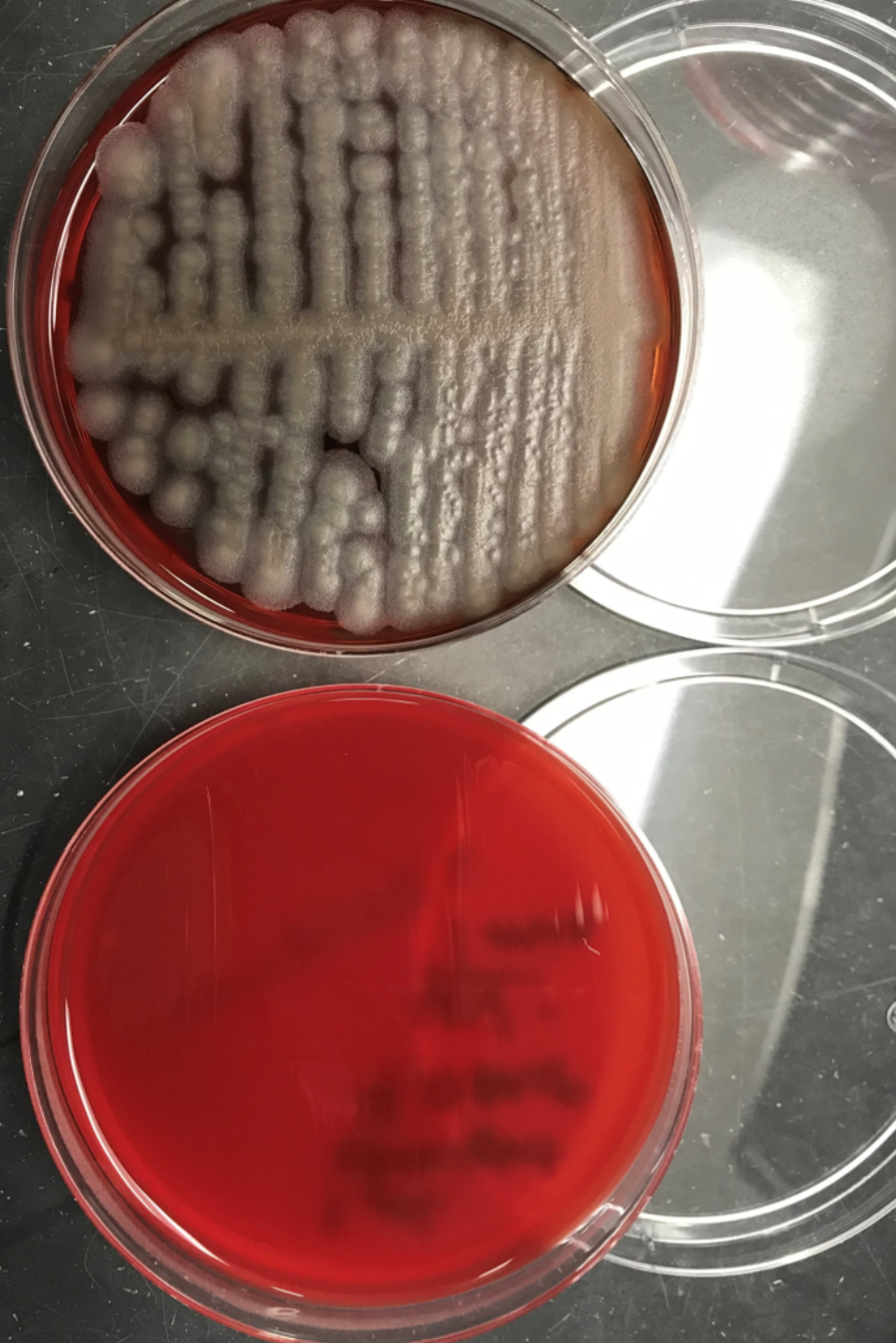# DYI PPE Disinfectant Methods

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
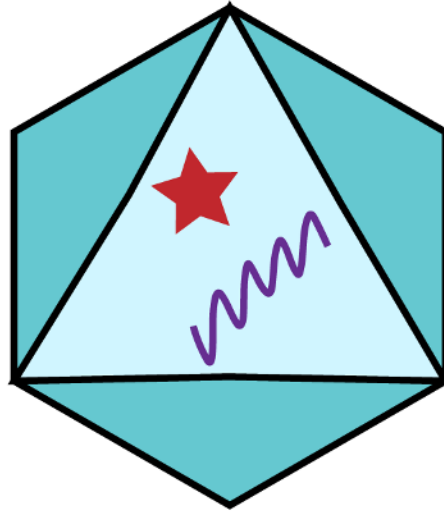SK Gupta

