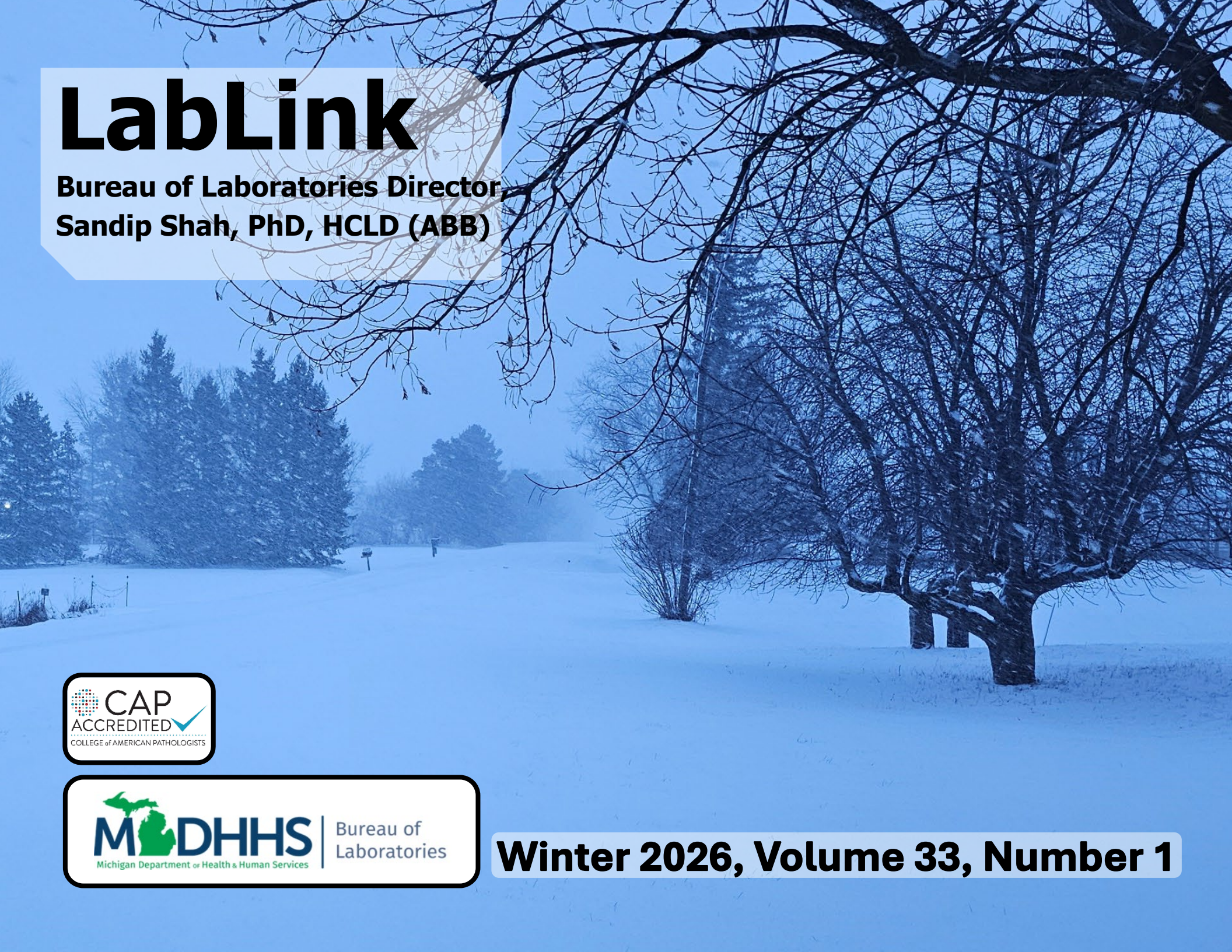

LabLink

Bureau of Laboratories Director
Sandip Shah, PhD, HCLD (ABB)

CAP ACCREDITED
COLLEGE of AMERICAN PATHOLOGISTS

MDHHS Michigan Department of Health & Human Services | Bureau of Laboratories

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In This Issue...

Bureau Mission

We are a team dedicated to continuing leadership in providing quality laboratory science for healthier people and communities through partnerships, communication and technical innovation.

Bureau Vision

To strive for equitable health outcomes by serving Michigan's diverse population using the highest standards of laboratory science.

Stay Current

Visit our web page at

Michigan.gov/MDHHSLab

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Editor: Heather Seymour

Upcoming Changes to the Rabies Submission Kit

The Bureau of Laboratories' rabies submission kits will soon have a new look.

