Research Note

Testing the Waters:
Heavy Metal Levels in Urine and Municipal Supply

UTRI – Urine Therapy Research Initiative | M Macdonald, PhD | 2025
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Urine Therapy Research Initiative

<u>Urine Therapy Research Initiative Aims</u>

This discussion is part of the Urine Therapy Research Initiative which has two specific research aims – to link cutting edge scientific research on human urine-derived stem cells (USCs) to the health benefits reported by urine therapy practitioners; and to examine the detoxification potential of urine in relation to toxins and heavy metals (HMs). The overarching research initiative also has an education component as urine is not yet known for its far-reaching health benefits.

This research note is part of a series of short discussions on various topics to highlight the potential to apply urine studies to a broader range of topics.

This draft document has not yet been revised by outside readers, nor experts in various fields. This work is by definition exploratory and interdisciplinary.

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[Note: The analysis of existing research was reviewed and integrated into this note by the author. The author used AI-assisted (ChatGPT OpenAI, 2025) analysis to bring a wider scope to the discussion.]

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Testing the Waters: Heavy Metal Levels in Urine and Municipal Supply

Abstract

This exploratory study presents a single-subject (N-of-1) analysis of heavy metal (HM) concentrations in urine from a practitioner of urine therapy (uropathy) who has engaged in daily ingestion practices since 2013. The urine sample was tested by a certified laboratory, and the raw concentrations of 17 heavy metals were analyzed. Nine of these were compared to municipal drinking water standards set by Health Canada (2024), the United States Environmental Protection Agency (EPA), and the World Health Organization (WHO), all expressed in micrograms per liter (µg/L). The analysis aimed to determine whether daily urine consumption could result in a toxic intake of heavy metals relative to regulatory exposure thresholds.

Findings show that for all but one metal—arsenic (As)—the subject would need to consume quite large volumes of urine (often exceeding several liters per day) to reach the safety thresholds established for drinking water. Arsenic, which appeared at low levels in the sample, theoretically approached threshold limits at volumes potentially consumable within a single day (1.3 L), but without speciation[1] analysis, the toxicity risk remains uncertain. Most urinary arsenic is derived from organic, non-toxic sources (e.g., seafood), emphasizing the need for arsenic speciation in future research.

This initial case study suggests that long-term urine therapy may not inherently increase toxic load from heavy metals and offers a foundation for further investigation. It challenges conventional assumptions about urine toxicity and highlights the importance of dose-dependent toxicological assessment. Future larger studies (N>1) with more people and repeat tests (including speciation) are warranted to confirm these findings.

Introduction and Context

As part of a larger research review on the possible health benefits and implications of urine therapy, this article asks two main questions.

Question 1: What can be learned from an analysis of an N-of-1 or single subject heavy metal (HM) test performed on the urine of a urine therapy practitioner?[2]

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[1] For more on speciation see Crea (2020) and ETR Labs: Arsenics speciation tests are to determine the different forms of arsenic in a sample, whether water or urine, etc. Each type (species) has its own toxicity.

[2] The author is providing access to a urine HMs test from October 2024 as an example for this paper. For HM testing to provide a holistic picture of toxic load, it is ideal to perform hair, urine and blood tests, as well as to repeat the tests at set intervals. The HMs excreted in urine are generally more indicative of excretion after recent ingestion (generally food related). The HMs in hair and blood are generally more indicative of total toxic load. As hair and blood tests are completed on the subject, and further urine tests are completed, this example will be added to with those results. These are the first tests the author has had done since beginning Uropathy protocols in 2013. Two of

Question 2: Whether drinking urine is problematic or dangerous because of the toxins in urine and the potential to increase toxic load in the body?

The long-held understanding is that all the elements, chemicals and metabolites, that can be detected in urine will be reabsorbed if drunk. However, consumption does not equal absorption, and the elements would necessarily be in an altered state to when they entered the body.[3] It is unknown whether urine consumption could increase toxic load in the body.[4]

Context

As a first step, the HMs in the urine test are compared to HM standards in drinking water. Water is a relevant comparison because urine is 95% water. Acceptable levels of HMs based on concentration in water are highly studied. This basic analysis of the concentrations found in the example HM test provides starting information.

