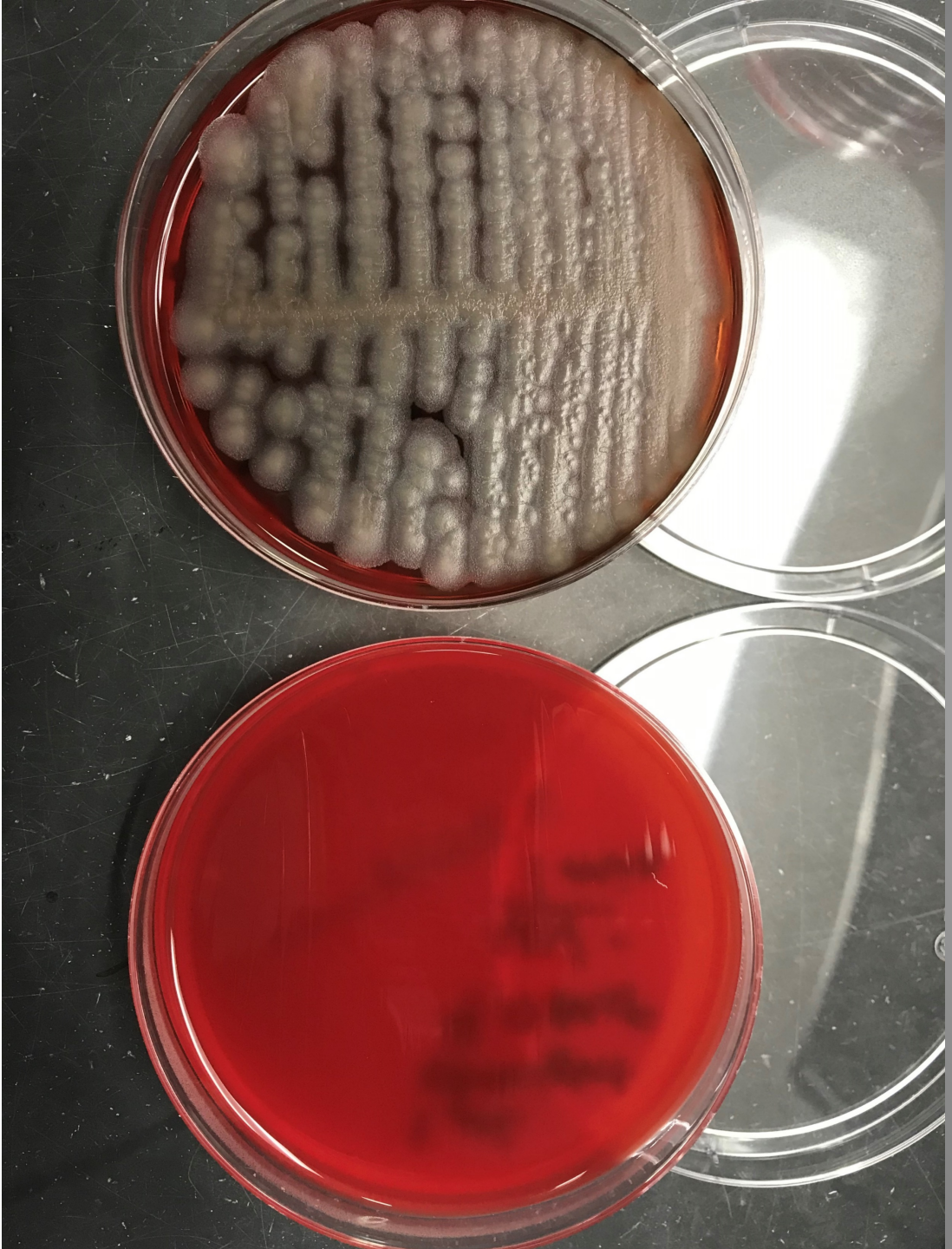

USC Viterbi
School of Engineering

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
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Qiming Wang
George Hatch
Yuji Zhao
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More info

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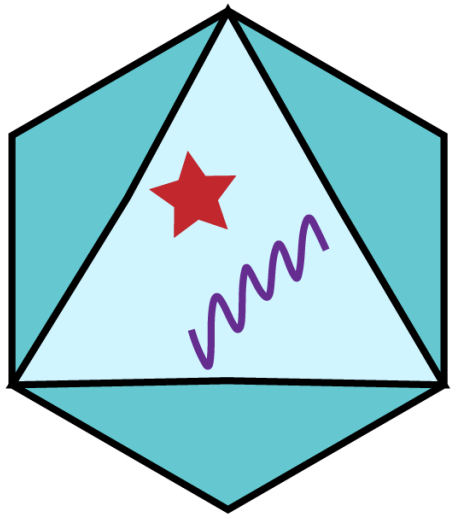
What is viral disinfection?