More info

http://armani.usc.edu

@ArmaniLab

@ArmaniResearchLab

armanilab
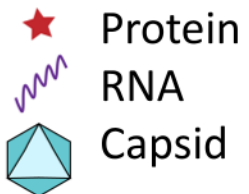
USC Viterbi
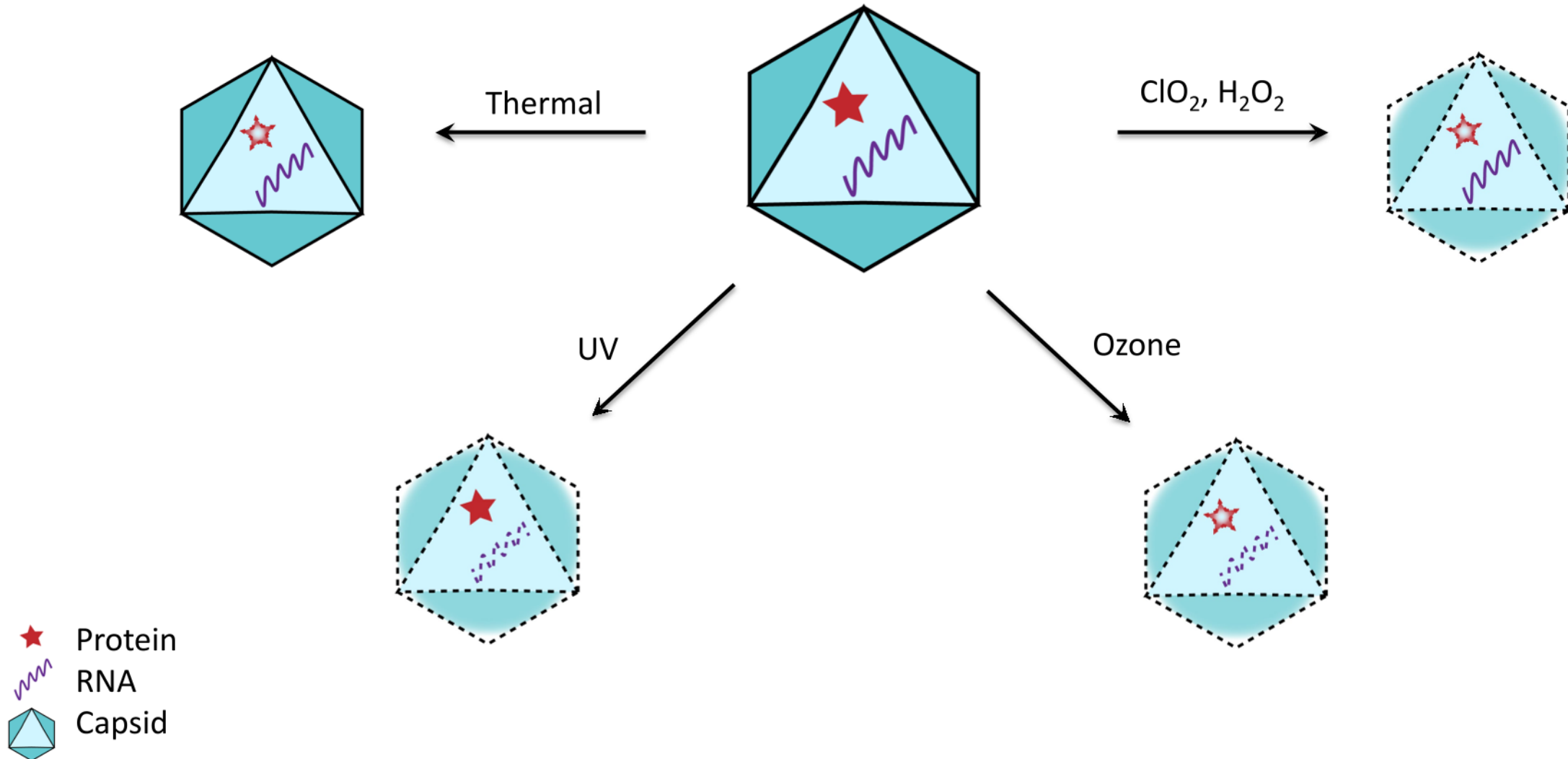School of Engineering