This N-of-1 analysis considers an individual patient as the sole unit of observation. In general, the diagnostic model has led to medical interventions that use the same treatment for everyone. attempting to treat the majority of common chronic conditions in the majority of people. In the last decades there has been more acceptance that this is exceptionally difficult to do. Clinical practice has started to recognize that the uniqueness of each patient, specifically at the genetic level, demands more individualized patient care (Lillie et al. 2011). Urine fits the criteria of a protocol that is patient specific, as a self-produced, bio-available, highly individualized biological fluid.

This research note is focussed on the efficacy of urine therapy interventions. It is based on one test, from one person. This analysis is therefore limited, and also worth developing. No conclusions can be drawn from one test; however, further lines of inquiry can be advanced. The comparisons are drawn using the water safety standards for municipal water set in Canada (CND) in 2024. As well, US based Environmental Protection Agency (EPA) and World Health Organization (WHO) values are used secondarily.

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the largest doubts around Uropathy, from those who do not practice, are about long-term practice and the re-ingestion of toxins. The daily practice of drinking approximately 250ml a day since 2013 provides a good example for discussion, until a broader study can be completed. At the very least, this example demonstrates that daily consumption is not immediately dangerous.

[3] The HMs themselves are of interest, and a detailed breakdown is beyond the scope of this current example. A longer discussion of HMs and their taxonomy will be part of future research notes.

[4] Specifically, when people undergo detox protocols, and the concentrations of toxins increases such that it can be detected in the urine, the understanding is that this urine would be counter to promoting health. However, studies also indicate, that substances in the body undergo many processes as they pass through the organs and are subjected to bonding, conjugation and other reactions. A comprehensive study is necessary to examine urine during detox. In particular, what is the state of any HM as it exits the body, and what is the effect of drinking urine on the HM and toxic loads of the individual?

Challenges
The main challenge to this work and analysis is that no similar supporting studies currently exist. There are many studies that analyze what can be detected in urine. There are no studies on what can be detected in the urine of people who drink their urine, neither is there a study on the general health of people who drink their urine. This lack of data cannot be redressed without a long-term study. Until such time, this example provides some specifics to begin the discussion.

The test provided for this analysis is a start for discussion, but is not indicative of total toxic load. It is only indicative of what was being excreted from the body that day. This test is the first HM test performed on the subject since beginning daily uropathy practice in 2013. This provides a first look at whether there are any discernable signs of toxic load that might have built up with consistent ingestion and other protocols.

There are two health questions that are most often asked about urine therapy. The question from those unfamiliar with urine practice: does drinking urine increase the toxic load in the body? And the question from holistic practitioners and urine therapy practitioners: does drinking urine help to remove toxins from the body? These questions can both begin to be addressed by this analysis and future analyses of this kind. Neither the test nor the analysis is conclusive as there is too little data.

One other limitation of this research note is the topic of molecular and ionic mimicry.

Molecular mimicry is when a metal attaches to a natural molecule in the body to create a new metal–molecule combination. This new compound can closely resemble an important molecule the body needs, allowing it to bypass the body's defenses and be transported into cells. These molecular mimics can be structural or functional.

- Structural mimics**,** have a similar shape to the nutrient
- Functional mimics**,** can behave in similar ways inside the body, at least at first

Ionic mimicry is when a toxic metal takes on a form that looks like a nutrient the body needs. The body's transport systems are fooled by the similarity. The transport system is designed to move essential elements like calcium, zinc, or iron into cells. However, the toxic metal can be mistaken for the real nutrient and let into the cells.

Determining whether this has happened in an individual would only be borne out in repeated studies and interventions to redress mimicry. This current research note does not extend to any hypotheses about molecular and ionic mimicry in this individual.