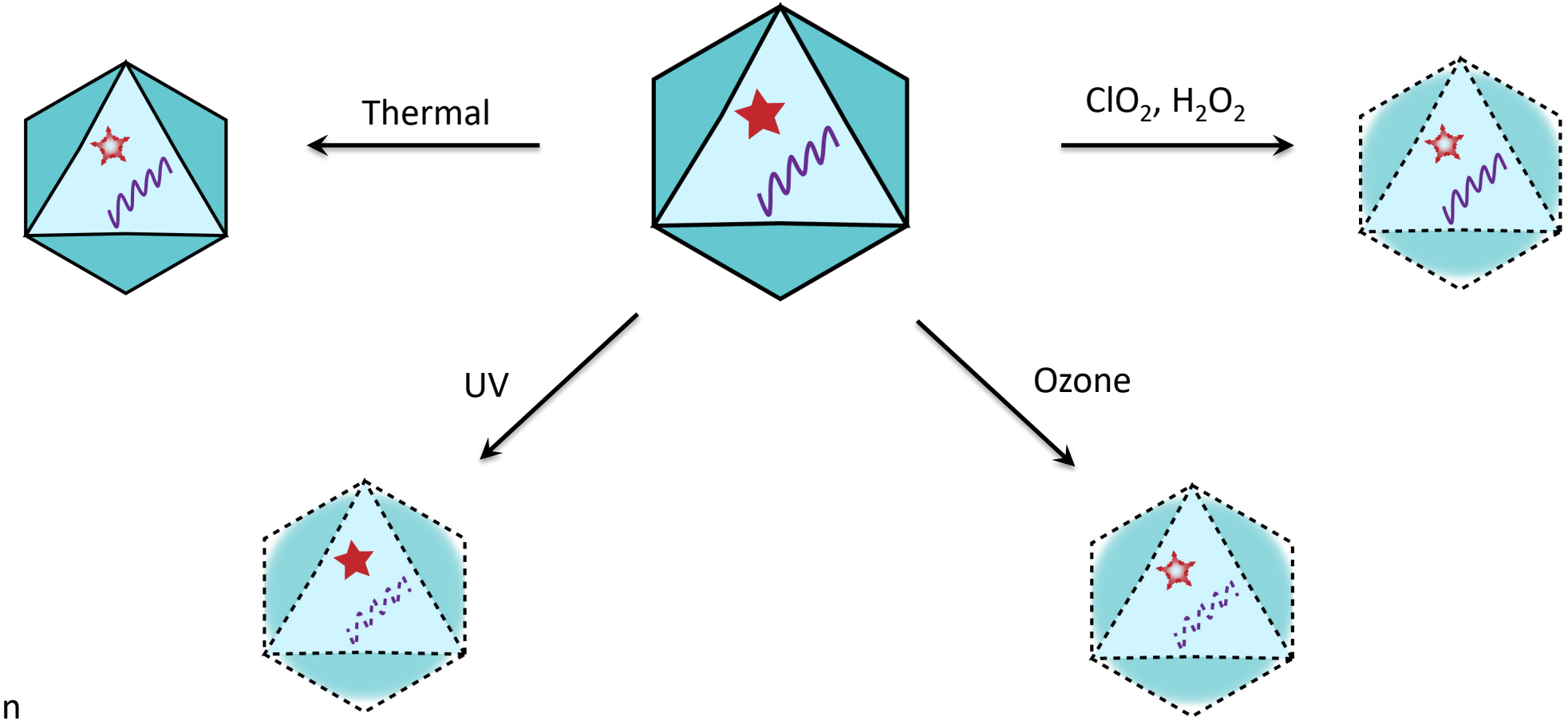


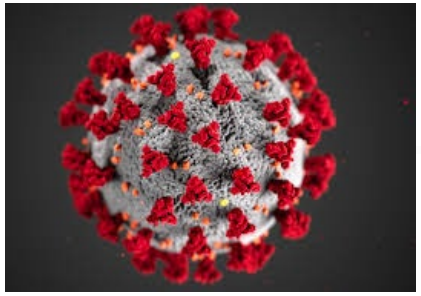
Key features for viral function:

