Decontamination of Category A Viruses on Porous Surfaces and Sensitive Equipment

2019 EPA International Decontamination Research and Development Conference

November 20, 2019

METSS Corporation
300 Westdale Avenue
Westerville, Ohio 43082

Dan Lorch, Sr. Microbiologist (dlorch@metss.com)

www.metss.com

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2014 Ebola Outbreak

Stateside Ebola cases

CNN health

LIVE TV

American woman infected with Ebola arrives in U.S.

By Jason Hanna and Holly Yan, CNN

Updated 9:07 PM ET, Wed August 6

RIGHT NOW ATLANTA

0:00 / 2:09

Sections

The Washington Post

Democracy Dies in Darkness

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Post Nation

Health-care worker with Ebola flew on commercial flight a day before being diagnosed

2nd infected nurse flew day before

0:01 / 1:18

CDC Home

Centers for Disease Control and Prevention

CDC 24/7: Saving Lives. Protecting People.™

SEARCH

A-Z Index A B C D E F G H I J K L M N O P Q R S T U V W X Y Z #

Ebola Virus Disease Cluster in the United States — Dallas County, Texas, 2014

Early Release

November 14, 2014 / 63(Early Rele

Michelle S. Chevalier, MD[1,2], Wendy Chu

Sibeso N. Joyner, MPH[3], Emily Hall, MPH

Cervantes, DrPH[4], David L. Lakey, MD[4]

Since March 10, 2014, Guinea, Liberia, a

epidemic with approximately 13,000 pe

patients with Ebola had been treated in

medically evacuated to the United State

On September 25, a man aged 45 years

to a Dallas County, Texas, emergency d

abdominal pain, and headache (Figure).

returned to the hospital by ambulance w

he was placed in a private room under s

30, real-time polymerase chain reaction

that patient 1 was positive for Ebola viru

United States. A CDC team arrived in Da

to assist with its investigation. The obje

monitoring of contacts, 3) review plans

practices.

CNN World

LIVE TV

Deadliest outbreak of Ebola virus: What you need to know

By Susannah Cullinane and Nick Thompson, CNN

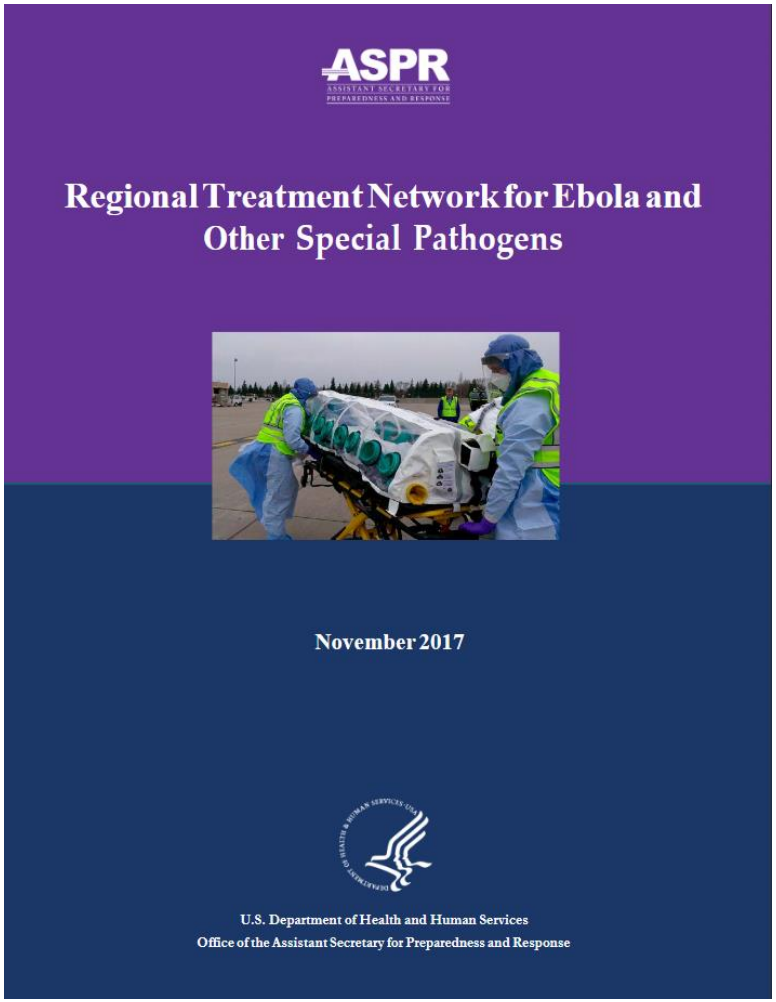
Updated 6:51 AM ET, Thu September 18, 2014

Lessons Learned

- Events identified opportunities to improve preparedness for and treatment of suspected and confirmed patients with Ebola

NETEC
NATIONAL EBOLA TRAINING & EDUCATION CENTER

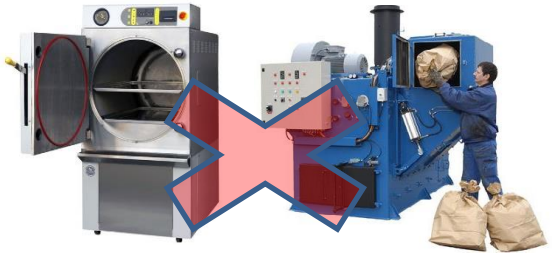
- **Identified need for better handling techniques of contaminated waste generated by Ebola patients before and after hospital admission**



