Toxins Within Collections

Jim Fuller, PharmD
MA Candidate Museum Studies
IUPUI
Indiana Medical History Museum Intern

Sarah M. Halter, MA
Executive Director
Indiana Medical History Museum
Challenges with the Collection
Challenges with the Collection
How do Medical History Museums identify, assess, and mitigate toxins or poisons lurking in their collections?

- **Situation**
- **Background**
- **Assessment**
- **Recommendations**
Medical History Museums (and all museums) with objects and artifacts made from natural products may have toxins, poisons, or hazardous compounds present in their collections.

Additionally, Medical History Museums may have fluid preserved specimens that may contain hazardous chemicals.
In order to protect from pests, from the 1800’s to approx 1970, museums and collectors routinely treated their perishable artifacts with pesticides. ¹

Among these, arsenic and mercury have significant human toxicity and leave significant quantities of residue on treated objects. ¹

Especially objects made of or containing: Leather, Wood, Feathers, Vegetable matter, and other natural fibers. ¹

Tissues may be preserved in a variety of chemicals including solvents, acids and alkalis, metals and their salts, and plastics. ²

“There are no safe organic solvents, only more or less toxic ones”² Catherine Hawks et al

A poison is a substance that can do harm if it enters the body.

The results can be immediate, injuring the organs, and/or cumulative, ultimately resulting in cancer or reproductive problems.

Even common substances, like water and salt, can be toxic if ingested in a high enough quantity.

Substances like arsenic are also poisonous, but a lesser dose is required to cause harmful effects.

Poisonings

Entrance of a poison into the body depends on:

• Form (solid, liquid, or gas)
• Chemical properties
• Availability (open container or spill)
• The person's activities (occupational, accidental, or suicidal)
• Body's built-in defenses (skin or stomach lining).


Photo credit: clipart-library.com
The pathways for poisons to get into the body are referred to by toxicologists as:

- Ingestion (swallowing)
- Dermal exposure (skin contact)
- Inhalation (breathing)

Types of Poisonings

Once a poison has entered the body, poisoning may be:

- Acute
- Chronic
- Cancer/reproductive related


Photo credit: wikimedia.org
When dealing with the issue of pesticide contaminated museum collections, adverse health effects are related to:

- Inherent toxicity of a substance
- The quantity and duration of exposure to it (a dose-response relationship)
- Individual susceptibility to its effects

Personal Protection Equipment (PPE): Individuals who use protective equipment in handling contaminated objects will be at very low exposures (and very low risk).

Pesticides containing arsenic and mercury are of greatest concern.

- Use has been ubiquitous, for a long time, and generally in amounts that are capable of producing human toxicity.
- The particular forms that were used are of high toxicity.
- Once applied, arsenic and mercury tend to remain on the treated object.
- The degradation that does occur may only change the route of exposure and spectrum of toxicity.
- The signs of toxicity, especially when exposure is to small amounts over time, can be subtle and difficult to diagnose.
- Both arsenic and mercury are elements so they are environmentally permanent and can contaminate air, soil, and groundwater.

Arsenic

Arsenic is the toxic chemical used as a pesticide that is of the greatest concern.

The toxicity of arsenic is determined both by its chemical formulation and by the dose.

The toxicity levels for arsenic in general are:

- **Acute toxicity by ingested dose:**
  - 1 mg-10 g: toxic and fatal
  - 1-3 mg/kg ingested: potentially fatal

- **Chronic (cumulative) toxicity by ingested dose:**
  - 3-4 mg/day

Employee 150 lbs.

150 lbs x 0.4536 kg/lb = 68.04 kg

Recall 1 mg - 10 gm of Arsenic is potentially toxic dose

Poisoning dose 1-3 mg / kg x 68 kg = 68 - 204 mg

By comparison: Baby aspirin has 81 mg active Aspirin ingredient
Arsenic in 50 A.D.

- Dioscorides, a Greek physician in the court of the Roman Emperor Nero, described arsenic as a poison in the first century.
- Its ideal properties for sinister uses included its lack of color, odor or taste when mixed in food or drink.
- Symptoms of arsenic poisoning were difficult to detect, since they could mimic food poisoning and other common disorders.