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

Protein
RNA
Capsid

Approaches for (viral) disinfection





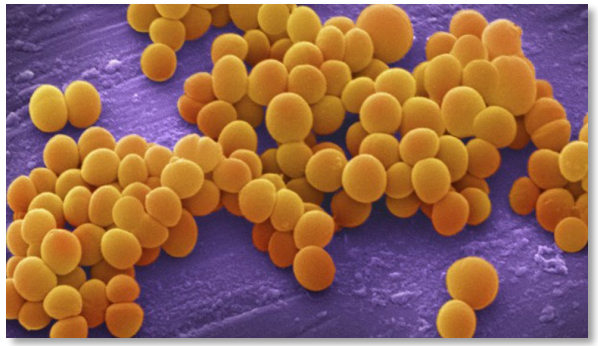
Looking past COVID-19

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

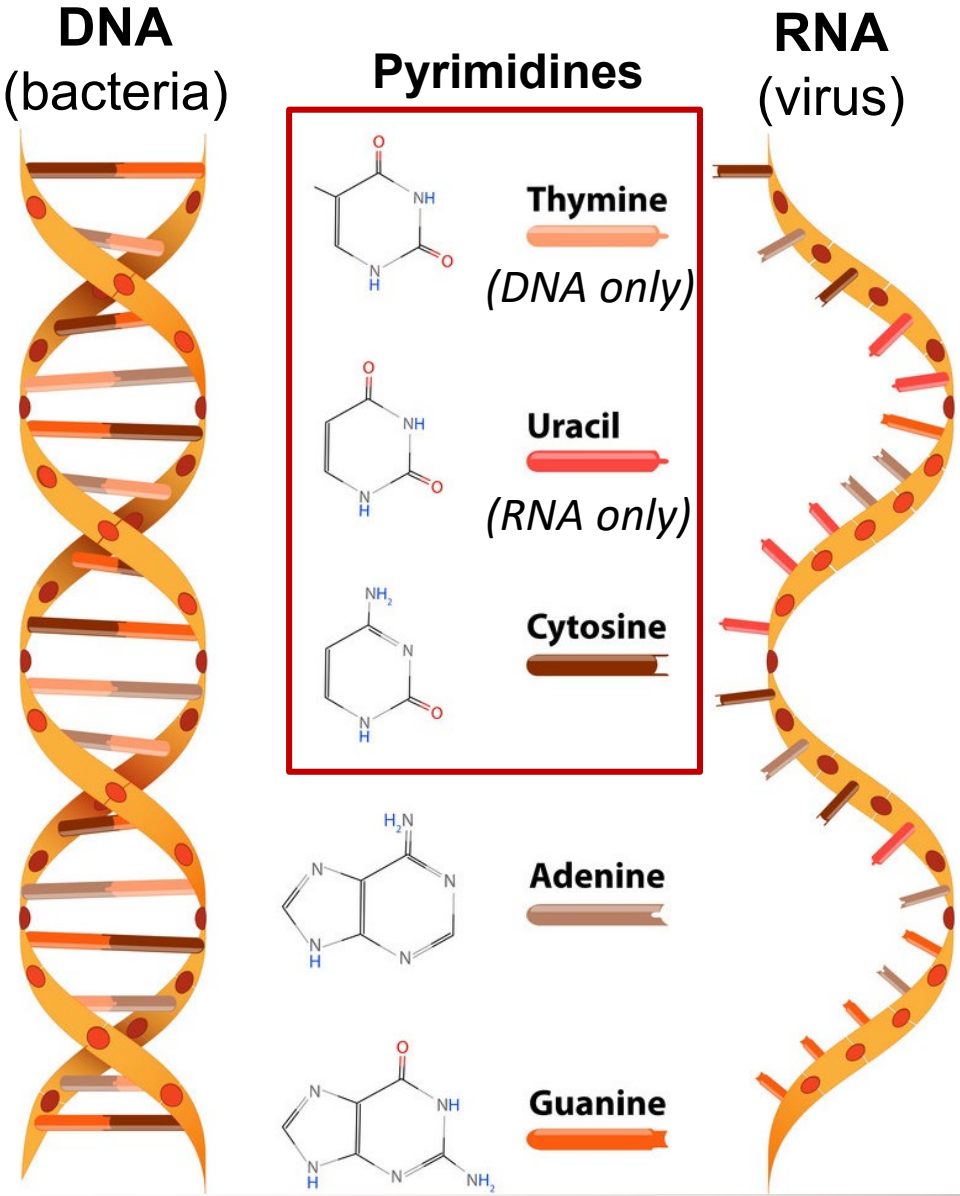
Pseudomonas aeruginosa



Staph

Salmonella

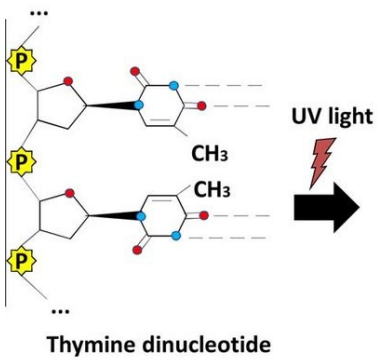
Why does UV-C work? Biology

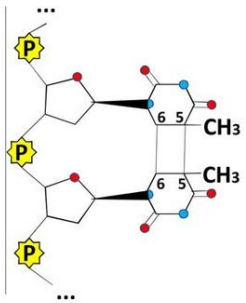