Background

PROBLEM - Need for an on-site decontamination technology to treat potentially infected **large, bulky, porous items** and **sensitive equipment**
>>> non-hospital and hospital settings; non-destructive <<<

- Common treatment technologies and infectious waste disposal protocols are not conducive for such items



BENEFITS – Eliminates need for transporting bulky infectious waste to an off-site treatment facility and reduce risk of secondary exposure [decontaminated items can be disposed as municipal waste or reused]

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Innovative Solution

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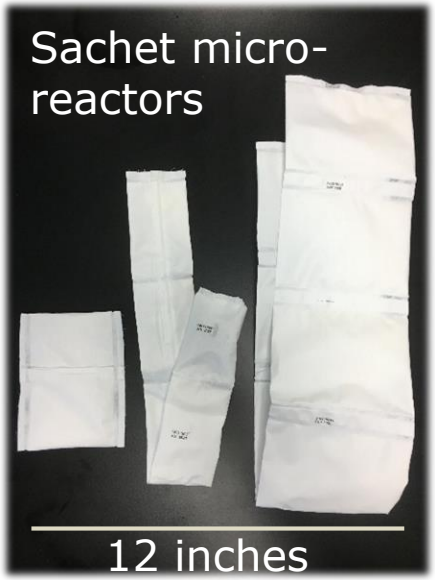
Six-month study to demonstrate feasibility of **chlorine dioxide (ClO_2)** gas to decontaminate a small room containing large, porous items and sensitive equipment in a non-destructive manner

Concept - Utilize proprietary **micro-reactor technology** to generate a solution of solubilized pure ClO_2 gas ⇨ utilize off-gas to fumigate room



Selective Micro Technologies (SMT Inc)

- EPA/FDA liquid disinfectants
- Assorted sizes
- Proprietary membrane
- Contains sodium chlorite
- Generates pure ClO_2 gas in water within 2 hours
- Dispose spent sachet as non-hazardous waste

Innovative Solution

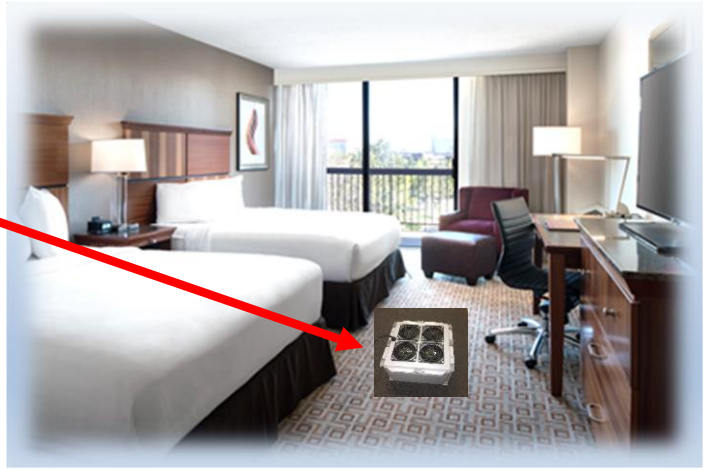
Room decon concept

Gas Dispersion Unit (GDU)

Micro-reactors immersed in water inside GDU; ≤2 h generation period

Fans blow air over surface of dissolved ClO_2 gas solution and disperse gas into room

- *Mattress*
- *Upholstered furniture*
- *Carpet*
- *Subflooring*
- *Sensitive, Electrical Equip.*



Goal: >4 log reduction on, in, and under porous materials

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Benefits of ClO_2

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Gas

- Proven (2001 anthrax)
- Registered sterilant (sporicidal)
- Penetrates & Disperses
- No residue
- Non-carcinogenic
- Material Compatible
- Odor detectable at low, safe levels

Patented Micro-Reactor Technology

- Used in EPA-registered and FDA approved disinfection products
- Adaptable to specific needs
- Portable
- Robust
- Dual-use
- Cost competitive

