

Improving Processes for Decontamination of Laboratory Waste

Aufra C. Araujo, PhD^{1,2,3}; Paul J. Meehan, PhD⁴ and Carolyn M. Black, PhD¹

1. Division of Scientific Resources/Office of the Director/National Center for Emerging Zoonotic and Infectious Diseases. 2. Laboratory Leadership Service Program. 3. Division of Laboratory Systems/Center for Surveillance, Epidemiology and Laboratory Services. 4. Office of the Associate Director for Laboratory Science and Safety

ABSA International
60th Annual Biological Safety Conference
16 October 2017







**125
bags/day**

Roybal Waste Management Risk Assessment

- Who? Autoclave operators, scientists, and engineers
- What? The process of autoclaving waste- evaluate risk of thermal and/or biohazard exposure
- How?
 - Observation of procedure
 - Evaluate each step of waste management
 - Mitigate risk
 - Reevaluate the residual risks
 - Demonstrate risks are at very low level
 - Summarize assessment to stakeholders, including standardized process

Objective

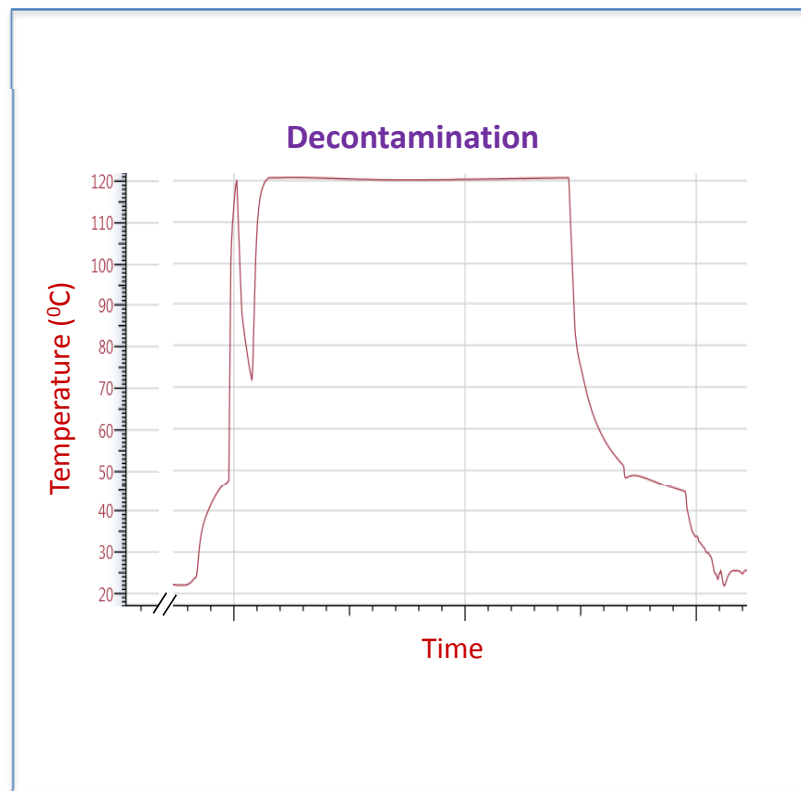
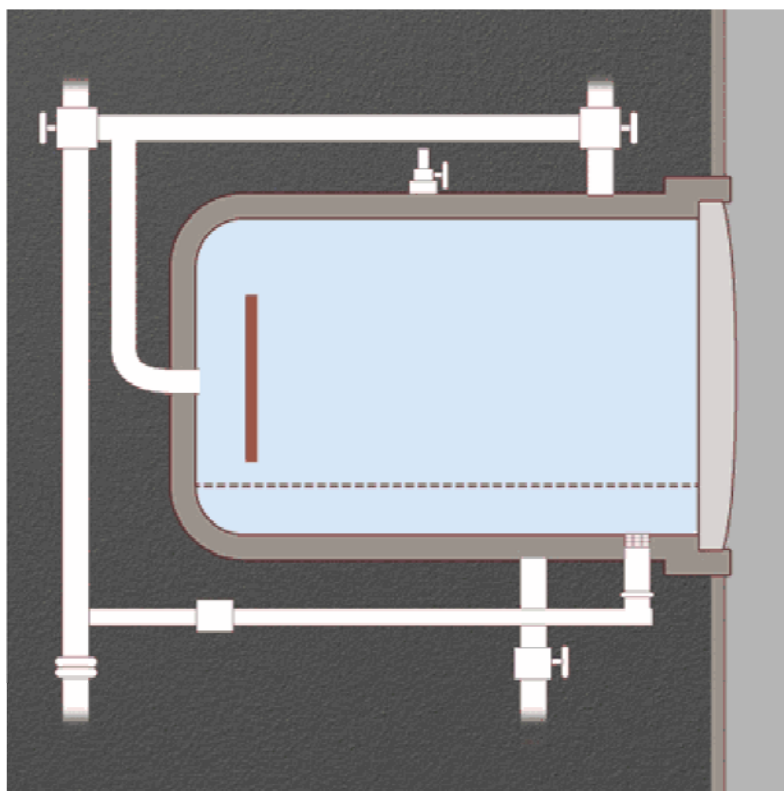
- **To develop scientifically based evidence for improving lab waste management practices at CDC**
- **Specific Aims**
 - Evaluate use of a new procedure for standardizing closure of autoclave bags
 - Test whether the addition of H₂O is needed
 - Standardize use of autoclave cycles and contact time
 - Optimize autoclave monitoring methods
 - Optimize loading configurations of autoclaves