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
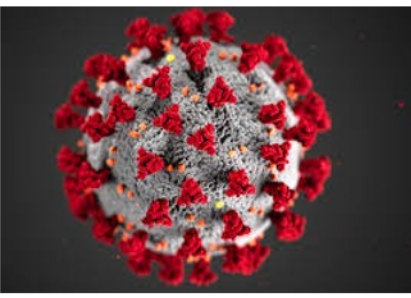
Looking past COVID-19

28% fewer deaths from antibiotic resistance in hospitals (since 2013 CDC AR Threats Report); however, <u>community spread has increased</u>.
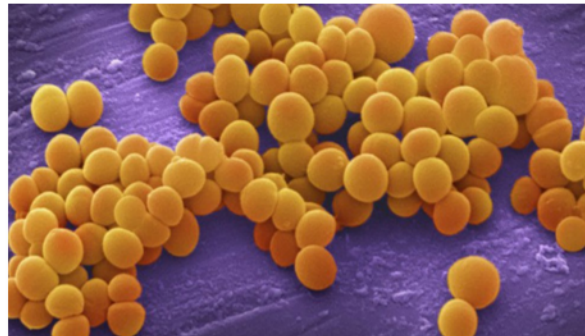
"More action is needed across settings, industries and countries to fully protect people from antibiotic resistance threats." – 2019 AR Threat Report, CDC
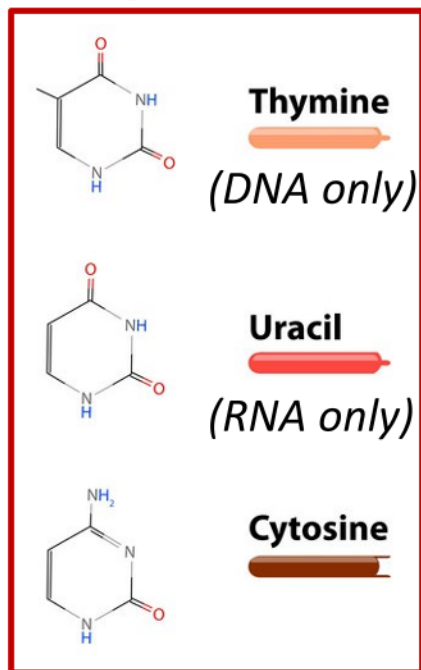
E. coli

Pseudomonas aeruginosa

Staph

Salmonella

USC Viterbi
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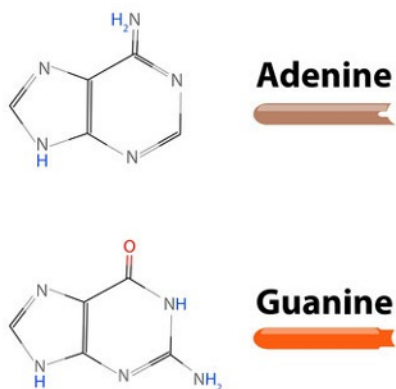
Why does UV-C work? Biology

DNA
(bacteria)