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Scope of Work

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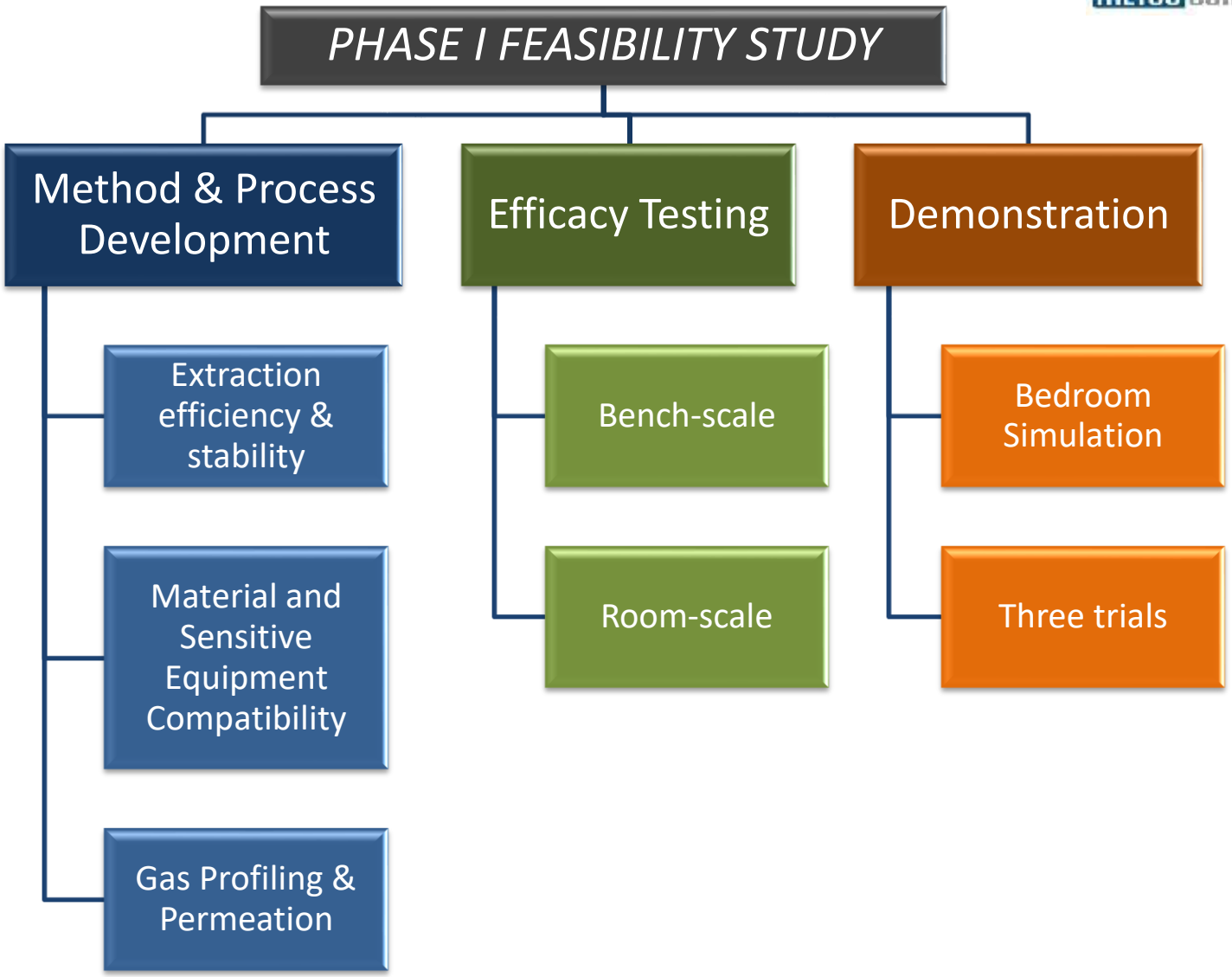
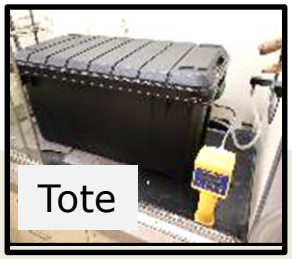


Method Development

❑ ClO_2 Efficacy Test Methodology



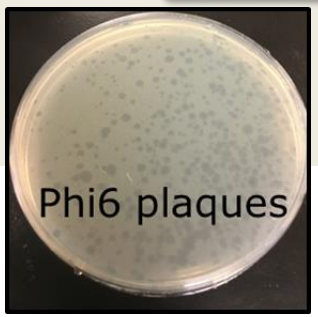
Phi6 Bacteriophage used as Ebola surrogate
- Enveloped RNA virus
- Comparable resistance to chlorine-based disinfectants

Inoculate Coupons
- Porous & non-porous coupons
- >6 log virions
- Allow to dry

Gas Treatment
- Bench or Room-scale

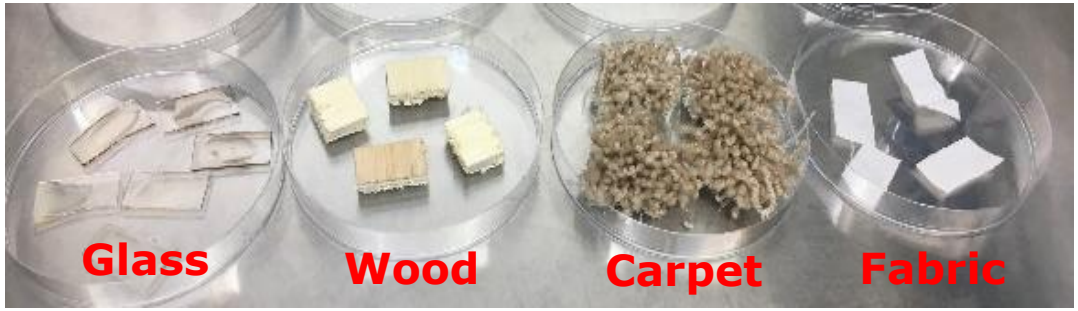
Extract & Enumerate
- Tween buffer
- Vortex and sonicate
- Double Agar Overlay