Test Subject

As there is one urine test, on one practitioner, the parameters are limited. Taking into account the details below, the test is understood within these parameters:

- The subject has been drinking urine daily since 2013 (other protocols have also been done regularly, but this analysis is restricted to a water comparison and is therefore focussing on drinking).
- Daily consumption averages 750ml a day (a general range of 250ml to 1500ml a day has been ingested since 2013)
- The subject has drunk filtered water almost exclusively since 2013 (gravity filtration system[5]), and distilled water since 2021. Both types of water significantly limit HMs (filtration), or completely exclude HMs (distilled).
- The subject has had no signs of HM related illnesses, toxic load increase, nor had any other health issues that have been linked in any way with HM or toxins since starting this practice.
- The general diet and medication history of the subject[6]:
    - at the time of this test was not taking medications, and has never taken daily, weekly or monthly pharmaceuticals;
    - does not smoke (linked to higher instances of arsenic (As), cadmium (Cd), chromium (Cr), nickel (Ni), and lead (Pb));
    - has a diet high in plants, local foods and has been vegetarian since 2018; the exceptions to the vegetarian diet are less than 8 times a year ingestion of shellfish (primarily marine seafood) and therefore does not count as a pescatarian. This is relevant because HM analyses might look for higher levels of HMs from fish and seafood sources which are linked to higher Cd, mercury (Hg), Pb, As, and Cr.

Methods

One urine sample was collected and sent to the Medivere lab in Mainz, Germany. The kit provided by Medivere contains the instructions and all materials needed to collect the biospecimen. The sample was collected on 14.10.2024 and the test results published on 23.10.2024.

The lab provided two data sets: (1) HM concentrations in urine expressed as raw values in micrograms per liter (µg/L), and (2) concentrations adjusted for creatinine, reported in micrograms per gram of creatinine (µg/g). For the purposes of this analysis, the raw values

[5] The ceramic filter system from Radiant Life was used and maintained by the subject as per the instructions. The system includes a guarantee of the following specs: 0.5 Micron absolute, >99.9% Efficiency at 0.2 micron, Meets or Exceeds NSF/ANSI Standards 42 & 53 for the following: >99% Chloramine reduction, >99% Chlorine reduction, >99% Lead reduction, >99% Herbicides and Pesticides reduction, >99% Glyphosate reduction, >98% VOC's reduction, >96% Pharmaceutical reduction, >98% Heavy metals reduction, >98% THM's (Trihalomethanes) reduction, >92% Nitrates reduction, >97% Fluoride reduction, >99% Fluorinated Organic Acids (PFOA & PFOS) reduction, >99% Micro plastics reduction. Source: Radiant Life Website. https://radiantlifecatalog.com/ss-gravity-filter-replacement-filters-accessories/

[6] This analysis cannot take into account the diet of the subject in terms of testing and monitoring ingestion. However, these points are relevant for future papers. There is no expectation of high concentrations of HMs in this subject because of a known source of HMs, for example seafood, as the subject consumes a mostly vegetarian diet.

(µg/L) are used to compare urine samples directly with municipal drinking water standards, which are also expressed in µg/L. The creatinine-corrected values are not used for this comparison because they are for analyses focussed on the volume of HM excreted by the body over time, given the body's metabolic context, regardless of the dilution in the urine.

Whereas, this paper takes up the question of volume of urine needed to reach the same HM exposure limits as with municipal drinking water. In this context, there is no need to normalize for hydration status and metabolic context using creatinine-corrected values. The goal is to compare urine's heavy metal concentrations directly to municipal drinking water standards, which are expressed per liter of fluid. The raw values allow for a clear comparison of absolute concentrations in two different liquids.

The test returned values for 17 HMs: Aluminium (Al), Antimony (Sb), Arsenic (As), Lead (Pb), Cadmium (Cd), Chrome (Cr), Iron (Fe), Cobalt (Co), Copper (Cu), Nickel (Ni), Palladium (Pd), Platinum (Pt), Mercury (Hg), Silver (Ag), Thallium (Tl), Zinc (Zn), Tin (Sn). Not all of these HMs have standards for water concentrations. The analysis is limited to the 9 HMs included in the three standards for HM in water provided by the WHO, the EPA, and the Guidelines for Canadian Drinking Water Quality (2024).