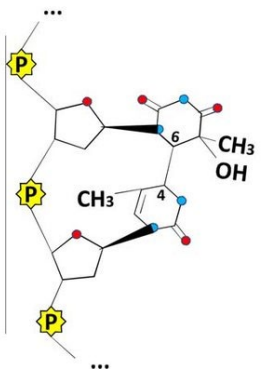
Pyrimidines are in both bacteria (DNA) and virus (RNA), so anything that impairs DNA or RNA will impact both.

Why does UV-C work? Biology

Expose either DNA or RNA to UV-C

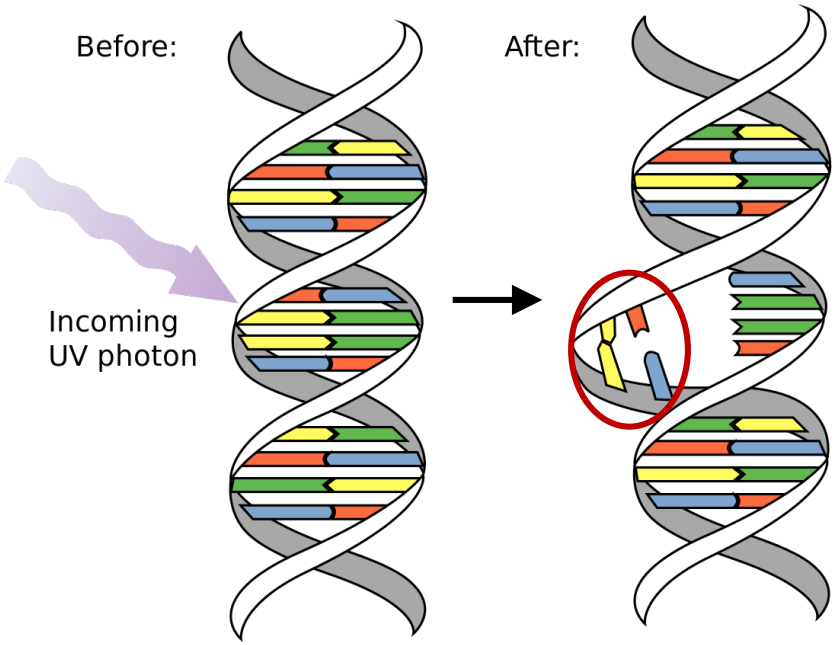






Pyrimidine dimers form

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

Conventional UV-C disinfection system

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

Biosafety cabinet
(research setting)