Analysis
- Log pfu recovered from treated vs. controls



Method Development

- Extraction efficiency from substrates and stability in a Fetal Bovine Serum

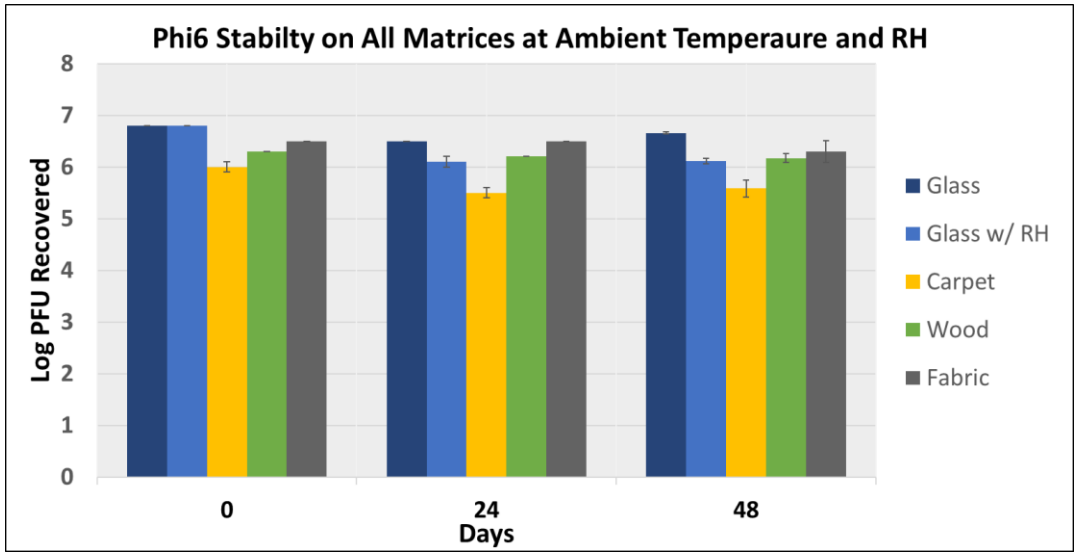


Non-porous and porous substrates

Extraction Efficiency

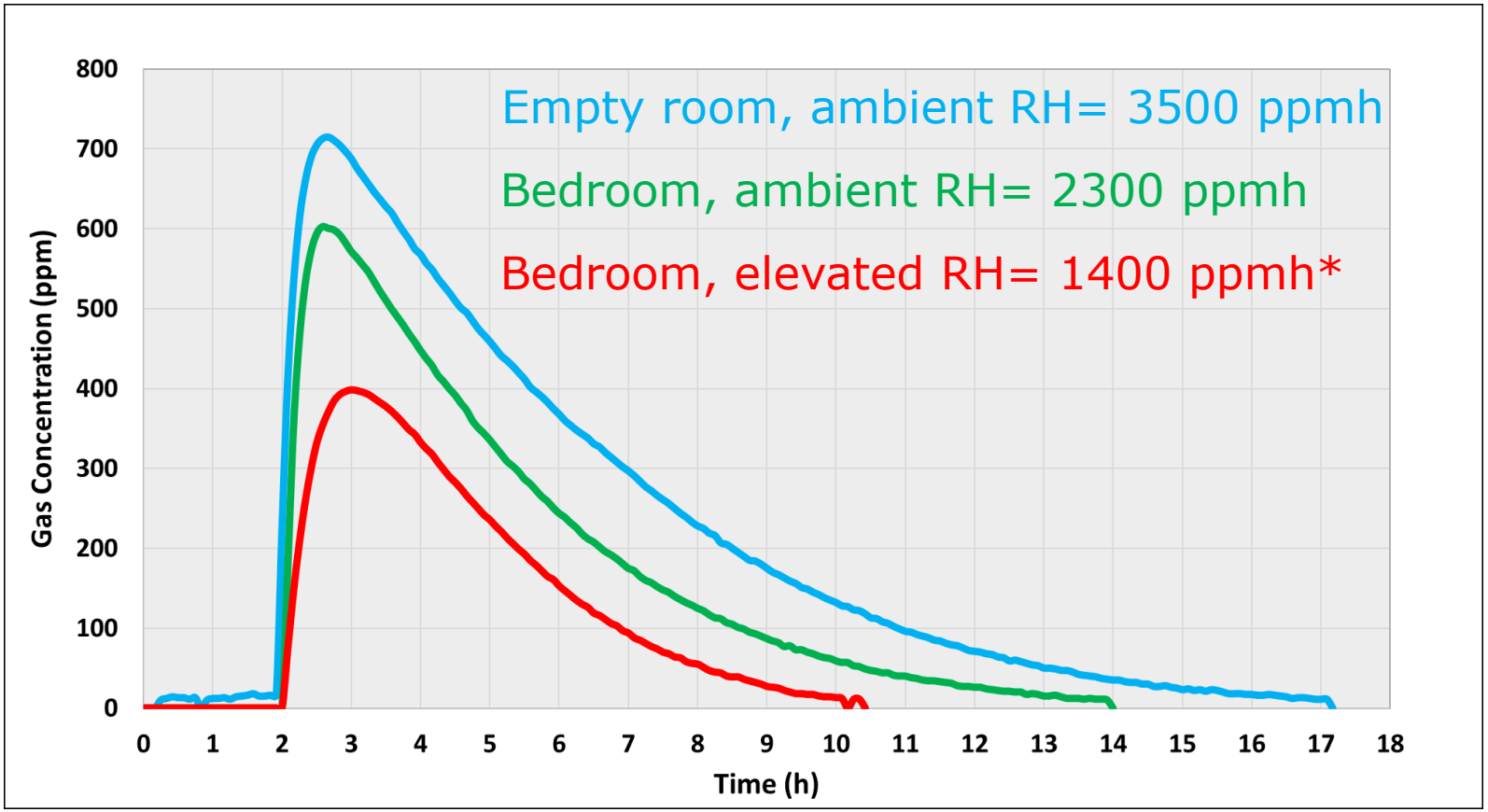
Matrix	Mean % Recovery
Glass	89 ± 9%
Carpet – Nylon	64 ± 6%
Carpet – Polyester	79 ± 10%
Carpet – Triexta	76 ± 28%
Wood	78 ± 22%
Fabric	76 ± 11%