Arsenic and Old Lace in 1944

A drama critic learns on his wedding day that his beloved maiden aunts are homicidal maniacs, and that insanity runs in his family. (23 September 1944)
Methods:

- Literature review
- Created targeted survey questions with input from my museum mentor
- Created Survey Monkey on-line survey tool
- Distributed survey to:
  - Targeted museums as identified by my mentor
  - Museum-L Listserv
  - Other museums as identified by faculty
- Collated results and discussed with museum mentor
- Compiled related resources
Survey Respondents: 16 Responses

• States and Districts represented: 10
  • DC, IN, MD, MN, NJ, NM, OK, PA, UT, WA

• Types:
  • Medical Museums: 3
  • Governmental: 8
  • Colleges / Universities: 2
  • Private 501c3: 3
Question 1: Assess, identify, mitigate?

Yes, we’ve assessed our collection
Yes, we’ve worked to identified hazardous compounds
Yes, we’ve worked to mitigated hazardous compounds
Yes, I’m willing to share developed materials
No, no assessment, identification or mitigation
No, Comments offered

Due to the historical use of preserving collections with pesticides and other hazardous chemicals, has your organization taken active steps to assess, identify, and mitigate toxins or hazardous compounds that may remain in your collection – either on treated objects or otherwise? (Check all that apply)

- Yes, we’ve assessed our collection: 68.75%
- Yes, we’ve worked to identified hazardous compounds: 50%
- Yes, we’ve worked to mitigated hazardous compounds: 37.5%
- Yes, I’m willing to share developed materials: 6.25%
- No, no assessment, identification or mitigation: 31.25%
- No, Comments offered: 18.75%
Question 2: Active testing?

We have not done any active testing

- X-ray fluorescence (XRF)
- Test Strips (please indicate brand)
- Other methods (please describe)
  - We are, and I’ll share materials
  - We have not done any active testing

Has your organization done active testing using any of the following methods to determine if objects have any toxins or hazardous compounds present? (Check all that apply)

- X-ray fluorescence (XRF): 31.25%
- Test Strips: 12.5%
- Other methods: 12.5%
- We are, and I’ll share materials: 6.25%
- We have not done any active testing: 62.5%
Does your organization actively promote the use of Personal Protection Equipment (PPE) when staff or volunteers are handling objects that may contain toxins or hazardous compounds?

- Yes: 75%
- Yes, and I’ll share info: 6.25%
- No: 25%
Question 4: Handling of broken objects / spills?

Does your organization have a formal process to handle broken objects or spills from objects that may contain toxins or hazardous compounds?

Answered: 14  Skipped: 0

- Yes: 50%
- Yes, and I’ll share: 6.25%
- No: 50%
Question 5: Good reference materials?

Are you aware of good reference materials or publications from museum-based professional organizations that may help inform this research question?

Answered: 14   Skipped: 0

Yes: 50%
No: 50%
Key Findings:

- 68% have assessed but it was difficult for them to quantify what that meant when asked as follow-up.
- 50% indicated they had worked to identify compounds but 62% indicated they had done no active testing.
- ~20% have done no assessment, identification or testing.
- 75% indicate they actively promote PPE but few have a formal policy or procedure when asked in follow-up.
- 50% do not have a formal process for broken objects or spills
- 50% are unaware of good references or materials
Recommendations:

- IMHM to implement Personal Protective Equipment (PPE) for staff and volunteers. (deliverable)
- IMHM should consider working with an external conservator to identify priorities and strategic plan. (draft grant proposal deliverable)
Limitations of my study

- Small sample size (may be able to increase with more time, recirculating survey, targeted requests to complete)
- Difficult to get engagement to complete survey
- Responses may be more aspirational than factual
- Museums may be reluctant to acknowledge that they are inadequately addressing toxins within their collections
What We Learned

- We are not alone.
- We can work together.
- We can learn from others.
What's Next?

Disaster planning

Policies and procedures
Questions?

Thank you!