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

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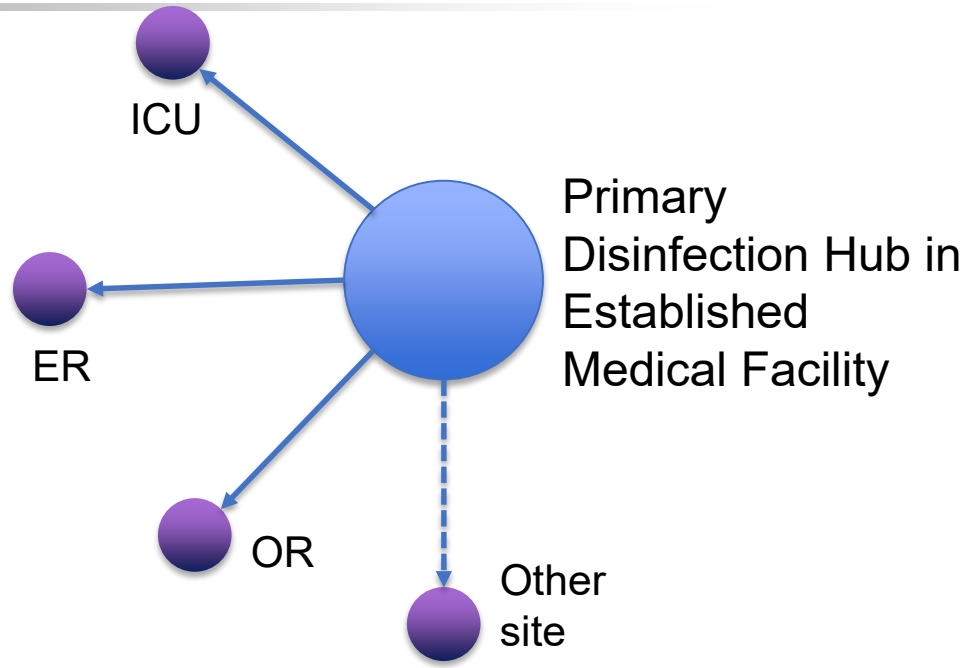
EPA/FDA guidelines:

- Dose for virus: ~100mJ/cm^2
- Dose for bacteria: ~10mJ/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”.

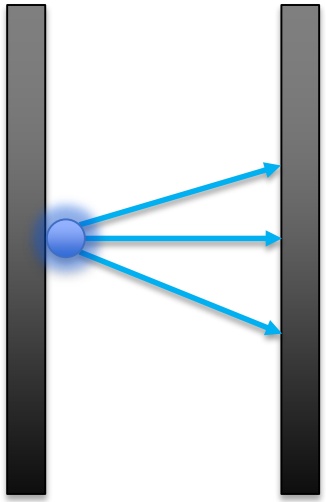


Key design criteria (FDA/others):

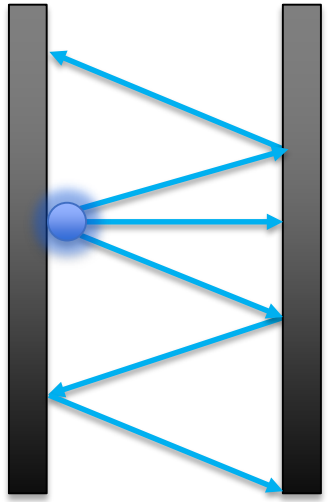
- Achieve >100mJ/cm^2 of UV-C intensity
- Lightweight, inexpensive, portable
- 3 log reduction in growth (FDA standard)

Digging into the science a little: Why chrome?

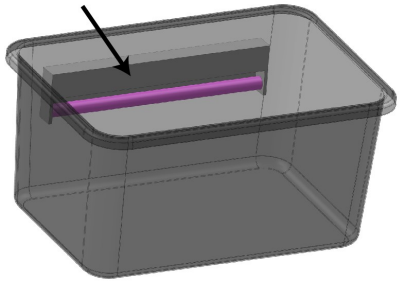
No interior coating
(no reflection)