Stability



Process Development

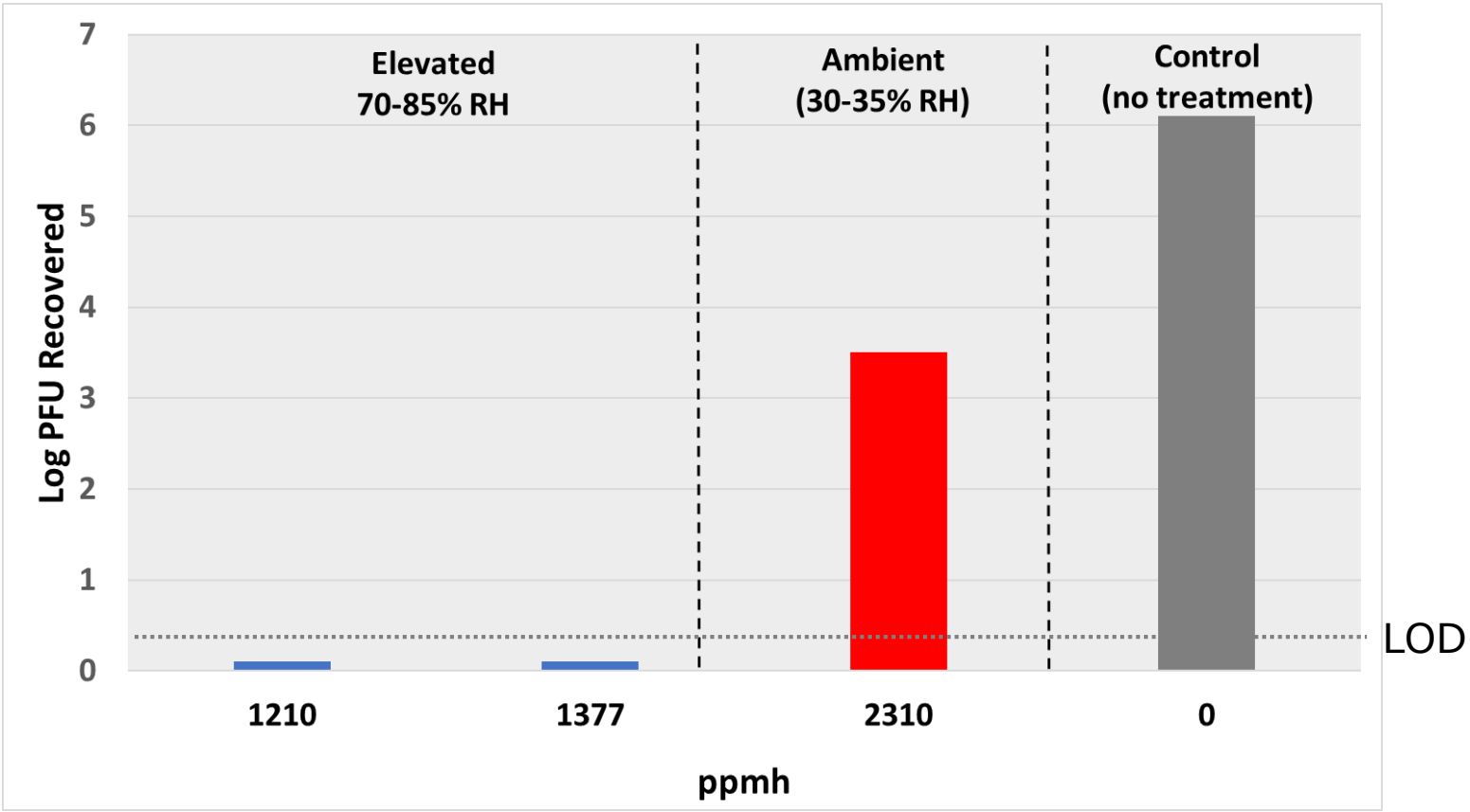
- ClO_2 gas profiling in room-scale test system



*Treatment to achieve >4 log reduction (~10 h cycle)

