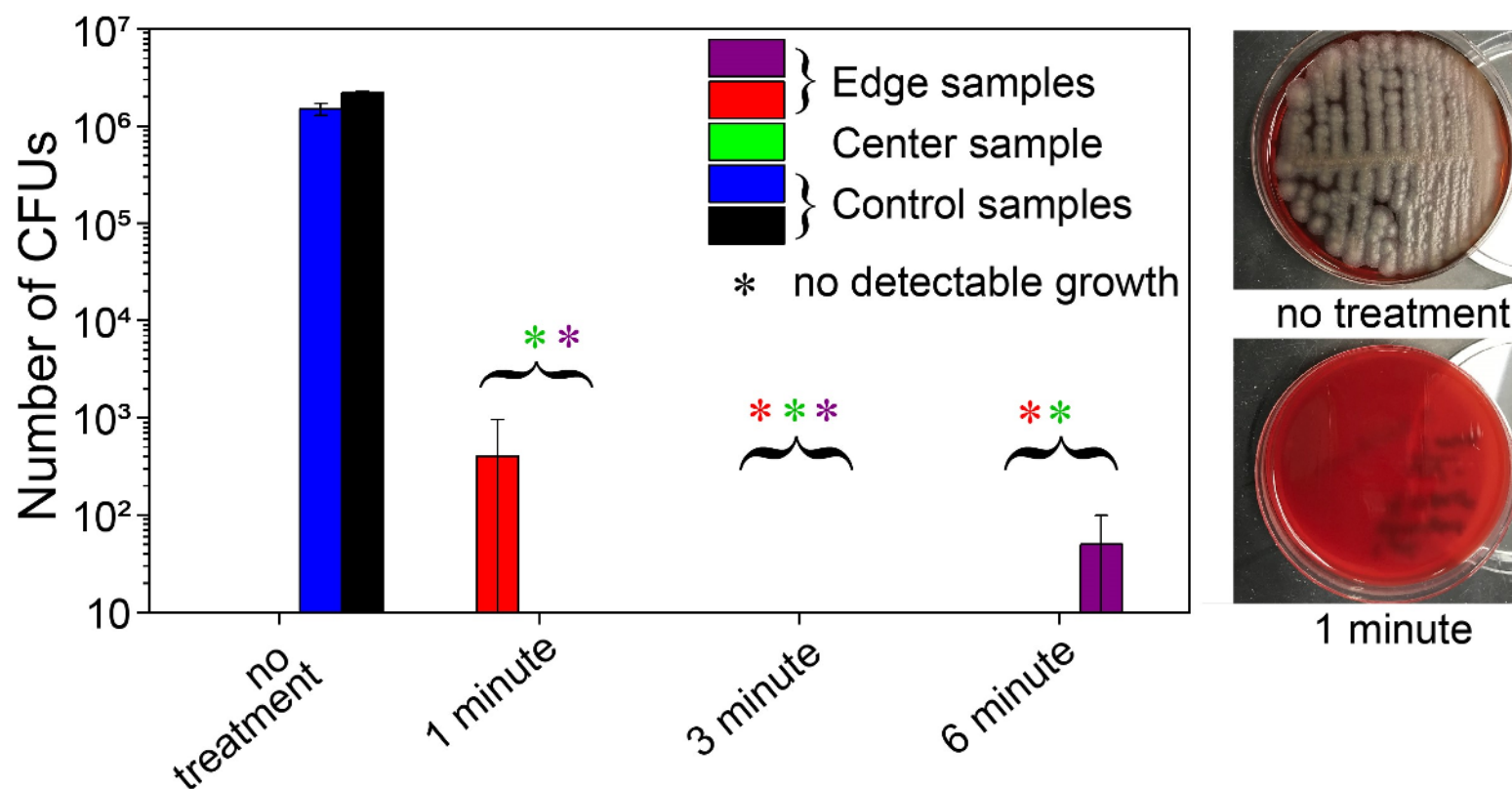
*Bacillus cereus* as test system  
(gram +, endospore forming, UV resistant)