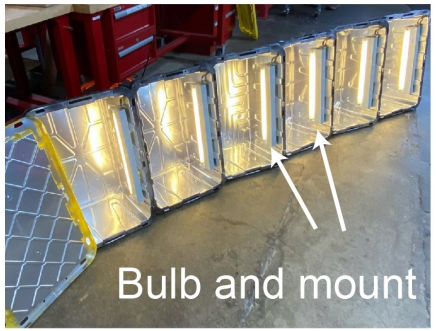


66% reflectivity



UV-C bulb and mount





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

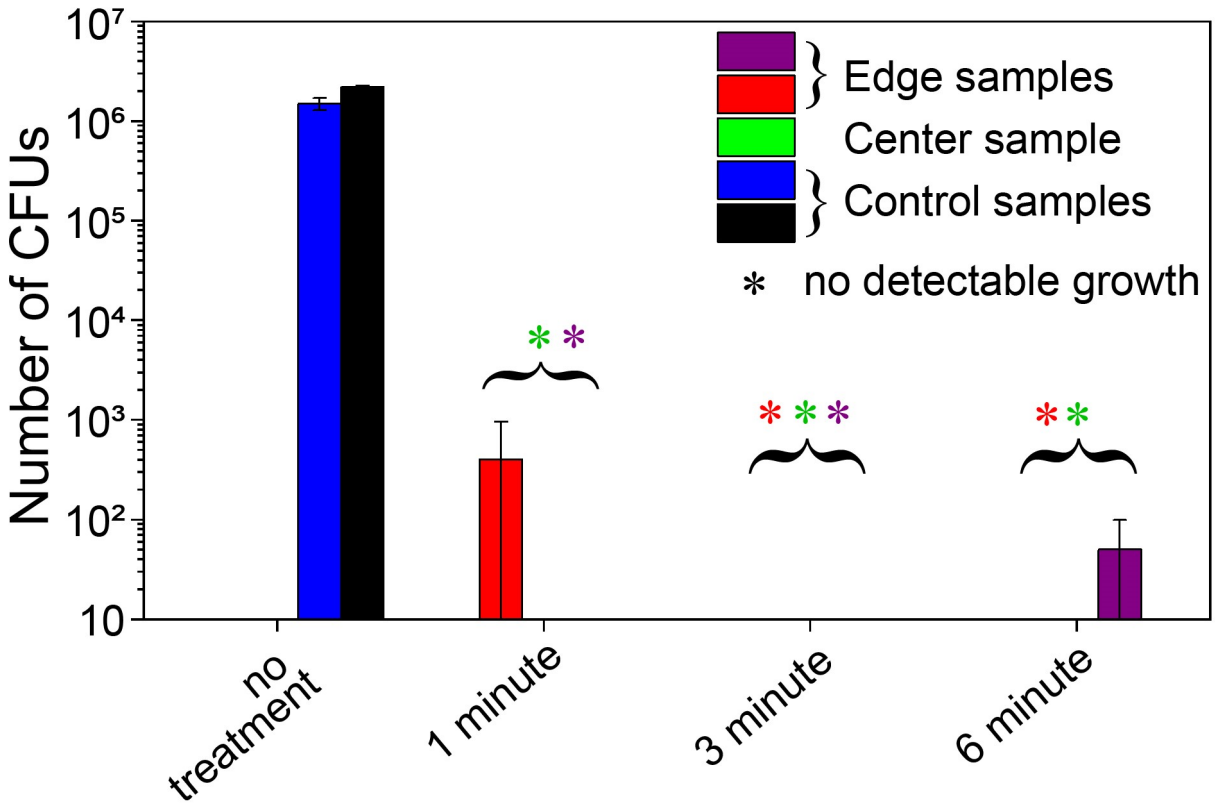
Test system

Used plastic petri dishes as mimic

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

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

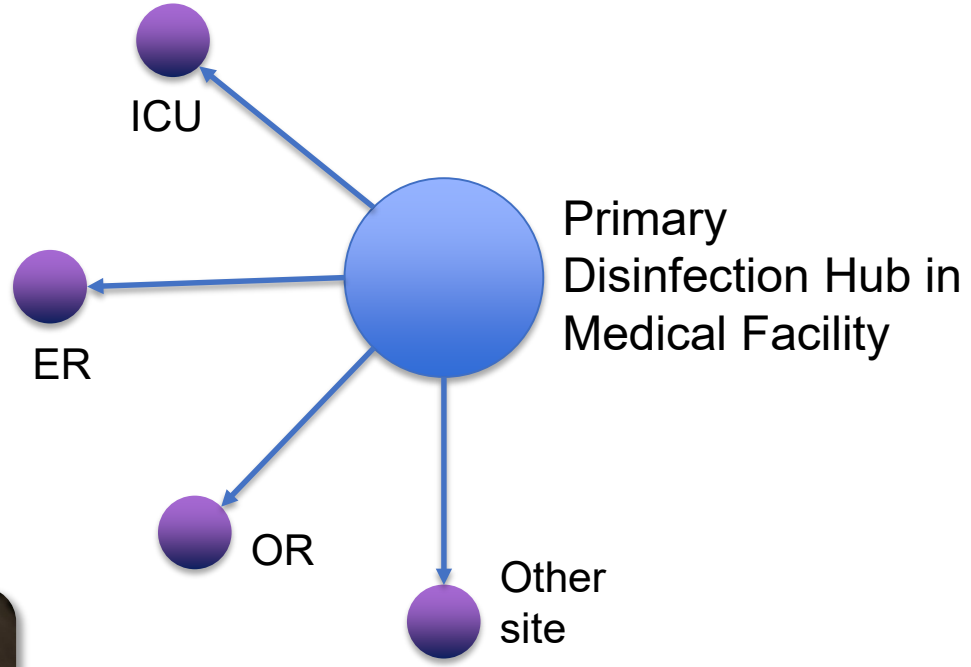
Achieved goal!



>3 log reduction with 1 minute exposure!