The purpose of municipal water standards is to address potential exposure levels in drinking water. The comparison of municipal water standards to urine is therefore to determine whether a practitioner of urine therapy could increase their toxic load by drinking urine. This analysis is not seeking to understand the body's exposure to HM nor the possible HM load of this individual. The focus is strictly on the hypothetical of what volume of urine would have to be drunk to approximate the acceptable concentrations of HM by set by drinking water standards.

Drinking Water Standards and Toxicity

Drinking water standards are set by various organizations based on criteria from multi-step scientific and policy processes. The criteria are developed through toxicological research, risk assessment, and regulatory decision-making.

One of the biggest objections to urine therapy is that it could be toxic. There are no set standards for urine consumption, and practitioners of urine therapy report drinking 15ml – 2L (possibly more) a day. Therefore, the focus in this example is on the possible dose of HMs that could be ingested by an individual drinking their own daily urine.

Toxicity is not determined by the 'substance or element' but by the dose. The background to this statement comes from the father of toxicology, Paracelsus, and his fundamental principle that: "All substances are poisons; there is none that is not a poison. The right dose differentiates a poison from a remedy" (Paracelsus 1538, in Klaassen & Watkins, 2015). Or said more simply – the dose makes the poison. The logic of this statement presents toxicity not as an inherent quality of an element, but directly linked to the quantity and context of the situation. When this principle is implemented, even substances usually held as toxic can be used in small doses. Modern pharmacology, Ayurvedic Medicine, Traditional Chinese Medicine, holistic western medicine, herbalism, naturopathic, homeopathic and allopathic medicine, all hold to this principle.

Applying this to urine therapy naturally challenges conditioning about waste. To fully follow the logic, it becomes necessary to view urine through the same lens as any other substance; with the potential to be a remedy. As a remedy, its constituent parts can be analyzed, taking into account possible doses of the over 5000 metabolites found in urine (3,151 of which are endogenous), as outlined in the Human Metabolome Database (HMDB) hosted at the University of Alberta (Wishart, HMDB). As urine is 95% water, 2.5-3% urea/uric acid/creatinine, that leaves 2.5-3% volume for trace volumes of all other metabolites (Sarigul and Kurlutak, 2019). Many metabolites detected in urine can be effectively neutral, versus in their original forms, bound to conjugates that limit their biological activity, and water-soluble, ready for elimination. Following through with the logic of Paracelsus, consuming one's own urine does not inherently increase toxic load, nor the absorption of toxins. Urine therapy can therefore be viewed as a practice that works synchronistically with the body's regulation and elimination pathways. The "dose makes the poison" maxim allows for more openness to further investigation.

Goals

The aim of this discussion is to show the promise of further research in this area. Specifically, that consuming urine is unlikely to endanger anyone who practices urine therapy. This work is foundational for the future stages of the project, which will demonstrate that urine consumption helps the body with health overall, as well as aids in the processing and releasing the HMs and toxins that accumulate over time.

Discussion

Table 1 shows the comparison in micrograms per liter (µg/L) between the HM concentration norms in urine to the sample provided by the subject. These are then compared to the CND, EPA and WHO municipal water heavy metal standards. **Table 2** shows the comparison of volume in litres (L) of urine (through drinking) to approach the CND, EPA and WHO heavy metal standards. The comparison across the three standards shows some variance. The Canadian standards are used for the majority of the discussion because they were updated in 2024. As well, the subject of the test was living in Canada throughout most of the eleven years of uropathy practice before the Medivere test.