After exposure, transfer to agar, let grow from 24hrs, then count colonies



# Achieved goal!



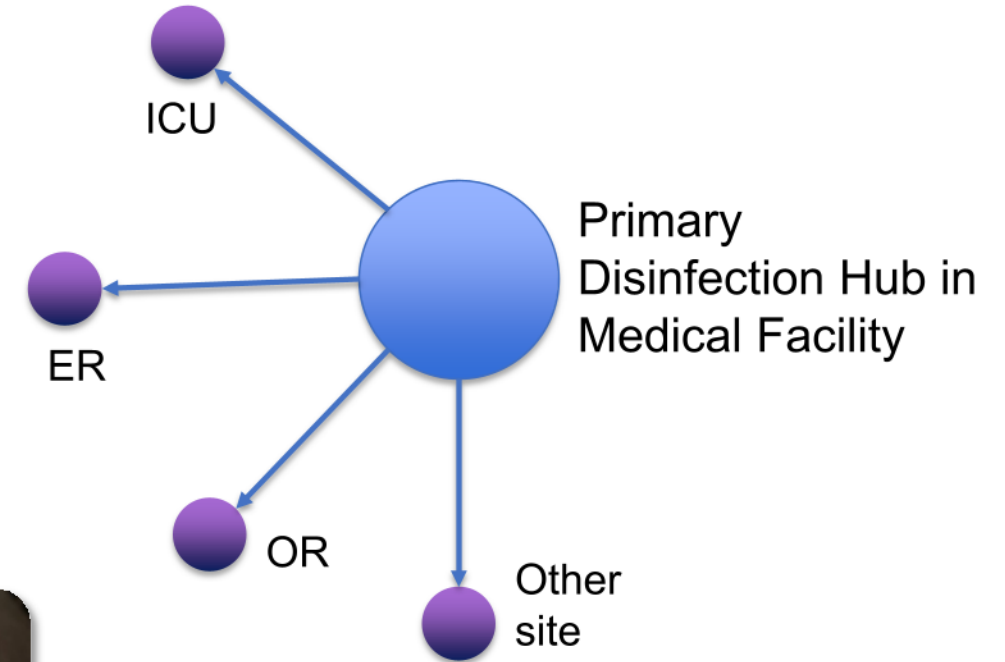
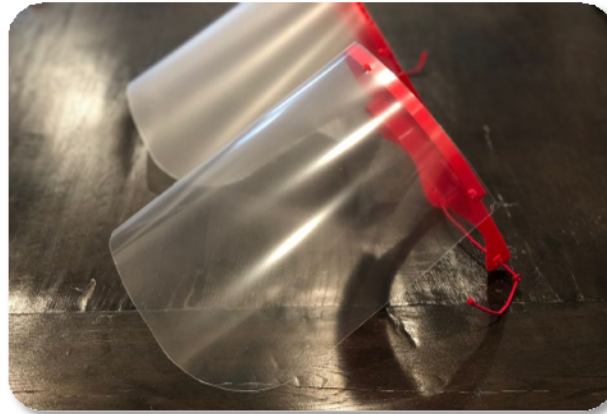
>3 log reduction with 1 minute exposure!

Specs at: <https://armani.usc.edu/>

# Then what?



Plus reusable PETG face shields to create an ecosystem.