Pyrimidines
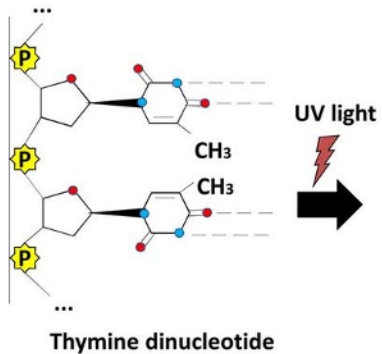
Thymine
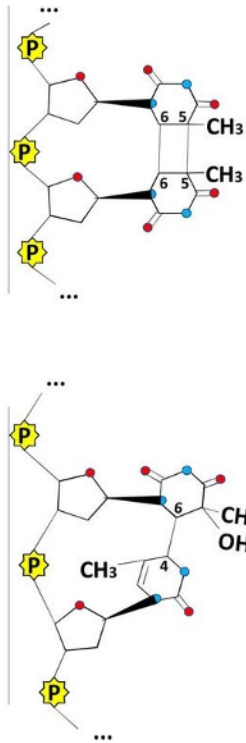*(DNA only)*

Uracil
(RNA only)

Cytosine

Adenine

Guanine

RNA
(virus)

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

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Why does UV-C work? Biology

Expose either DNA or RNA to UV-C

UV light

Thymine dinucleotide

TT-CPD

TT-6-4PP

Pyrimidine dimers form

UV-C works with both bacteria and viruses.

Before:

After:

Incoming UV photon

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

UV-C disinfection approaches

AUVS

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
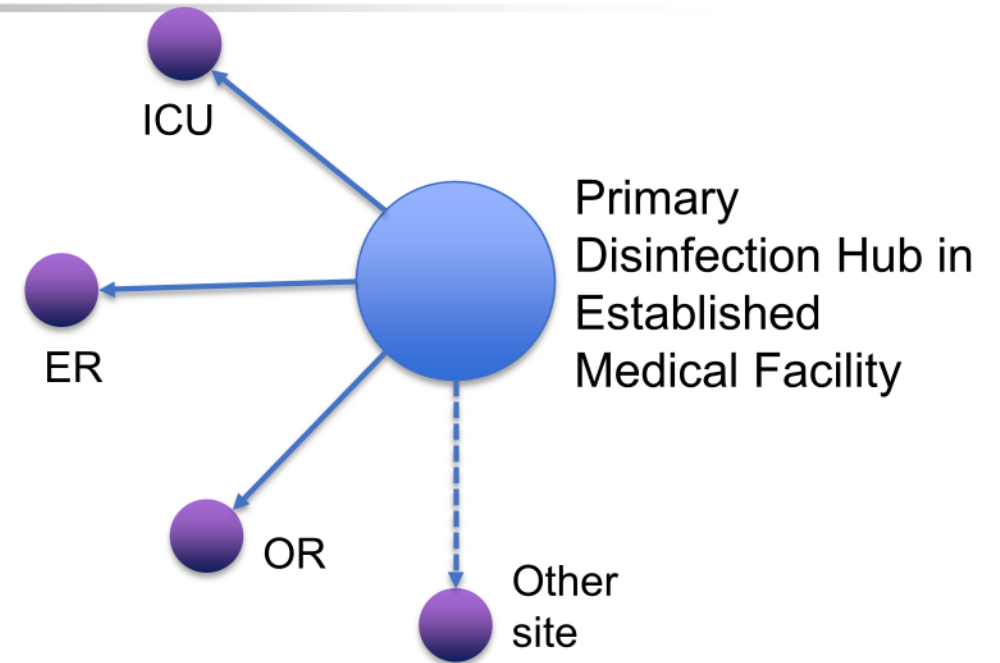- No safety precautions or shields

EPA/FDA guidelines:
- Dose for virus: ~100mJ/cm^2
- Dose for bacteria: ~10mJ/cm^2

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Distributed UV-C disinfection