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

Then what?



Plus reusable PETG face shields to create an ecosystem.

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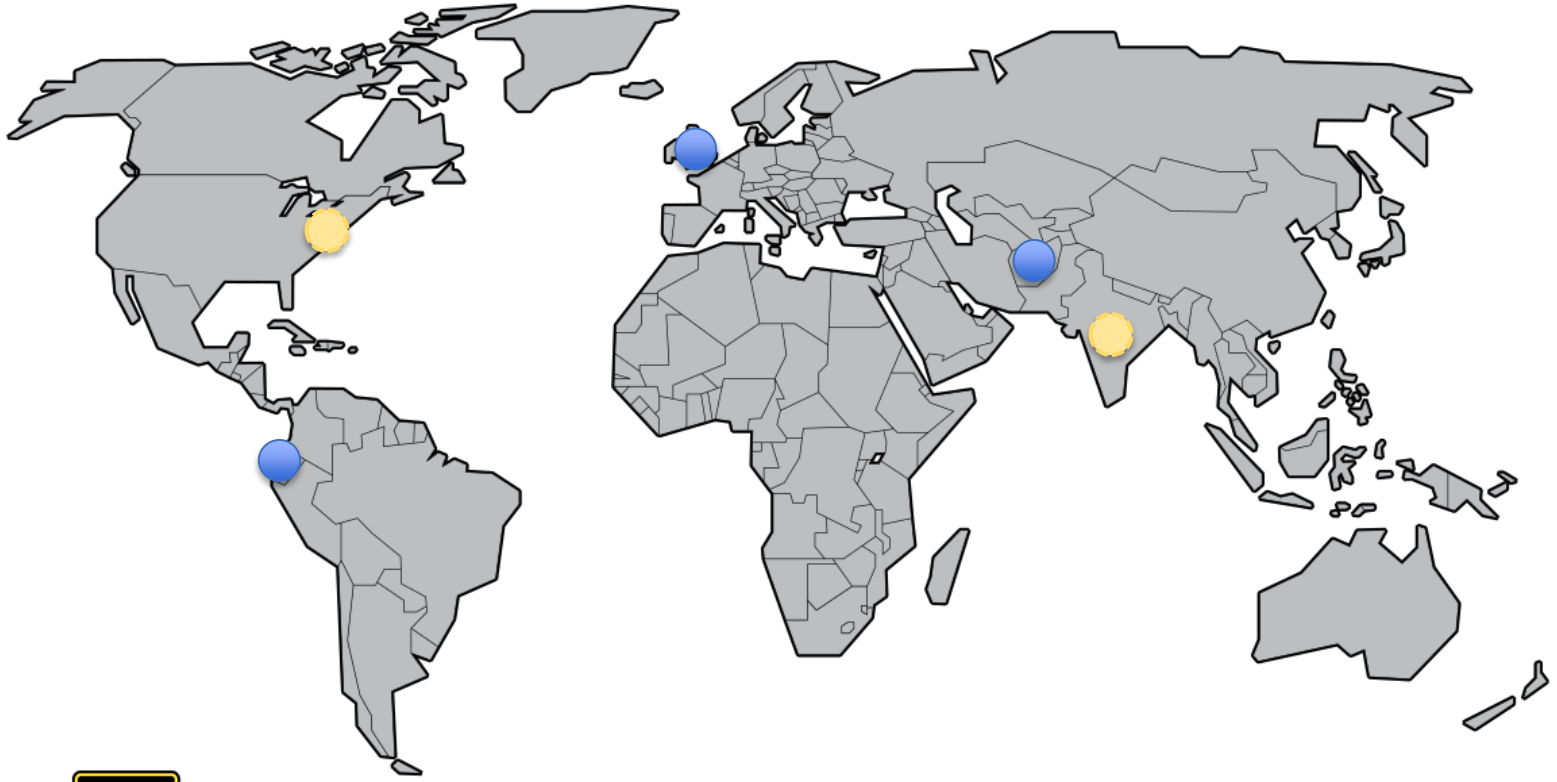
True meaning of Trojan Family