Parameters Tested in Autoclave Bags/Pans

Variables	Autoclave Bags	Autoclave Pans
Content of Bags	Unused PPE (coveralls)	Unused PPE (coveralls)
Content Weight (lbs) per Bags	4 (previously tested by ESHCO) 12 (BagPipe prototype 1.0) 18 (highest weight in actual use) 8 (average weight selected for study)	3.5
Density of Loading	Folded Opened and fluffed	Folded Opened and fluffed
Closure of Bags	Twisted 5X and taped tightly BagPipe (PEX tube) Loosely closed with a knot	Twisted 5X Folded over loosely
BagPipe Diameter and Length	p1.0 = 1/2" diameter, 18" long PEX tubing p2.0 = 2" diameter, 6" long	Not applicable
H₂O Addition	No 250 mL 500 mL	No 250 mL
Number of Bags (or Pans) per load	2 Large 3 Large 4 Large 2 Large + 2 Small	8 Large 12 Large
Load Configuration	Vertically and horizontally combination Stacked horizontally w/o blocking BagPipe opening	Stacked leaving space between the stacks (crisscrossed)
Autoclave Monitoring Indicator Location	Top Center Bottom	Center
Autoclave pan lids	Not applicable	Closed with gap Closed without gap

All experiments in autoclave A043 (Bldg 18/SSSB/505); PreVac cycle

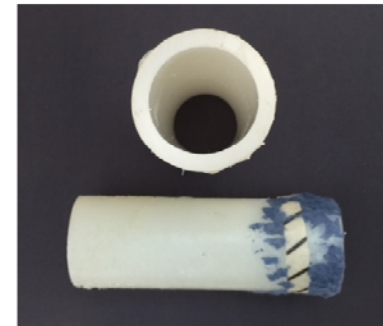
PreVacuum Cycle



1. Evaluation of BagPipe



6" long, 2" diameter
Cross-linked polyethylene (PEX) tubing



- Placed in the opening of an autoclave bag
- Held in place by taping neck of bag
- Standard opening allows steam to deeply penetrate bag to inactivate all contaminated material
- Top can be covered with Al foil until loaded into autoclave

Materials and Methods

PPE (coveralls) inside autoclave bags

Folded



(1)

Opened



(2)

Fluffed



Preparation of Autoclave Bags with or without BagPipes



- **Conditions**
 - Small and large bags
 - **8 lbs per bag**
 - Different density levels PPE
 - Two bags: sealed
 - Two bags: BagPipes

Preparation of Biological Indicators for Monitoring Procedure

BI* placed at the bottom, center and top of an autoclave bag filled with coveralls



* *Geobacillus stearothermophilus* 7954 (Accufast, Getinge)

Small and Large bags each containing 8 lbs PPE (different density levels)



Experiment Design

Six Runs

- **Conditions**

- All **experiments** were repeated in **triplicate**
- Load: **Four bags; 8lbs/bag** (13 coveralls)
- Autoclave bags filled up to 2/3rd of capacity
- Autoclave Cycle: **Pre-Vac**
- Temperature: **121°C**
- Pressure: **15 psi**
- Exposure: **60 minutes**



Treatment 1 (3X)

Added Water: 250 mL

Treatment 2 (3X)

No Water

Results I

Addition of Water to Autoclave Bags

Controls

Pass Fail



Large Bag

Top Center Bottom



Small Bag

Top Center Bottom



Bag Twisted and closed with
autoclave tape



BagPipe secured
in place with autoclave tape

Biological Indicator: *Geobacillus stearothermophilus* 7954 (Accufast, Getinge)