Goal: Create, lightweight, inexpensive, easily-manufacturable system that could be used to create a distributed network of "localized disinfection stations".
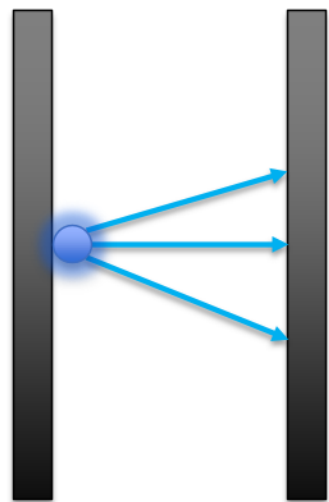
Key design criteria (FDA/others):
- Achieve >100mJ/cm^2 of UV-C intensity
- Lightweight, inexpensive, portable
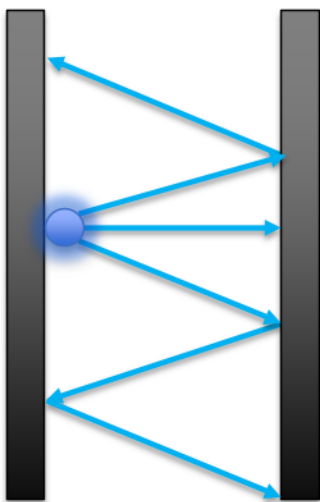- 3 log reduction in growth (FDA standard)

ICU

ER

OR

Primary Disinfection Hub in Established Medical Facility

Other site

Central Park, NYC

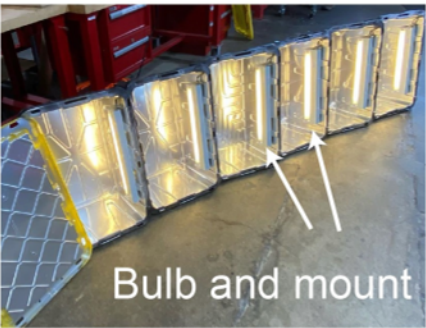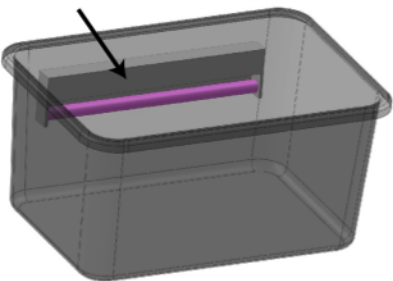# Digging into the science a little: Why chrome?

No interior coating
(no reflection)

66% reflectivity

UV-C bulb and mount

Bulb and mount

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

Test system

Used plastic petri dishes as mimic

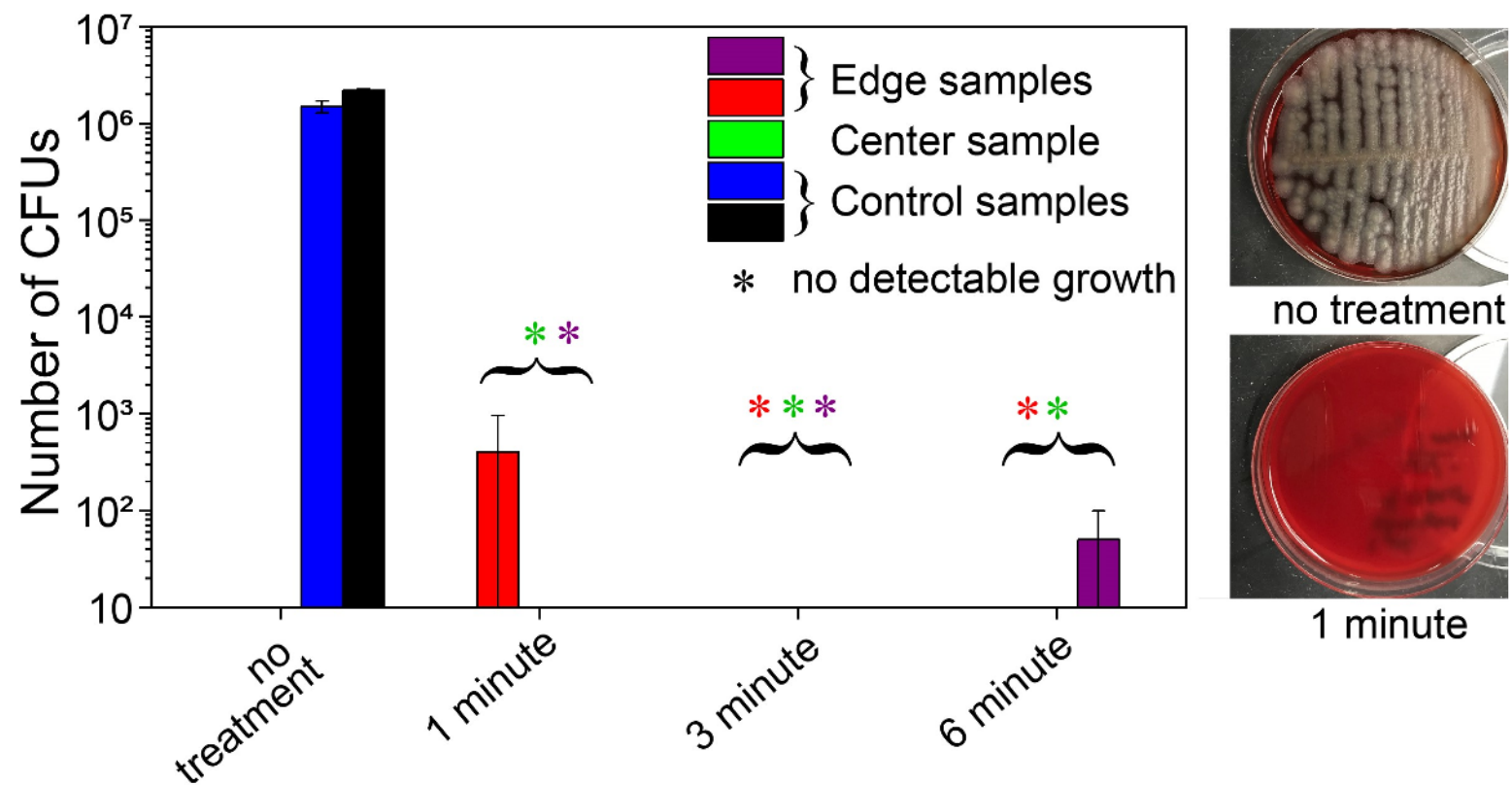Bacillis cereus as test system
(gram +, endospore forming, UV resistant)

