
Title

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Unmasking the contribution of poisoning to child mortality in Soweto South Africa: results from the CHAMPS study

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Summary

Toxicology testing to detect suspected poisoning cases or cases where the cause of death is undetermined is not yet being done in the CHAMPS panel of tests. This leaves a gap in understanding the contribution of poisoning to under-5 mortality. Routine admission records from Chris Hani Baragwanath Hospital pediatric wards have previously shown high hospitalization rates from suspected poisoning. As a test case the CHAMPS South Africa site conducted mass spectrometry analysis on a case of suspected poisoning and the substance naphthalene, which is found in mothballs, was detected. Mothballs are a household item that is sold in supermarkets and at street vendors in South Africa.

The shape and color of mothballs resemble a hard candy and can easily be ingested by a small child. Unfortunately, we were unable to contact the mother of the child who demised to provide her with this information. However, we discussed these findings with the community advisory board as a way of raising awareness of the potential for child poisoning through mothballs or other poisonous substances. In addition, we are conducting further testing on samples where the cause of death was undermined to assess whether they may be a result of poisoning. Such findings are needed to fully address the issue of poisoning in children and to justify the need for inclusion of toxicology testing in future CHAMPS cases. treatment of *K. pneumoniae* infections.

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Background and Context

In a recent study conducted at the Chris Hani Baragwanath Academic Hospital, the hospital in which our site enrolls participants, 4.4% of admissions to the pediatric wards had a discharge diagnosis of poisoning between the period January 2016 to December 2021. The toxic substance was unspecified in 3.5% of cases (Khan et al., 2023). The study used either patient history or toxidrome classification to identify toxins; specific poison testing is not mentioned. In the CHAMPS database, there are 118 cases where no underlying cause of death has been determined as well as three cases where poisoning is suspected as the underlying cause of death. Toxicology testing is done at the National Health Laboratory System (NHLS), there is a backlog of samples and the turnaround time for toxicology results from the NHLS can take up to five to eight years (Sobuwa, 2023; Maqhina, 2024). Without being able to determine the toxic agent in the case of suspected poisoning, it is difficult to prevent such deaths occurring in the future. Additionally, providing feedback to families where no cause of death could be ascertained is neither helpful for the family nor for public health action.

At our site, there is a study called MITS-lite that is conducted in parallel to the CHAMPS study where the cause of under-five mortality is being analyzed. This study differs to the CHAMPS in that it only enrolls participants that were dead on arrival (DOA) to the health care facility. In the MITS-lite database, there were seven cases where poisoning was suspected as the underlying cause of death, and 55 cases where the underlying cause of death was undetermined. From these cases, we selected a suspected poisoning DOA case from the MITS-lite database to perform toxicology testing on.

The case here reported was a 4 year 5-month-old male with a history of vomiting and suspected poisoning who died on arrival to hospital. From the maternal verbal autopsy, the mother reported that the child had been well until the day of death when the child ate some food and then began to vomit a foam like substance, and it seemed like he had been poisoned. She rushed the child to the hospital and he was declared dead on arrival. The forensic report noted that the death was consistent with aldicarb poisoning, however the toxicology report is not yet available. From the MITS procedure performed, the real time molecular testing called TaqMan and post-mortem cultures showed no significant results. The histopathology of the lungs and heart were unremarkable, and, in the liver, it was noted that there was mild sinusoidal leukocytosis. On gross exam, there were no significant findings. During the DeCoDe panel, the underlying cause of death was assessed as suspected poisoning.

The aim of this case study was to ascertain whether the above-mentioned child may have died from poisoning. We performed toxicology testing, not currently included in the CHAMPS testing panel, to confirm if the cause of death was poisoning and identify the exact toxic agent.

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Interventions

To receive expedited toxicology results, and as per protocol allowances, the site collaborated with the Integrated Molecular Physiology Research Initiative (IMPRI). The liver biopsy sample was transported to the IMPRI to conduct the untargeted mass spectrometry testing.

The untargeted mass spectrometry analysis detects a wide range of biomolecules of interest. In the current case, the naphthalene metabolites were detected in the liver along with a high number of different lipid species that were detected suggesting possible dysfunctional lipid metabolism. In addition, the bile-associated metabolites were detected. Naphthalene is used as a pesticide and is commonly found in mothballs. This is a product that is commonly used in households to prevent moths damaging linen and have the appearance of a hard candy.



Figure 1: Conventional microbiology method (culture) process flow

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Impact of Interventions

Without a timely way to identify and diagnose cases of poisoning, no public health action can be taken. Community members are affected as they are often unaware of the toxicity of substances and without being informed of the toxin that led to the death; they cannot prevent further episodes occurring. For this particular case, the site tried to reach out to the mother of the child to provide feedback, confirm if mothballs are used within their home, and offer education around the danger of mothballs. However, the mother had relocated out of province. Despite not being able to contact the affected family, we discussed these findings with the community advisory board and community members to help create awareness on toxic items used in households.

The intervention is ongoing; five more samples have been identified and sent to IMPRI for testing. With further expansion of this type of testing, CHAMPS hopes to provide more specific results to the families and to use this data to inform public health officials of the extent and severity of accidental poisoning for public health action.



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You cannot prevent the birds of sorrow from flying over your head, but you can prevent them from building nests in your hair.”

— Old Chinese proverb



Lessons Learned

- It is crucial to conduct toxicology tests in children with suspected poisoning as poisoning could potentially account for those deaths where the cause of death remains unknown.
- To consider implementing this as standardized testing for a MITS procedure where poisoning is suspected and cause of death remains unknown. Especially in view of the delayed turnaround time for toxicology testing at the government services.
- In South Africa, there are very few regulations around the distribution, selling and purchasing of household products that may be potentially toxic. A review of and possible update of these regulations could be conducted to prevent these harmful substances from being readily available.
- Specific to mothballs and naphthalene poisoning, ingestion is not always necessary to cause harm: 'If someone breathes in enough of the vapor or eats a mothball containing naphthalene, they might develop hemolytic anemia.'

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THANK— YOU



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Child Health And Mortality Prevention Surveillance

The CHAMPS network uses innovative approaches to generate and share knowledge that improves understanding and prevention of child mortality.



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