Table 1
***Comparison: Heavy Metals in Urine Sample and CND, EPA and WHO Municipal Drinking Water Heavy Metal Standards in* µg/L**

Metal	Concentration Norm for Urine Test (µg/L)	Concentrations in Urine Sample (µg/L)	CND HM Water Standard (µg/L)	EPA HM Water Standard (µg/L)	WHO HM Water Standard (µg/L)
Aluminium (Al)	<20.0	16.5	2900	50-200	<200
Antimony (Sb)	< 0.25	<0.25	6	6	20
Arsenic (As)	< 25.0	7.7	10	10	10
Lead (Pb)	< 4.5	0.53	5	10	10
Cadmium (Cd)	< 0.50	0.14	7	5	3
Chromium (Cr)	< 1.00	<0.04	50	100	50
Copper (Cu)	2.0 – 80.0	5.0	2000	1300	2000
Nickel (Ni)	< 3.30	2.54	20	NA	70
Mercury (Hg)	< 2.3	0.2	1	2	6

Table 1 – Columns from left to right: the chemical element and its symbol; the established concentration norms in urine for each chemical element; the concentration of each chemical element found in the test subject's urine; the CND standards for HM concentrations in municipal drinking water; the EPA standards for HM concentrations in municipal drinking water; the WHO standards for HM concentrations in municipal drinking water. All concentrations are presented in µg/L.

Table 2
Urine Volumes Reflecting CND, EPA and WHO Heavy Metal Water Standards in (L)

Metal	Urine Volume (L) CND Standard	Urine Volume (L) EPA Standard	Urine Volume (L) WHO Standard	Range of Urine Volume (L) across the Standards
Aluminium (Al)	175.8	3-12.1	12.1	3-175.8
Antimony (Sb)	24	24	80	24-80
Arsenic (As)	1.3	1.3	1.3	1.3
Lead (Pb)	9.4	18.9	18.9	9.4-18.9
Cadmium (Cd)	50	35.7	21.4	21.4-50
Chromium (Cr)	1250	2500	1250	1250-2500
Copper (Cu)	400	260	400	260-400
Nickel (Ni)	7.9	NA	27.6	7.9-27.6
Mercury (Hg)	5	10	30	5-30

Table 2 – Columns from left to right: the chemical element and its symbol; the volume in L of urine (through drinking) to approach the CND heavy metal standard; the volume in L of urine (through drinking) to approach the EPA heavy metal standard; the volume in L of urine (through drinking) to approach the WHO heavy metal standard; the volume range in L across the three standards.

Observations

1. **9 HMs were compared**:
   - Of the 17 HMs in the urine test, nine are included in Table 2, and eight were part of all three drinking water standards. Nickel is not included in EPA values.
2. **Highest Urine Volumes**:
   - Cr has the highest values at 1250-2500L. Cu is next with a range of at 260-400L and then Aluminium 3-175.8L.
3. **Middle Volumes:**
   - Sb 24-80L, Cd 21.4-50L, Hg 5-30L, Ni 7.9-27.6L and Pb 9.4-18.9, have ranges of values all too high for a person to reasonably consume enough urine to approach the water drinking standards.
4. **Low Volumes for Arsenic**:
   - Urinary Arsenic has the lowest volume result of 1.3L returned by all three standards.
5. **Variance Across Standards:**
   - The variance in standards is quite stark. This is likely due to large organizations following ALARA standards, or what is considered ‘as low as reasonably achievable.’

6. **The Big Four**:
    - Arsenic, cadmium, mercury and lead, are referred to as the big four of HMs.
    - Cadmium, and lead are low in the subject's sample, compared to norms. It would be highly unlikely that someone could drink enough urine in a short period of time, to approach the standards.
    - Mercury is low in the sample, and the threshold is also low. Even at the 5 L reference point from the CAD standards, it would be very hard to approach the standard by drinking this urine example.
    - Arsenic is the outlier as all the standards return 1.3 L as the volume needed to reach the drinking water threshold, which might be possible to drink in a short period of time. However, arsenic differs greatly from the other Big Four because of the variance in arsenic species in water, versus arsenic in food, and in urine.