Process Development

- Elevated humidity increases efficacy



Log Reduction: >5 log w/ elevated RH and 2.5 log at <35% RH

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Process Development

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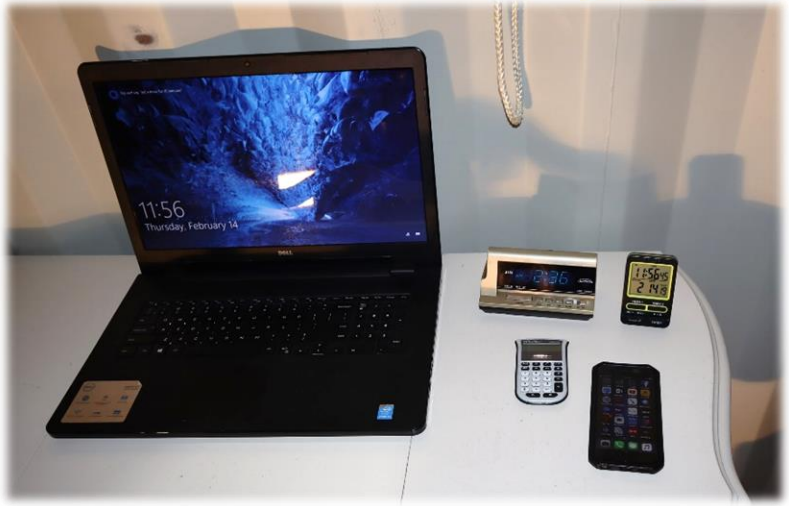
- ClO_2 treatment was not destructive to electrical equipment
  - Retained functionality
  - No altered appearance



Exposed to approx. 10 treatment cycles

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Full-Scale Demo

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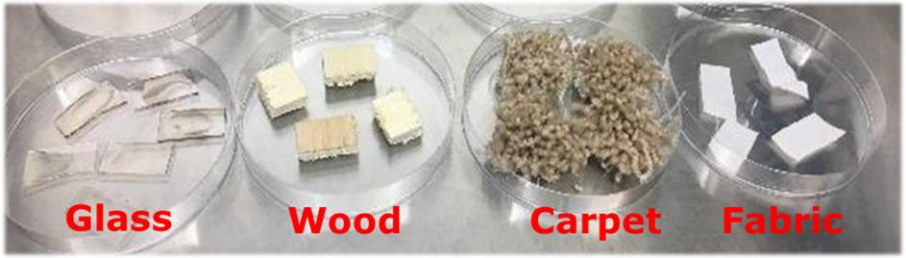
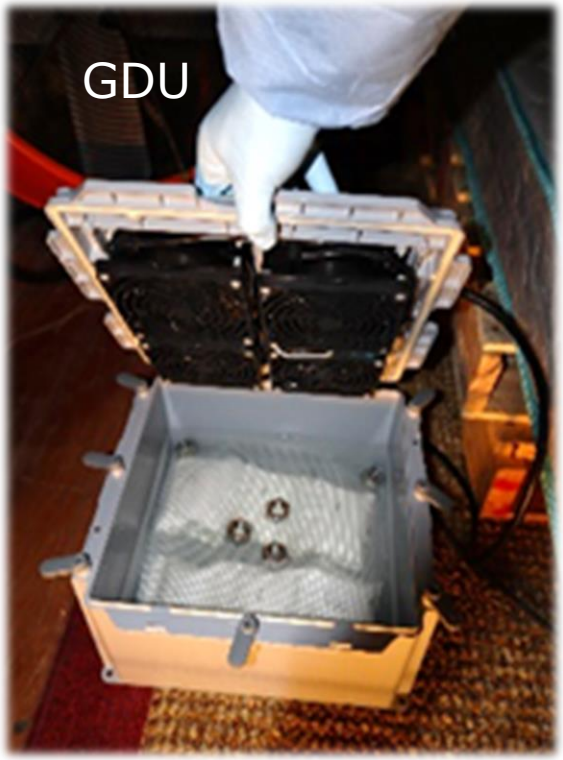
- Non-destructive decontamination of items in a small bedroom



- Three trials
- >6 log virions/coupon
- Triplicate samples per 11 sample locations



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Full-Scale Demo Results

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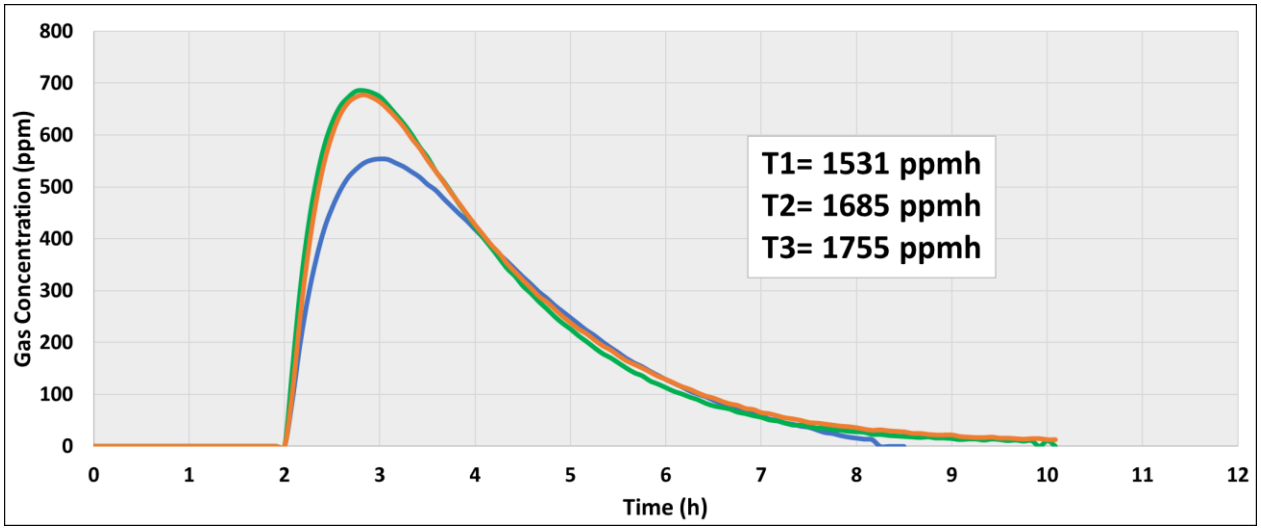
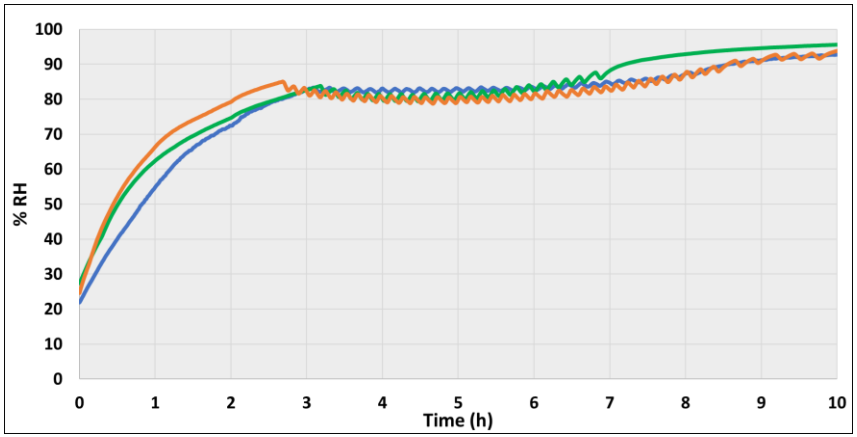
Profiles