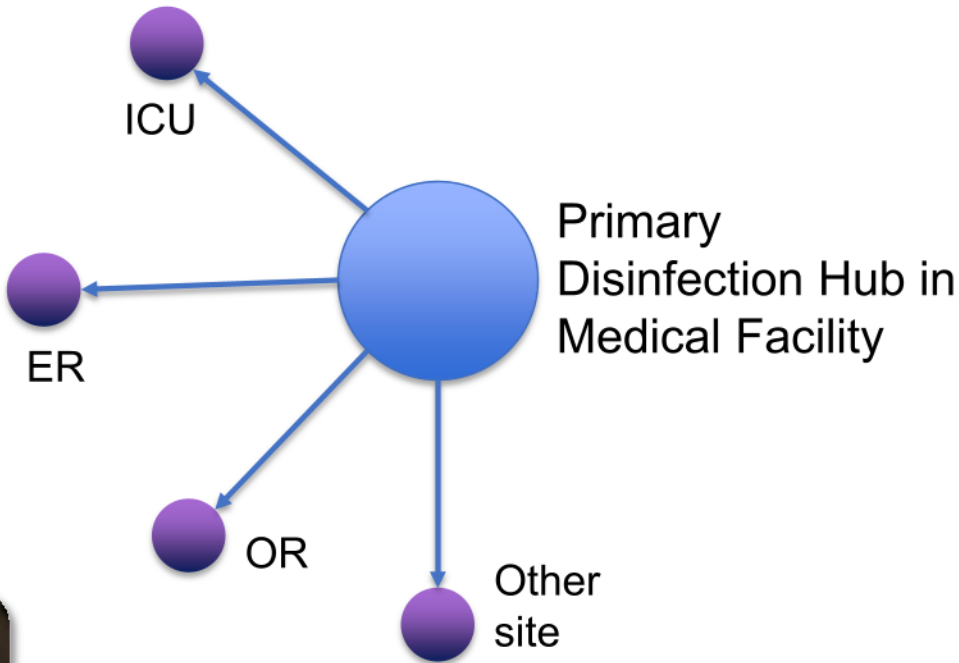After exposure, transfer to agar, let grow from 24hrs, then count colonies

Achieved goal!

