DLS ECHO Biosafety Session: September 26, 2023

Medical Waste Management

Nikki Parrish, PhD

Associate Professor of Pathology, John Hopkins University School of Medicine

Director of Medical Mycobacteriology, John Hopkins Hospital

Baltimore, MD

Agenda

- Didactic and Case Presentation
- Discussion
- Summary of Discussion
- Closing Comments and Reminders

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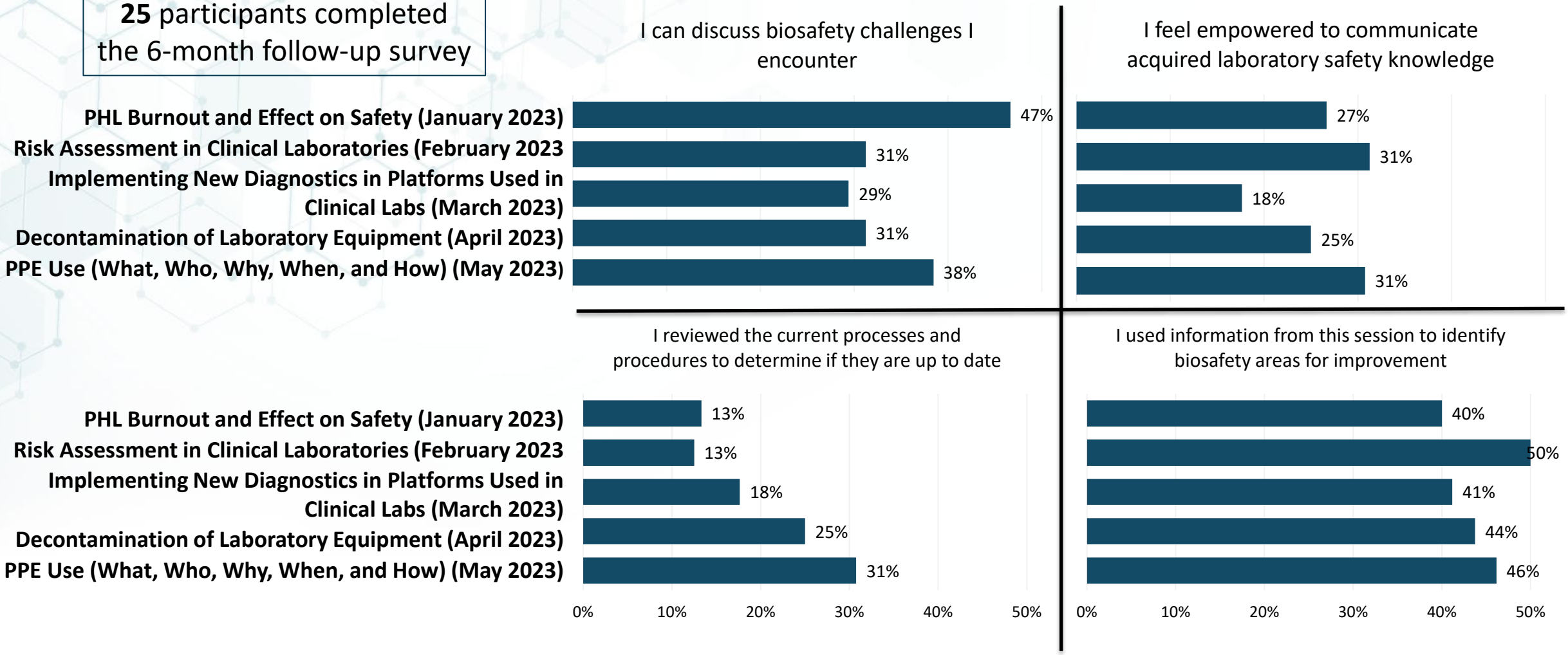
Survey Respondents Feedback at 6 Months

25 participants completed the 6-month follow-up survey



Medical Waste Management in the Laboratory

JOHNS HOPKINS
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Disclosures

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- **NIH-DAIDS**
- **Thermo Fisher**
- **doTerra**

Medical Waste Management and the Impact of a High-Consequence Pathogen

- In 2014, an Ebola outbreak in West Africa revealed potential **gaps** in the abilities of US hospitals and laboratories to provide care
- Prior to this, care of these patients restricted to a limited number of facilities or biocontainment units (BCUs)
- CDC recommended tiered approach: US hospitals-frontline health care facilities, Ebola assessment hospitals, or Ebola treatment centers
- Regional Ebola and Other Special Pathogen Treatment Centers (RETCs) were established in the US

Questions About Management of Ebola Medical Waste….

- This outbreak presented hospitals and laboratories with unique challenges
- Care of these patients generated a significant amount of patient and laboratory medical waste containing category A infectious substances
- The amount of waste was much greater than that for routine medical care
- The CDC recommended that facilities preparing to care for patients infected with Ebola consider installing on-site autoclaves to handle category A waste

Establishment of a Biocontainment Unit at JHH

- The Johns Hopkins Hospital constructed a state-of-the-art Biocontainment Unit (BCU)
- Designated as the Region 3 Regional Ebola Treatment Center serving MD, DE, PA, VA, WV, and DC
- The BCU is a negative pressure facility with controlled access and contains multiple patient rooms and an onsite laboratory
- It also includes 2-pass through autoclaves (Class B) for sterilizing infectious waste
- All waste is autoclaved before exiting the unit

The Johns Hopkins Biocontainment Unit

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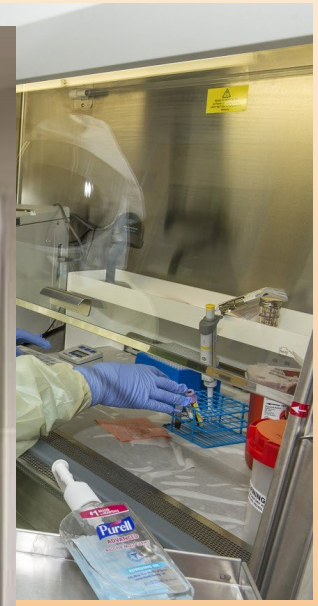

A Word About Autoclaves

Gravity displacement autoclaves (Class N and S): Steam displaces a portion of the air in the chamber by gravity through a drain port. Steam application can be single (used for simple loads like flat medical tools) or multiple (used for bagged waste and porous loads).