The changes will meet shipping requirements and will improve protection during transit to support safer, smoother and more reliable shipping.

Changes are shown in the tables on page four and will include:

- Dual heavy-duty zip-closure bags to prevent tears and leaks.
- Highly absorbent padding.
- Adhesive envelope for requisition forms.
- Additional ice packs.

Current supplies may be used until exhausted, and the new kits placed in use when received.

The change date will be announced using the GovDelivery system. If you are a BOL partner not currently receiving notifications and would like to subscribe, please send a request to MDHHSLab@michigan.gov.

Packing and shipping instructions will be updated and available on the Specimen Collection and Shipping Instructions web page.

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47S: Kit # 47S: Rabies Infections (Submission of Small/Routine Specimens) 1.3 Gallon Pails

Current Kit	Upcoming Kit
1 - Corrugated box, 9.5" x 9.5" x 8"	1 - Corrugated box, 9.5" x 9.5" x 8"
1 - Plastic 1.3 Gallon Pail with Lid	1 - Plastic 1.3 Gallon Pail with Lid
1 - Ice pack	4 - Ice packs
1 - Zipper Bag, 4" x 8"	1 - Zipper Bag, 9" x 12"
1 - Zipper Bag, 10" x 12"	1 - Zipper Bag, 13" x 15"
2 - Absorbent Strips	2 - Absorbent Pads
1 - Biological Substance Shipping Label (DCH-0800)	1 - Biological Substance Shipping Label (DCH-0800)
1 - Refrigerate on Receipt, Do Not Freeze Label	1 - Refrigerate, Do Not Freeze Label
1 - Requisition/Directions (DCH-1053)	1 - Biohazard Sticker
	1 - Requisition Form/Directions (DCH-1053)
	1 - Adhesive envelope for requisition form

47L: Kit # 47L: Rabies Infections (Submission of Large Specimens) 3.5 Gallon Pails

Current Kit	Upcoming Kit
1 - Corrugated box, 12" x 12" x 12"	1 - Corrugated box, 12" x 12" x 12"
1 - Plastic 3.5 Gallon Pail with lid	1 - Plastic 3.5 Gallon Pail with lid
4 - Ice packs	8 - Ice packs
1 - Zipper Bag, 10" x 12"	1 - Zipper Bag, 13" x 18"
4 - Absorbent Strips	1 - Zipper Bag, 18" x 20"
1 - Extra Large Bio-hazard Autoclave Bag	3 - Absorbent Pads
1 - Biological Substance Shipping Label (DCH-0800)	1 - Biological Substance Shipping Label (DCH-0800)
1 - Refrigerate on Receipt, Do Not Freeze Label	1 - Refrigerate, Do Not Freeze Label
1 - Requisition/Directions (DCH-1053)	1 - Biohazard Sticker
	1 - Requisition Form/Directions (DCH-1053)
	1 - Adhesive envelope for requisition form

Advancing Drug Checking in Michigan: HRMS Detection of Novel Psychoactive Opioids

Authors: Xingxing Li, Ph.D., Michael Stagliano, Ph.D., Timothy Karrer, MS

Opium, originally isolated from a plant species known as *Papaver somniferum*, or opium poppy (Figure 1), is used to manage pain and as a sedative. Since the first potent and consistent psychoactive substance — the morphine alkaloid (Figure 1) — was isolated from opium in the early 1800s (1), opioid use has been a double-edged sword for human society. These compounds effectively block pain pathways in the brain and nervous system, making them essential in clinical pain management (2), but their euphoric effects can lead to misuse and fatal overdose due to respiratory depression, hypoxia and long-term side effects (2).

The U.S. opioid crisis evolved with three noticeable waves (3), the first beginning in the late 1990s with a rise in prescription opioid overdose deaths due to aggressive marketing by pharmaceutics and the second following fatalities associated with an increase in the use of heroin, a semi-synthetic opioid made from morphine. Starting around 2013, the third wave was characterized by a dramatic surge in death due to a variety of fully synthetic new psychoactive opioids (NPOs), represented by fentanyl (Figure 2) and its analogs (3, 4).