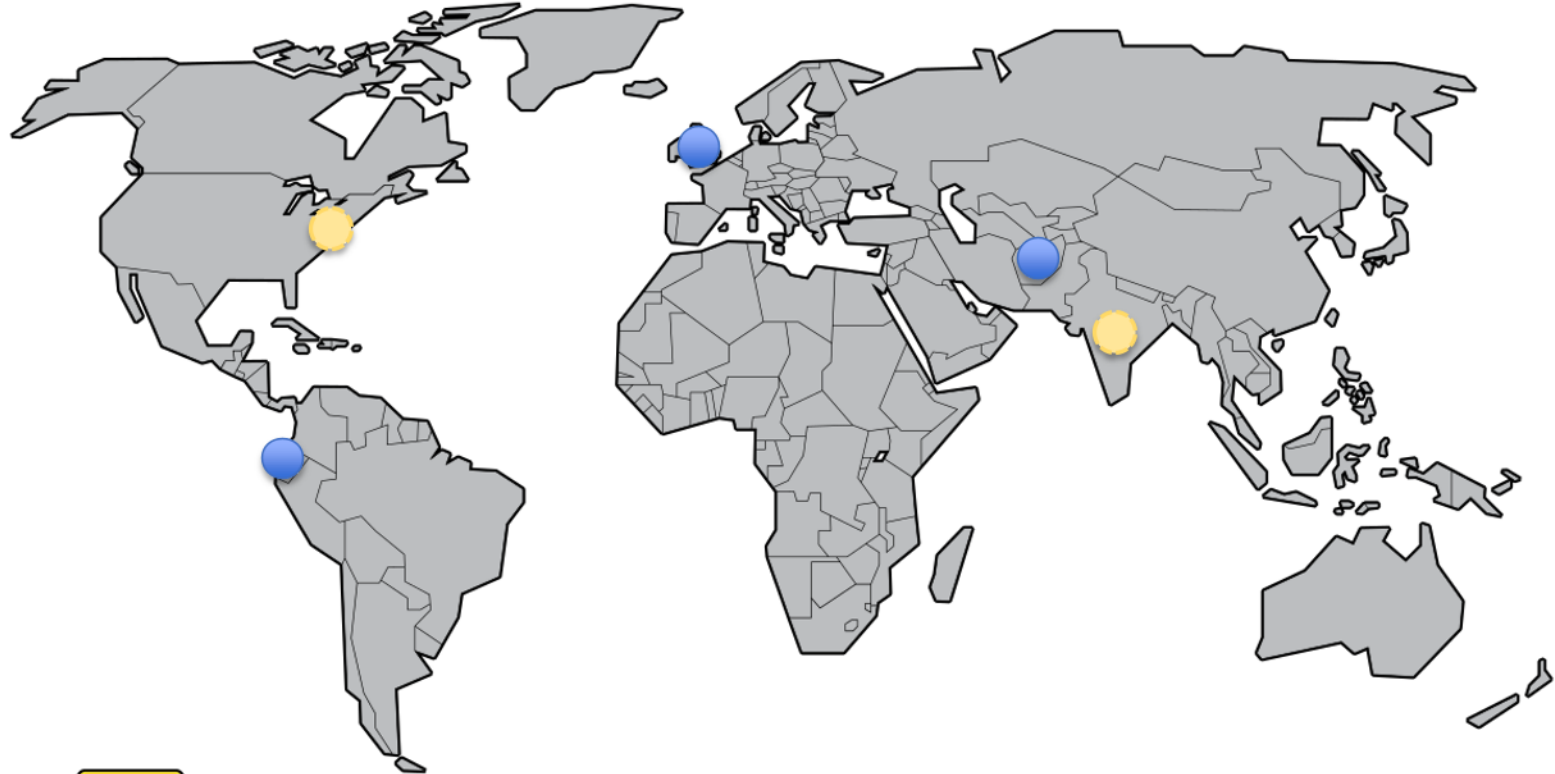
Specs at: <https://armani.usc.edu/>

# True meaning of Trojan Family



Specs at: <https://armani.usc.edu/>

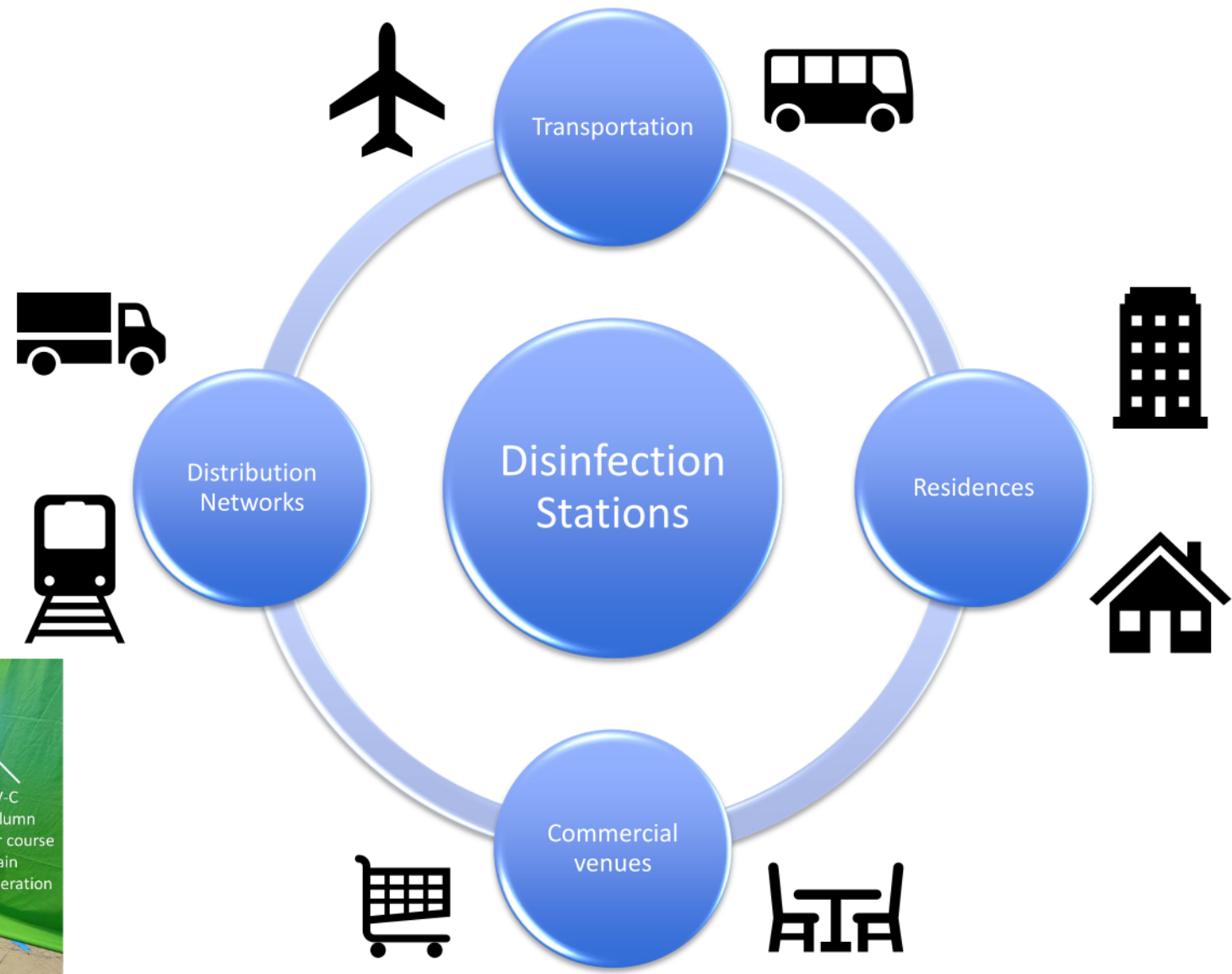
# Moving outside of USC



Specs at: <https://armani.usc.edu/>



# What now?



Collaboration with  
S. K. Gupta



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