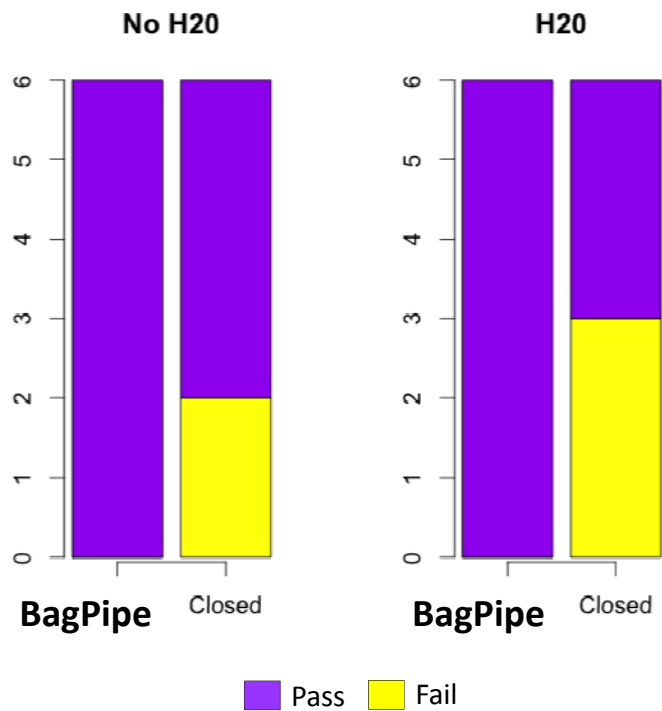
Results I



All BIs Passed Test with BagPipe

Closed Bags did not Consistently Pass BI Test

0% of bags ruptured



2. Loading Configuration

Position 1

Vertically and horizontally combination

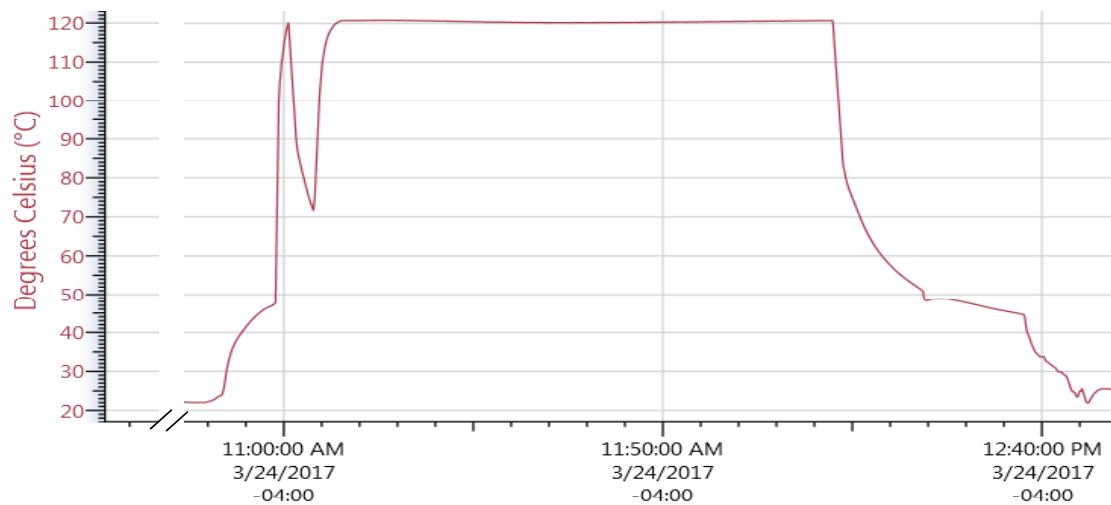


Position 2

Stacked horizontally



3. BagPipe Validation – Pre-Vac Cycle



* Indicates Data logger location inside the autoclave bag

Findings I

- Autoclave bags that were closed by twisting and taping shut either failed the biological indicator test or passed only as a result of bursting open inside the autoclave.
- The 2” diameter BagPipe used to vent autoclave bags resulted in successful decontamination of lab waste in all experiments.
- Addition of water to autoclave bags is not required for successful decontamination if using BagPipes in Pre-Vac cycle.
- Any tested loading configuration of autoclave bags worked as long as the BagPipe opening was not blocked.
- Same results were obtained in 14 autoclaves when using PreVac cycle (total of 76 autoclave bags).

4. Evaluation Using Autoclave Pan

Six Runs

Addition of Water to Pans and Loading Configuration

- **Conditions**

- All **experiments** were repeated in **triplicate**
- Load: **3.5 lbs/pan** (coveralls)
- Autoclave pans filled up to 2/3rd of capacity
- Autoclave Cycle: **Pre-Vac**
- Temperature: **121°C**
- Pressure: **15 psi**
- Exposure: **60 minutes**

Treatment 1 (3X)

Added Water: 250 mL

Treatment 2 (3X)

No Water

Loading the Autoclave

Bags folded loosely (F)

Bags twisted 5X and "closed" (C)

