Tissue Banks and Toxicology: A Collaboration for Public Health

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Title: Tissue Banks and Toxicology: A Collaboration for Public Health

Background:

Tissue donations save millions of lives each year through transplantations and medical research. With population wide drug use and exposure increasing, drug prevalence has a massive impact on public health. Since tissue donations are obtained from a variety of sources, toxicology testing on these samples can provide population level drug use trends that may not be available otherwise. NMS Labs provides approximately 100 toxicology testing options in tissue including comprehensive and targeted panels. NMS Labs has partnered with the NeuroBioBank repository to perform comprehensive toxicology screening on brain and tissue samples for several years.

Hypothesis:

Performing comprehensive drug testing on tissue bank donations provides information concerning drug prevalence for the populations being tested. These results may be used to inform public health decisions and enhance public safety.

Methods:

Toxicology results from brain tissue samples submitted by tissue banks between January 1, 2020 and March 31, 2023 (n = 524) were reviewed. Blind samples were submitted; demographic information was unknown. Testing was performed using gas chromatography mass spectrometry (GC-MS) and Enzyme Linked Immunosorbent Assay (ELISA) for screening with confirmation via targeted GC-MS or liquid chromatography tandem mass spectrometry (LC-MS/MS). Drug findings were totaled from the postmortem expanded tissue panel screen and/or the confirmation testing. The percentage of positive results were calculated using the total number of tests performed. Opiate results are total (conjugated and unconjugated) and, as a result, do not include 6-monoacetylmorphine.

Results:

The top ten drugs identified with the positivity percentages are included in Table I. Results for the aggregate and two distinct geographic regions in the United States: Northeast and Southeast are presented. There are clear differences in findings between the two populations. The Northeastern population had higher positivity percentages for prescription drugs and over-the-counter medications including acetaminophen and memantine, while the Southeastern population showed more illicit drug use with cocaine and methamphetamine being included in the top ten. Morphine was the most prominent finding across all populations. The aggregate results were consistent with the Northeastern findings with the notable exceptions of higher positivity percentages for fentanyl and cocaine.

Additionally, two specimens from the Southeast were tested for novel psychoactive substances (NPS) and were positive for eutylone.

Conclusion:

Performing comprehensive toxicology testing on tissue bank donations provides information concerning drug prevalence for the populations being tested. This was evidenced by looking at two distinct geographical regions in the United States. The Northeastern population demonstrated higher positivity for prescription and over-the-counter medications while the Southeastern population included higher positivity for multiple illicit drugs including cocaine and methamphetamine. The Southeastern drug use trends are consistent with the increasing number of fentanyl, cocaine, and methamphetamine results observed in drug overdose deaths reported by the CDC (1). Morphine was the most prominent finding across all populations while fentanyl was second on the list for the Southeastern region. Since morphine and fentanyl have licit and illicit sources, it is unknown if this represents medicinal use or a combination of licit and illicit use. The aggregate results were consistent with the Northeastern findings with the notable exceptions of higher percentage positivity for fentanyl and cocaine. This is likely due to over 60% of the submissions being received from the Northeast where cocaine and fentanyl combinations are common toxicology findings in postmortem and human performance populations.

Additionally, these results may be used to inform public health decisions and enhance public safety. Tissue bank donors include patients that may never undergo an autopsy or comprehensive drug screening after death. This study provided drug prevalence for a population that is not currently captured by the medical examiner and coroner system. Two tissue specimens from the Southeast underwent additional testing for NPS and were positive for eutylone. Eutylone is a novel synthetic stimulant. Since most NPS are not approved for medical use, prevalence and availability have profound implications for public health.

References:

1. Spencer MR, Miniño AM, Warner M. Drug overdose deaths in the United States, 2001–2021. NCHS Data Brief, no 457. Hyattsville, MD: National Center for Health Statistics. 2022. DOI: https://dx.doi.org/10.15620/cdc:122556.

Table I. The Top Ten Drug Findings in Tissue Samples with Positivity Percentages, January 2020 – March 2023

Aggregate Results (n=524)		Northeast (n=350)		Southeast (n=174)	
Drug	**Percent**	**Drug**	**Percent**	**Drug**	**Percent**
Morphine - total	38	Morphine - total	44	Morphine - total	25
Acetaminophen	12	Acetaminophen	13	Fentanyl	19
Sertraline	12	Memantine	13	Cocaine	10
Memantine	10	Sertraline	13	Diphenhydramine	10
Citalopram/ Escitalopram	10	Citalopram/ Escitalopram	10	Sertraline	10
Fentanyl	8	Levetiracetam	9	Nicotine	10
Lorazepam	7	Lorazepam	8	Acetaminophen	9
Levetiracetam	6	Bupropion	3	Citalopram/ Escitalopram	9
Diphenhydramine	6	Diphenhydramine	3	Methamphetamine	6
Cocaine	5	Fentanyl	3	Amphetamine	5