Arsenic

It is worth a slight detour to focus on arsenic before proceeding any further. In the tables above, the volume that could be drunk is lowest for arsenic at 1.3 L. It is possible for a person to drink 1.3 L of urine in a short period of time. However, it is almost impossible for a person to produce 1.3 L in < 2 hours. In part because the body produces urine in small amounts with an average total amount per day of less than 2 litres. All of the blood in the body, roughly five to six litres, is filtered by the kidneys about 300 times each day. These 1,700 liters of blood lead to the production of primary urine (glomerular filtrate), which then becomes urine or blood plasma ultra filtrate. The total daily urine production is a little more or less than 1.7 litres per day (Institute for Quality and Efficiency in Health Care, 2022).

Add to this, that the bladder has a limit to how much it can hold and most people get a signal to urinate at a low volume of urine because the bladder can hold between 500 ml (women) and 700 ml (men). A signal that the bladder contains urine can be sensed as early as 150ml. (Institute for Quality and Efficiency in Health Care, 2022).

Given the natural rhythm of urine production, most urine therapy practitioners drink small amounts during the day.[7] It is possible to collect small outputs throughout the day, save them, and then drink 1.3 L in a short period. However, the concentrations of most metabolites in urine are not stable throughout the day because of rapid human metabolism. This means that a single urine sample only represents momentary urinary arsenic excretion and cannot demonstrate average levels of exposure (Su L et al. 2025).

[7] A commonly shared experience from people starting the practice is that drinking urine can produce more urine, more quickly than normal. This seems to be a phase that people go through at the beginning of urine therapy practice. Consistent practitioners of many years report that the rhythm balances out over time. And that people who drink urine find they are more hydrated, need to drink less water and other drinks, and generally urinate slightly less than before starting the practice. This also makes it harder to drink large amounts of urine, when producing slightly less.

Arsenic Species

Beyond the mere detection of arsenic there is also the issue of which type of arsenic is being found in human urine. The main distinction is between organic (non-toxic) and inorganic (toxic) arsenic species.

While many foods contain small amounts of inorganic arsenic – e.g. marine and fresh water fish and seafood, raw rice, flour, grape juice and cooked spinach, these are generally found to be within deemed-safe exposure levels that the body can deal with over time. Sustained exposure to higher concentrations of inorganic arsenic species, mostly through contaminated water and soil, leads to chronic illnesses.

Organic arsenic is the opposite, as it is almost always non-toxic and is mostly found in marine (salt water) fish and seafood (e.g., shellfish). Eating marine fish and seafood can lead to higher levels of organic arsenic being excreted in the following days. This is not indicative of total arsenic load. The research goes as far as to say that organic arsenics have been found to be essentially nontoxic (Agency for Toxic Substances and Disease Registry. 2020).

Even though most urinary arsenic is non-toxic, general tests for arsenic are limited to total-urinary-arsenic and do not differentiate organic from inorganic. This can be misleading. A heavy metal test that returns a seemingly high arsenic level could be 95% organic (non-toxic) arsenic. This could be specifically linked with diet and recent ingestion of marine fish and seafood. In such a case the arsenic reported by the test would not be an indicator for overall health, in relation to heavy metal load.

It is the inorganic arsenic species that can cause problems as arsenic-induced toxicity in humans is almost always due to exposure to inorganic arsenic (Agency for Toxic Substances and Disease Registry, 2020). The sources for inorganic arsenic are varied, however, drinking water is the primary way arsenic enters the system (Su et al. 2025). In short, organic arsenic tends to pass through the body unchanged, while inorganic arsenic is more reactive, enters cells more easily, and is transformed into other forms before being excreted (Agency for Toxic Substances and Disease Registry. (2020). Other sources of inorganic arsenic include the already mentioned foods: flour, raw rice, and cooked spinach, as well as some seaweeds.

Research published in 2025 shows that levels of inorganic arsenic are higher in fresh water fish and seafood than previously thought. This may lead to a reframing of the term ‘fish arsenic’ if inorganic arsenic proves to be consistently detected in fresh water fish. Therefore, ‘fish arsenic’ does not apply equally to marine and fresh water fish and seafood (Lau C., Lu X., Chen X., et al. 2025., and Lau C., Lu X., Hoy, K. S. 2025).