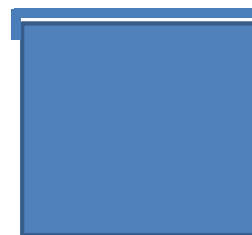
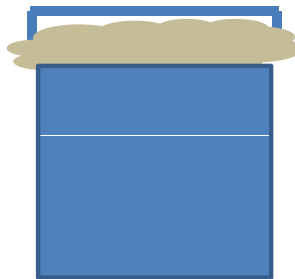
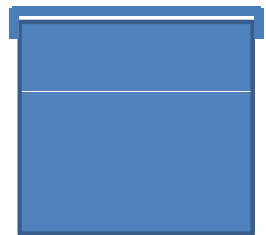
Lid closed completely
(LCC)

Lid closed with gap
(LG)

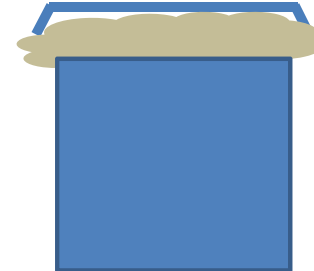
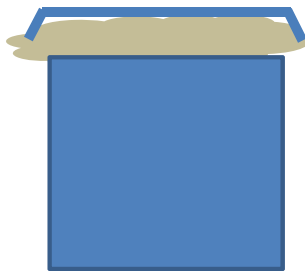
Lid closed completely
(LCC)

Lid closed with gap
(LG)

No H₂O
(A)



250 mL
H₂O
(B)



Loading the Autoclave

Before

After



Results II

- All pans passed the biological indicator test independently of addition of water.
- Pans with twisted bags containing fluffed PPE and closed with a gap had displaced lids and decompressed PPE after autoclaving. In one case, this pressure was strong enough to overturn the pan.

Findings II

- Autoclave pans do not require addition of water for adequate decontamination.
- A loose liner bag opening is important to minimize movement of pan and exposure of waste by dislodging of pan lids.

The background features a stylized globe with various network-like elements. There are several circular nodes connected by thin lines, some with arrows indicating direction. The globe is rendered in a light, semi-transparent style, allowing the underlying network patterns to be visible. The overall color palette is dominated by shades of blue and grey, with some green and purple accents in the footer.

**BASED ON THE RESULTS WE HAVE OBTAINED, WE
HAVE REVISED THE INTERNAL CDC GUIDANCE FOR
THE DISPOSAL OF LABORATORY WASTE**

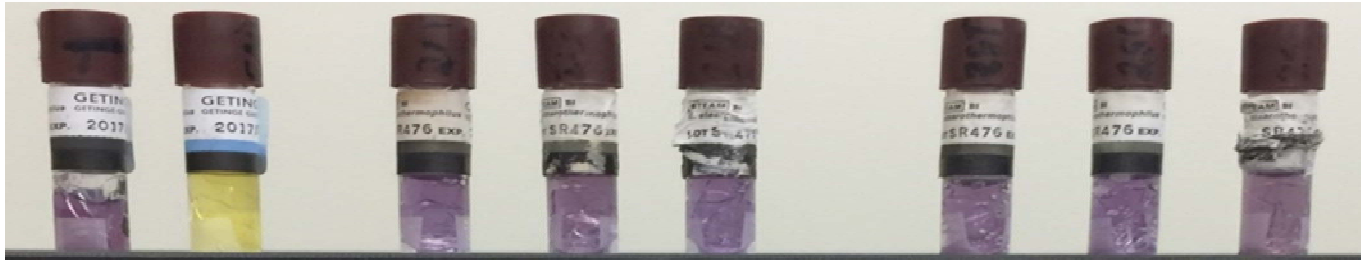
Revisions to the CDC Guidance for the Disposal of Laboratory Waste

- Do not add water to autoclave containers
- Use only Pre-Vac Cycle
- ALWAYS use a BagPipe when disposing soft lab waste in autoclave bags
- Do not use BagPipe when disposing hard lab waste in autoclave pans
- Do not mix hard/sharps with soft waste in autoclave bags

Outcome

- Autoclave safety training for CDC laboratorians
- CDC Guidance for the Disposal of Laboratory Waste
- SOPs for Lab waste management
- **These changes have already reduced incidents of rupturing and leaking autoclave bags.**

End



Acknowledgements

DSR

Carolyn M. Black
Cedric Jackson
Anthony Wimbush
Kismet Scarborough
Heather Hughes
Smitha Moter
Joseph Miller
Nathaniel Powell
George Lathrop

CSELS/DLS

Harold Bamberg
Elizabeth Weirich

OSSAM/AMSO

Paul Probst
Keith J. Smith

OADLSS

Paul Meechan
Rob Weyant
Mary Brandt
Carin DeBenedictis
Claire Kieger

Thank you!

NCEZID/OD

Kathleen Keyes
Cody Clemmons

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.