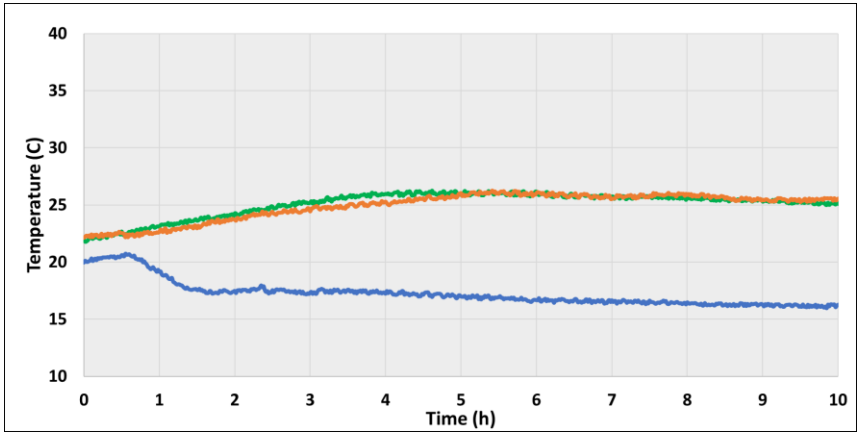
Trial 1
Trial 2
Trial 3



Gas



Humidity



Temperature

Full-Scale Demo Results

☑ *Feasibility Demonstrated*

Matrix	Mean Log-pfu Reduction
Glass	6.2
Carpet	5.1
Wood	5.7
Fabric	5.9

- >4 log reduction achieved on and under porous materials
- All electrical equipment unaffected