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

Moving outside of USC



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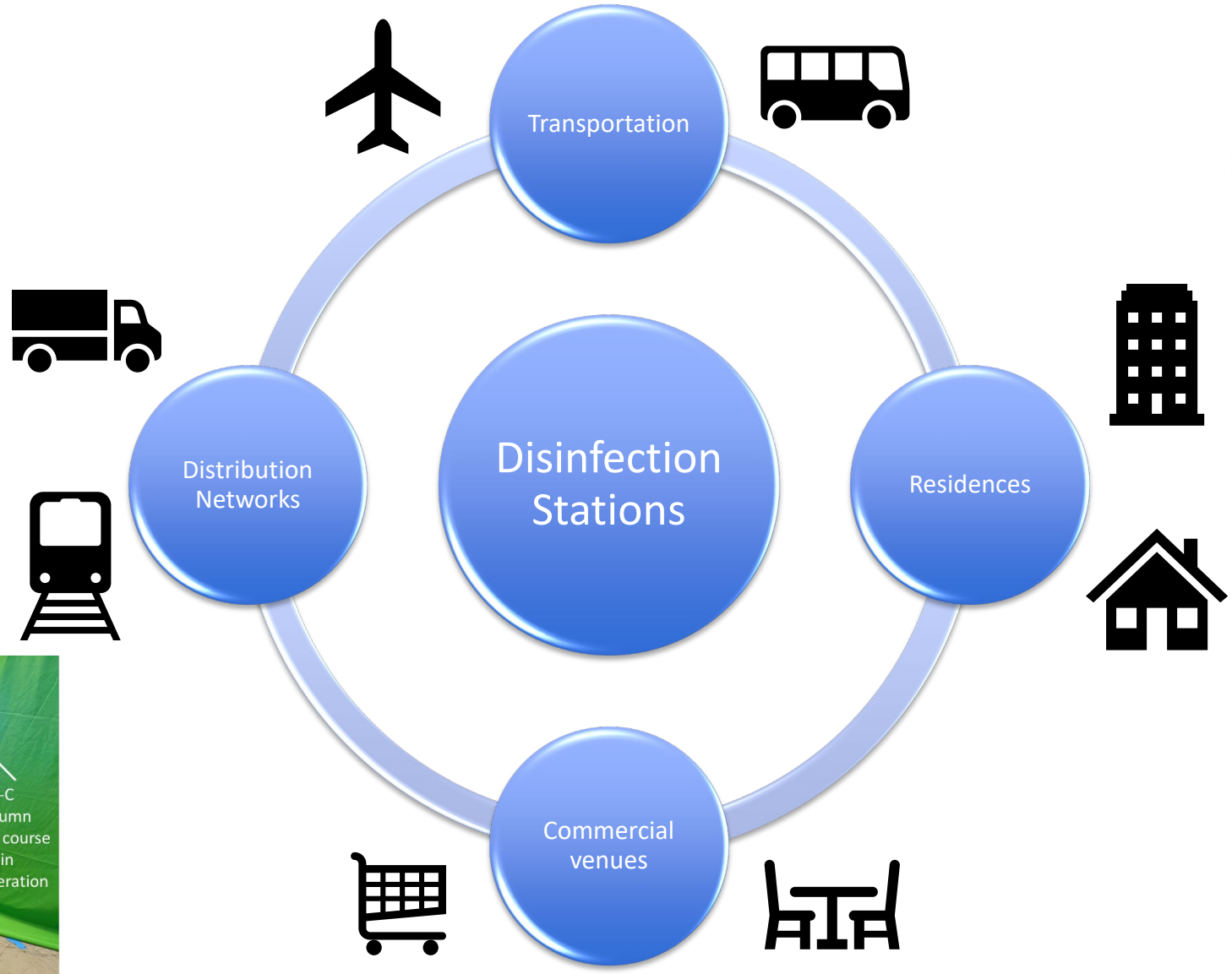
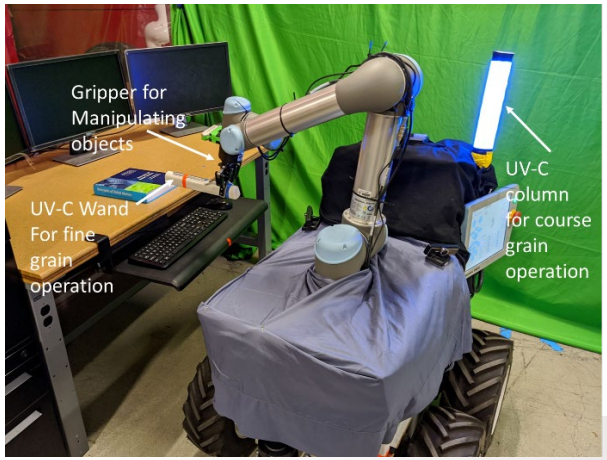
What now?



Collaboration with
S. K. Gupta



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