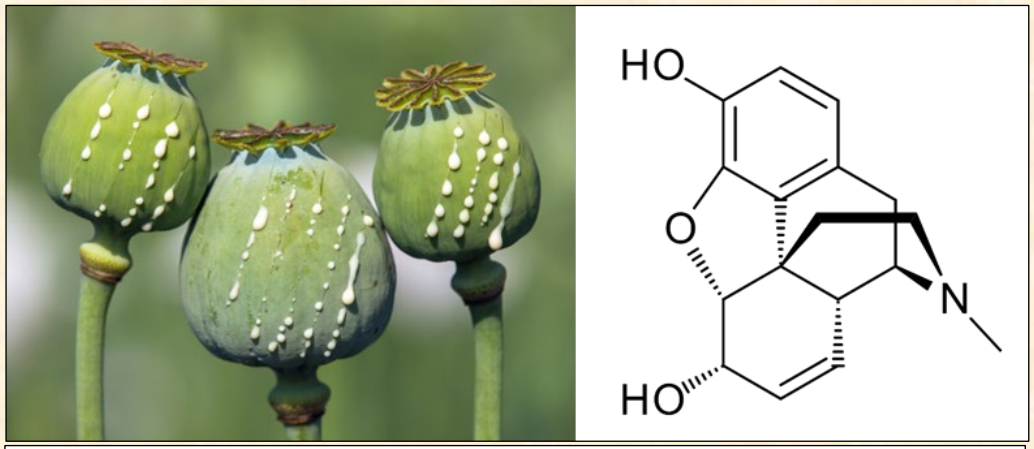

Figure 1
Papaver somniferum, commonly known as the opium poppy, with milky white opium latex (left), the raw source of opium that contains morphine alkaloids (right).

Although pharmaceutical fentanyl has long been a controlled substance in the U.S., its chemical precursors are often synthesized in foreign clandestine labs and then shipped to Mexico to be processed into illicitly manufactured fentanyl (IMF) (5). The IMF smuggled into the U.S. has flooded the street drug market in the form of powders, nasal sprays and pills that look like lawful prescription opioids.

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Some typical counterfeit prescription pills containing IMF are often pressed to look like legitimate oxycodone M30 tablets (Figure 2). They are sold via the internet for only a few dollars per pill under the street name “fentanyl blue” or simply the “blues” (6).

IMFs are often extremely potent. As little as two milligrams of fentanyl, an amount equal to about 10–15 grains of table salt, is considered a potentially lethal dose for an average adult (3, 5, 6). Carfentanil, a fentanyl analog used as a large animal anesthetic, is about 100 times more potent than fentanyl and 10,000 times more potent than morphine (7). Given the potency of fentanyl and its low production cost, drug dealers tend to mix it with other illicit drugs such as heroin, methamphetamine and cocaine, further complicating the forensic identification of street drug overdose (Figure 2).