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Next Step - Phase II

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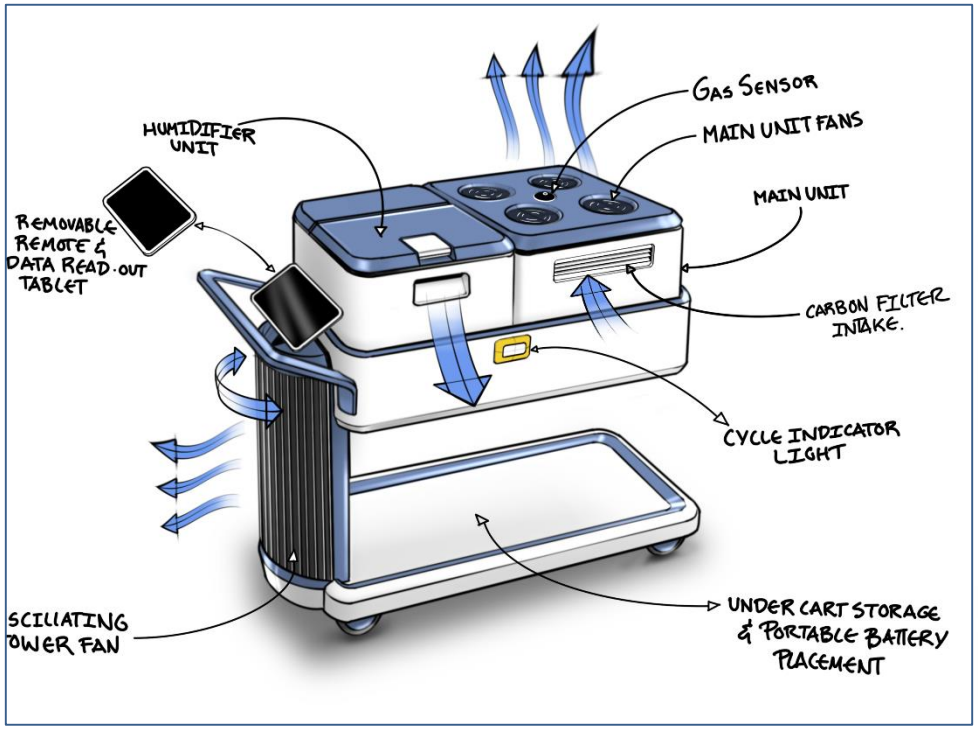
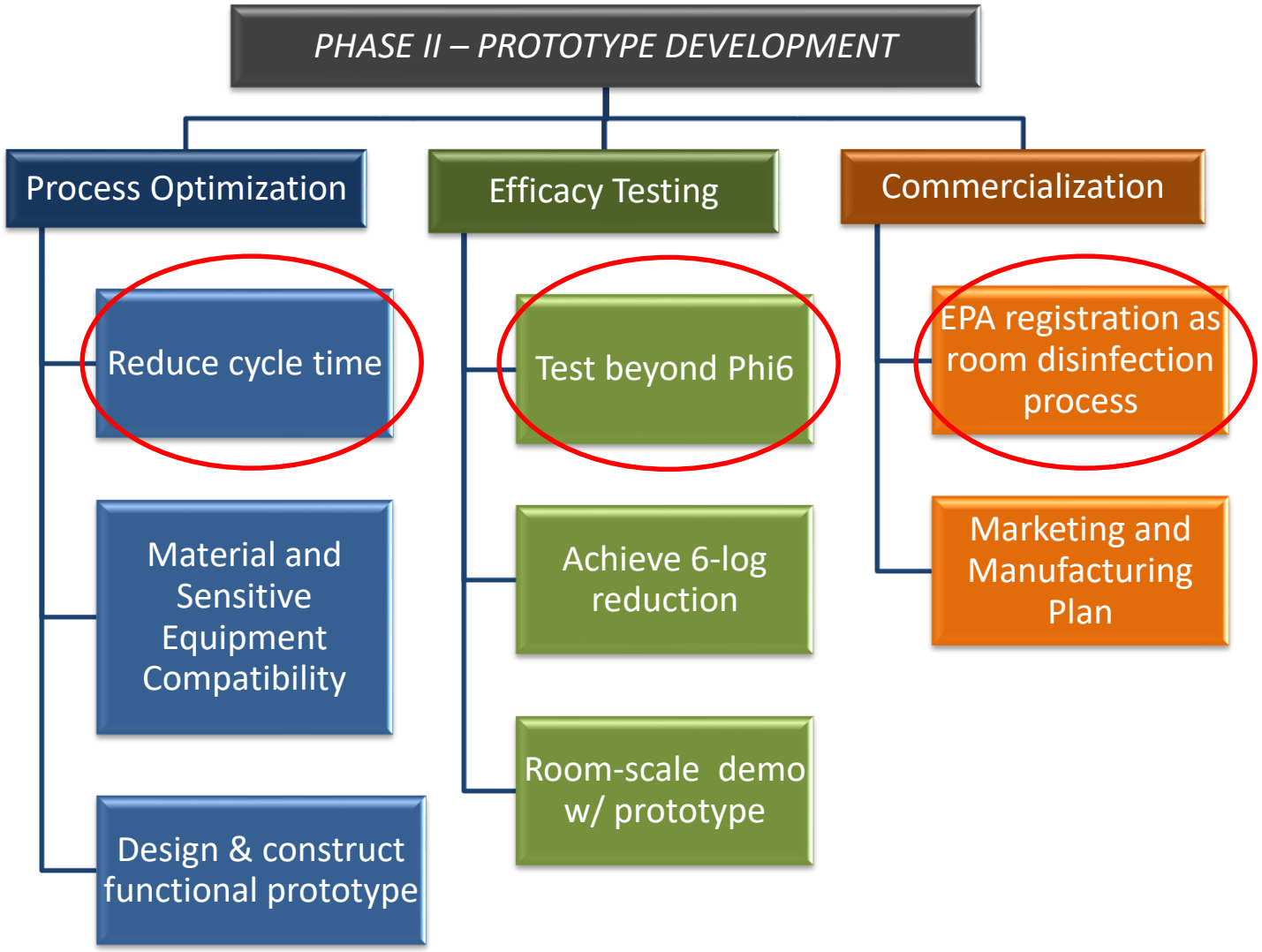
Continue development of micro-reactor centric ClO_2 gas dispersion system for on-site decontamination

- Safe, reliable, rapid, portable, user-friendly, low cost



Conceptualized "*Automated ClO_2 Gas Decontamination System*"

Next Step – Phase II



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Markets

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Potential Disinfection Uses – Ebola and other pathogens, pests, plant pathogens

Health Care
(non-hospital & hospital settings)

Home/Hospitality

Public Transportation

EMS Vehicles

Hospital

Isolation Chambers

Remote Care Units

Pests

Agriculture

We appreciate the opportunity to support the U.S. EPA

Special Thanks To
-SMT Inc.
-NSWCD (Tony Buhr, PhD)
-Foresight S&T
-BiggerTuna

METSS Corporation
300 Westdale Avenue
Westerville, Ohio 43082

Daniel P Lorch, Sr. Microbiologist
dlorch@metss.com
Angela Theys, PhD
atheys@metss.com

www.metss.com

METSS CORPORATION