Most Labs have this type of autoclave which operates at 121°C (15 lbs/in^2 of pressure)

Pre-vacuum autoclaves (Class B): a powerful vacuum pump is used to quickly remove all the air from the chamber, can sterilize most materials, many models utilize an automated process.

Some labs may have this type of autoclave which operates at 132°C (27 lbs/in^2 of pressure) higher temperature/pressure and greater steam penetration reduce recommended run time to at least 10 minutes

Question #1

Does your facility autoclave laboratory medical waste?

Answer: A. Yes

B. No

Question #2:

If your facility autoclaves medical waste, what type of autoclave is used?

Answer: A. Class N or S
B. Class B

Autoclave Phases

- Purge phase: Air present in the sealed chamber is displaced with steam that moves in through the sterilizer (some autoclaves use a vacuum to remove air in the chamber)

- Exposure phase: In this phase, the exhaust valve is closed and the temperature and pressure inside the sealed chamber are increased to the desired set point. The temperature is maintained for the set duration of time.

- Exhaust phase: The exhaust valve is opened, steam is removed, and the chamber is restored to normal temperature.

Points to Ponder for Our Purposes…..

- Autoclave loads in the BCU were often mixed (laboratory and patient medical waste)
- Amount of waste was too great to permit segregation of lab versus patient waste
- General accepted standard: 60 minutes at 121°C-131°C kills most microbes without regrowth (average 8-log reduction). (Note: this time does not include ramp up or cool down stages)
- So we started there……

Question #3

Do you think the 60-minute standard exposure time at 121°C to 131°C was sufficient to sterilize simulated medical waste loads from the BCU in these autoclaves?

Answer: A. Yes

B. No

Initial Factory Default Autoclave Parameters

Cycle Type	Sterilize Temp	Sterilize Time (Min)	Dry/Cool Time (Min)	No. of Prevacs
Vacuum	134°C	15	30	3
Gravity	123°C	30	30	0
Liquids	123°C	30	15	0

(Parrish et al, 2017)

Let's Talk About What Didn't Work…

- 16/19 (84%) of runs using factory default settings failed to sterilize biological indicators in the center of the simulated load

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- Included all runs performed using liquid or gravity cycles for 30 minutes at 123°C

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- Failures occurred regardless of type of bag closure (‘goose-necked’ lightly folded, or rubber-banded)
- Dissolvable autoclave bags were also tried but abandoned because they dissolve when in contact with any liquid

What was needed…..

- Autoclave sterilizing parameters which provided for the shortest turn-around-time, but could be used with mixed waste loads
- Amount of waste was too great to permit segregation of laboratory versus patient waste
- Had to be performed while wearing enhanced PPE under BSL-3 conditions

Autoclave parameters modified from factory default settings

Parameter	Settings/Ranges Tested	Purpose
Type of Cycle	Vacuum, Gravity, Liquid	Various cycle types were selected based on load type
Sterilization Time (Min)	15 - 180	Various sterilization times were tried based on load type
Sterilization Temperature (°C)	123 – 134	Various temperatures were tried based on load type and duration of sterilization phase
Slow or Rapid Exhaust	Rapid exhaust used for vacuum and gravity cycles; slow exhaust used for liquid cycles	
Dry Time/Liquid Cool Time (Min)	1 - 45	Time removing moisture/cooling the chamber
Purge Time (Min)	2 - 14	Time removing air from the chamber
Precharge (PSIG)	1 - 20	Pressure to be achieved during the charge portion of all prevac phases
# Prevacs	1 to 6	# of pulses autoclave will pull before starting a cycle
(Prevac) Vac Point (InHg)	5 - 10	Sets vacuum end point for pulses in InHg

Question #4

Based on your own experience, do you think we were successful in finding a single cycle and parameters which provided for decontamination of ALL medical waste considered together?

Answer: A. Yes

B. No

Optimized cycles and parameters used in this study for adequate sterilization of simulated waste

Parameter	PPE + Dry Trash	Saturated Linens	Liquids
Autoclave Bag Type and Configuration	Standard Clear Bags: Double Bagged		
Bag Closure	Clamped outer bag, loosely twisted inner bag*		
Cycle Type	Vacuum	Vacuum	Liquid
Sterilization Time (Min)	30	60	120
Sterilization Temperature (°C)	134	134	123
Dry/Cool Time (Min)	1	10	35
Purge Time (Min)	4	5	14
Precharge (PSIG)	20	20	20
Number of Prevacs	3	3	3
(PreVac) Vac Point (InHg)	10	10	10

Abbreviations: Min, minute, PSIG, pounds per square gauge (pounds per square inch relative to atmospheric pressure, InHg, Inches of mercury.

Question #5

Do you think it is necessary to utilize simulated loads of medical waste for validation of autoclaves used in laboratories for general decontamination purposes?

Answer: A. Yes

B. No

Question #6

What about for autoclaves used for decontamination of medical waste with highly-consequential pathogens including Category A?

Answer: A. Yes

B. No

What About Your Experience Using Autoclaves to Decontaminate Medical Waste?

Let's Talk About it……

DLS ECHO Biosafety Session: October 31, 2023

Quality in Biosafety

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