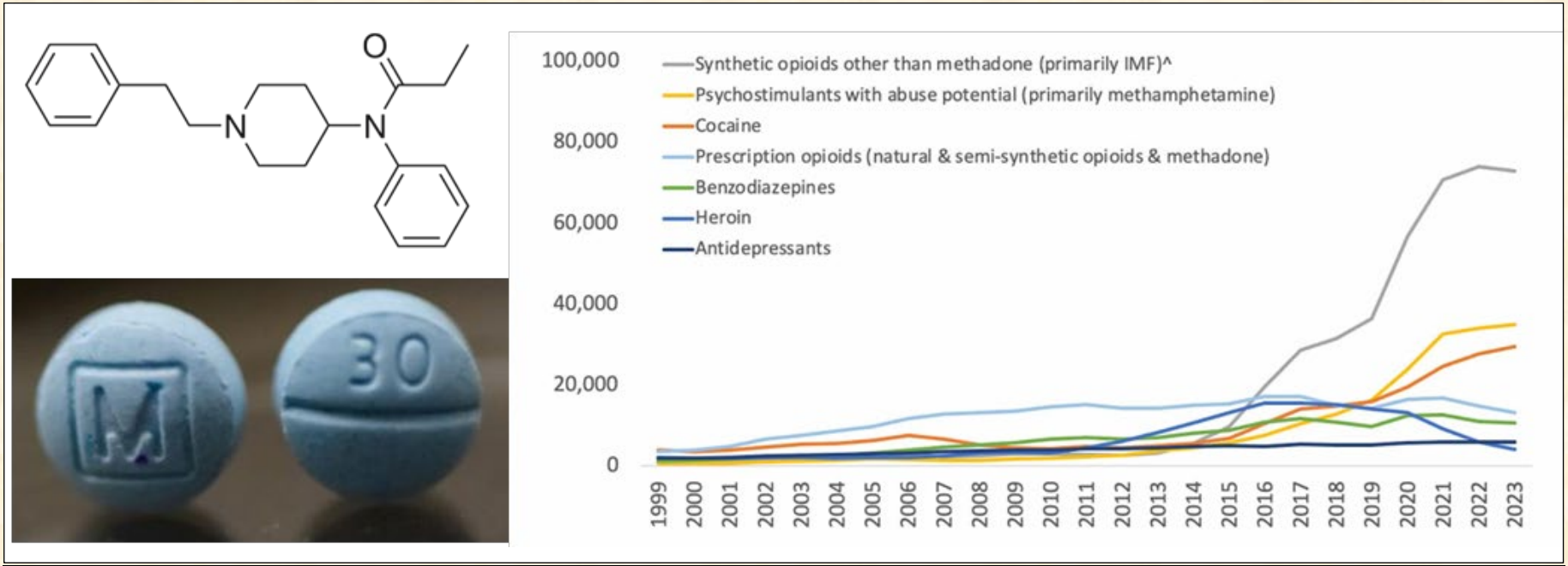

Figure 2
Chemical structure of fentanyl (upper left). IMF pills mimicking the appearance of authentic 30mg oxycodone pills (lower left) (Source: DEA). Street drug overdose deaths in the U.S. between 1999 and 2023 with the grey line representing the overdose death rate of NPOs, primarily IMFs (right) (Source: CDC WONDER).

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Like many other states, Michigan Department of Health and Human Services (MDHHS) started the harm reduction (HR) infrastructure for drug overdose prevention in 2018. The efforts include distribution of free naloxone overdose-reversing medication kits, operation of numerous HR sites providing essential supplies and services and data-driven response (8). However, one emerging challenge for the harm activities is the rapid evolution of NPOs, such as novel fentanyl analogs, and the complexity of polysubstance use. Without precise information about the chemical constituents of illicit drugs, determining the appropriate overdose treatment becomes more difficult.

Drug checking has traditionally been done at HR sites using portable tools such as Fourier-transform infrared (FTIR) spectroscopy, immunoassay test strips and paper analytical devices. These on-site methods are convenient and provide rapid results; however, their limited sensitivity, accuracy and resolution makes them less suitable for detecting NPOs, which are often present at trace levels below the detection limits of standard forensic toxicology techniques.

To address these limitations, a high-resolution mass spectrometer (HRMS) based method **(**Figure 3) was developed by the MDHHS Bureau of Laboratories (BOL) Clinical Chemistry Section to screen and identify NPOs and popular non-opioid central nervous system depressants and stimulants. Compared with conventional low-resolution mass spectrometers (MS), HRMS can measure exact mass, allowing for the differentiation of drug molecules with the same unit mass. This is comparable to the difference between a kitchen scale and a jewelry scale. A conventional MS is like a standard kitchen scale, which tells you the mass to the nearest whole number, e.g., 123 grams. This type of MS is sufficient to study molecules with larger differences, but not ideal for distinguishing subtle differences between similar drug molecules with masses that might differ by only a few decimal places. A HRMS is like a professional jewelry scale. It can measure the exact mass to several decimal places, e.g., 123.0156 grams. Therefore, just like a jewelry scale can tell the difference between a real diamond and a cubic zirconia, the HRMS can measure a tiny difference between similar molecules (Figure 3).

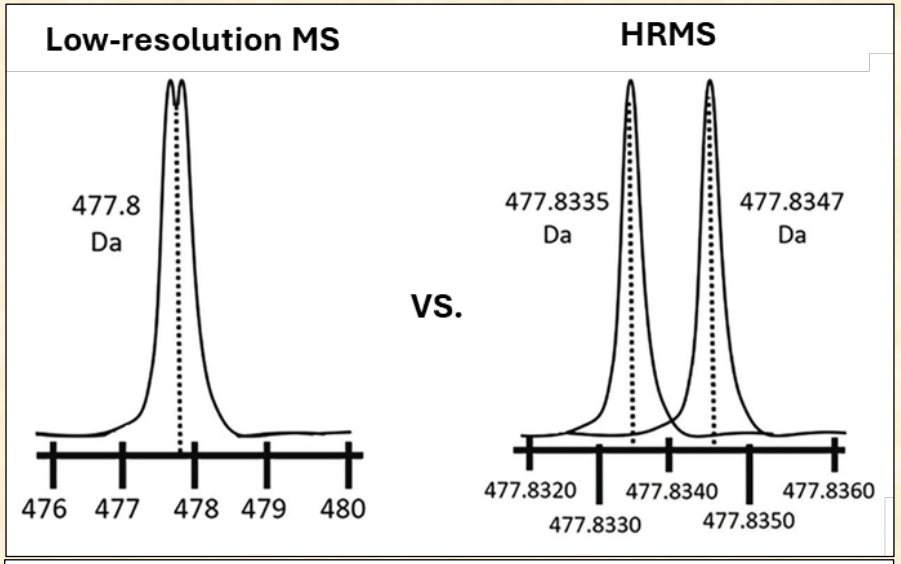

Figure 3
HRMS can resolve two very similar masses that low-resolution MS cannot (9).