>3 log reduction with 1 minute exposure!

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

Then what?

ICU

Primary
Disinfection Hub in
Medical Facility

ER

OR

Other
site

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?

Transportation

Distribution Networks

Disinfection Stations

Residences

Commercial venues
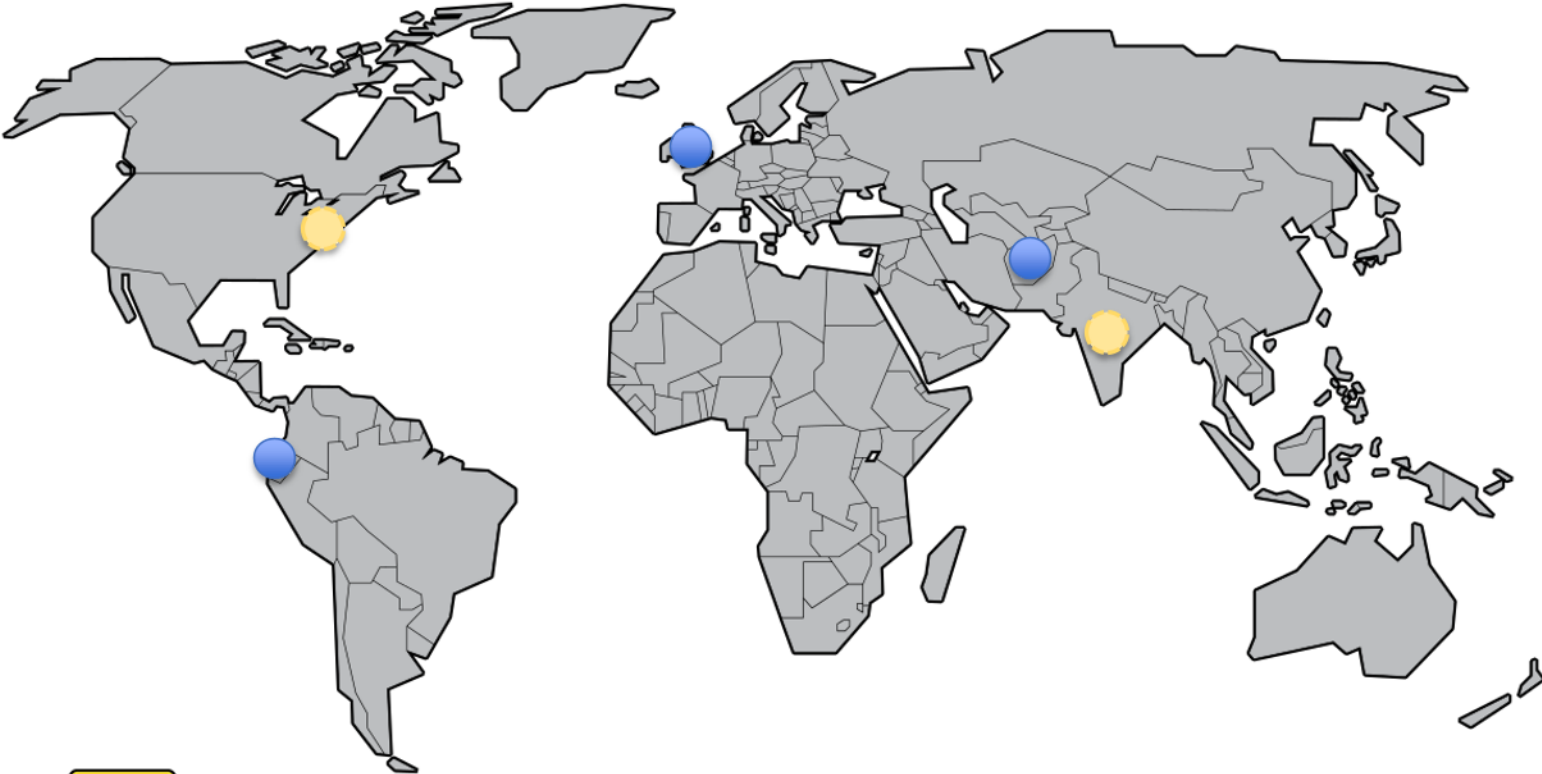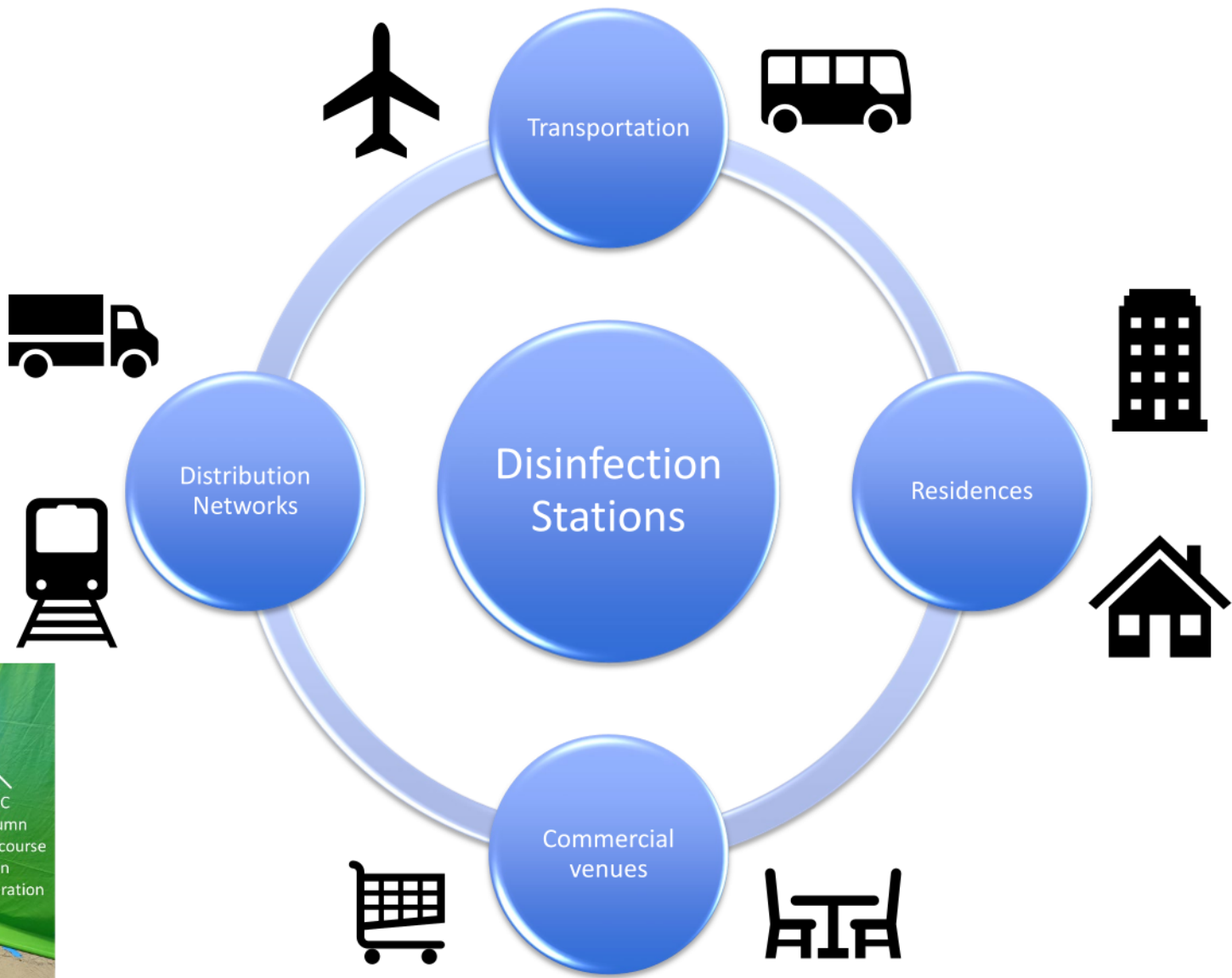
Collaboration with S. K. Gupta

Gripper for Manipulating objects

UV-C column for course grain operation

UV-C Wand For fine grain operation

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