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In addition, this precise measurement of the mass allows HRMS to determine a molecule's unique chemical "fingerprint" or elemental composition, i.e., exactly how many carbons, hydrogens, oxygens, etc. it has. When used in combination with the large-scale comprehensive drug screening libraries, unknown chemical substances such as adulterants in the drug samples may also be identified. The current drug library used at the BOL, Waters Toxicology Screening Library, covers more than 2000 illegal drugs, prescription drugs and common drug adulterants. In short, with highly accurate mass measurement, HRMS offers an orthogonal approach to the rapid on-site methods. This multi-instrument strategy helps balance the trade-offs among speed, cost, portability and analytical accuracy. The BOL supports HR efforts by offering this analytical service as an informative tool to HR agencies performing anonymous drug checking, public participants and MDHHS.

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History of Blood Lead Testing at the Bureau of Laboratories

Authors: Emily Garner, Sarah Lockwood O'Brien, PhD, Keri Fisher, MPH, CPH, MLS (ASCP)CM, ASQ CQPA, LSSGB

Lead contamination is a commonplace problem throughout the world as it can be found in a wide variety of environments and matrices. Michigan's industrialization is both a significant and proud part of the state's economic development but also resulted in contamination of the environment with lead. Due to the known risks for young children exposed to lead, it is especially important to monitor children's blood lead levels to ensure they are in a safe environment to grow and develop. In 2024, Michigan had 5,583 children under the age of six with elevated blood lead levels of greater than 3.5 µg/dL (1).

MDHHS began testing children's blood lead levels in the early 1990s. Lead is an invisible threat that can be toxic to people, particularly children, when ingested, inhaled or absorbed. Lead can poison the body by damaging the brain and nervous system, interfering with growth and development. Once introduced into the body, lead gets absorbed by the soft tissues in the body and can ultimately be deposited in the person's bones (2). Lead in blood will eventually be removed through urine and sweat, while lead that has been deposited into bone can take decades to be removed from the body (3). Found primarily in matrices such as contaminated soil and dust, lead can also be found in water, paint and some food items such as spices. Houses built before 1978 could have lead paint that may degrade into lead-contaminated paint chips and dust. People employed in manufacturing ammunition, metal alloys and batteries may also be exposed to lead (2, 4).

The State of Michigan has made many changes and improvements to the method over the years as testing abilities and knowledge of lead improves. Initially, graphite furnace was the primary instrument for blood lead testing at the BOL for both capillary and venous whole blood samples. In 2006, almost a decade after first taking on lead testing, the laboratory added dried blood spots on filter paper as a matrix for lead testing. This change was requested by clinics as an easier way to collect blood samples than with capillary tubes.

In 2008, the laboratory made the switch from graphite furnace to inductively coupled plasma – mass spectrometry (ICP-MS) which is still used to this day. As technology advanced and guidance evolved, the laboratory adapted, reducing the elevated blood lead levels from 10 µg/dL to 5 µg/dL in 2012. As lower concentration levels were required for screening purposes, the laboratory built an isolated space for trace metals analysis to mitigate risks of contamination.

Almost another decade later, in 2021, the CDC decreased the elevated blood lead levels from 5 µg/dL to 3.5 µg/dL, and Michigan quickly followed suit. In 2022, after 16 years, the filter paper method was discontinued due to lack of robustness at the newly established lower concentration levels.

In October 2023, the State of Michigan updated its blood lead action levels and established Universal Lead Testing for all children living within the state, going into effect at the end of April 2025. This change expanded the testing requirement from children enrolled in Medicaid to all children between the ages of 12 months and 24 months in the state. Children above the age of 24 months who have not been previously tested will need to be tested by the age of six. The State of Michigan also updated the action levels to match the CDC guidelines, which added a fourth action level range to the guidelines (5, 6). The additional range allows for more specific retesting schedules and assessments to better monitor children with elevated lead levels.

Research has continued to expand our knowledge regarding the effects of lead in the body while test instrumentation has simultaneously improved. The State of Michigan has maintained pace with the changes over the past three decades by acquiring advanced instrumentation and updating guidelines that have become more detailed and precise. As the scientific community continues evolving, the BOL will continue to improve the blood lead method to better screen young Michiganders from this invisible threat.

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