It should now be clear that while arsenic species are easily detectable in urine, they represent a category that has not yet been fully researched and developed. The most common way to report urinary arsenic has been with one number representing 'total urinary arsenic.' This number does not distinguish between organic and inorganic arsenic species. The results of the example urine test used in this research paper highlights the need for more clarity on testing for arsenic species. This distinction in test reporting will help confirm that drinking fresh urine is not a relevant source of inorganic arsenic.

Question 1
What can be learned from an analysis of an N-of-1 or single subject heavy metal (HM) test performed on the urine of a urine therapy practitioner

Given the results from this test, a few pieces of information stand out. The results cast doubt on the perceived toxic status of urine because of heavy metals. The test subject has been drinking 250ml-1500ml of urine a day since 2013. If urine was an efficient delivery system for the re-uptake of toxins and HMs, higher levels of toxins and HMs than this sample contains, would be assumed. At the very least, a higher level of arsenic might be posited as it requires much less liquid intake to approach the health standards, and excretion volumes indicative of recent arsenic exposure (via foods and other means).

Question 2
Is drinking urine problematic or dangerous because of the toxins in urine and the potential to increase toxic load in the body?

There are a large number of contributing factors in such an example – lifestyle, environmental, genetic, diet, geographical location, etc. With an N-of-1, or single subject, clinical trials consider an individual patient as the sole unit of observation in a study investigating the efficacy or side-effect profiles of different interventions.

Taken in light of the test subject's years of daily practice, the simple answer to question 2 would be, no. However, this information needs to be tested against other samples from urine therapy practitioners. Tests would ideally be run on those who have been practicing for many years, as well as on those who are undergoing HM detox, or have specific known toxic loads.[8]

To deepen the understanding of the implications of drinking urine extensive testing is called for to establish the effects and affects of urine. In particular, how is it similar and how is it different from water (e.g. ion charge, metabolites, plasma state, hormones, antibodies, etc.).

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[8] Many anecdotal examples exist of people who were in a toxic state and used their own daily urine output to achieve better health while the known toxic load was still high. There is no study on such examples to date.

For the purposes of this urine test, it has been assumed that 1 L of water is similar enough to 1 L of urine to run the example. However, to be more exact, tests would need to be run to determine similarities and differences, e.g. on the electrical charge in water and in urine, the chemical makeup of both, the blueprint, if you will, of both substances would need to be taken into account.

The answer to Question 2 is, no, insofar as for most of the HMs tested, it would be impossible to drink enough liquid to reach the volume in litres (L) listed in Table 2. Research into water toxemia, or water poisoning, which is excessive water intake, indicates that the kidneys can filter 800ml to 1000ml of water per hour. Anything above this disturbs the electrolyte balance and can lead to problems in brain function and ultimately, death. An example from Scientific American reports on a case where a woman drank six litres in three hours and died later that day.[9] The main issue is the shift in sodium levels in the blood.[10] There is no known example of someone consuming enough urine to create urine toxemia. Perhaps the volume would be similar to water, but perhaps it is different.

Keeping to the assumption that water and urine would be similar when drunk in large volumes, by the time a person had drunk enough urine to approach these standards (arsenic not included), the volume of liquid consumed would likely have led to water poisoning. However, it is not known if drinking high volumes of urine results in water toxemia at the same rate as with water. The electrolyte balance in urine is different than water. Indeed, given the information in the Human Metabolome Database, which lists more than 3000 metabolites in urine, this biofluid could be seen as nutritional with its complex chemical makeup (Wishart, HMDB). On the other side, a total of 316 contaminants were found in drinking water in the US during one study period between 2004 and 2009 (Primo Water 2018). These hypotheses are only taking into account ingestion and not absorption. While it is useful to compare water and urine simply based on volumes of liquid, they cannot be compared in terms of chemical makeup and possible absorption in the human body, without further study.

[9] There are specific cases of marathon runners drinking more than the kidneys can filter while under the stress of running. On an average day 800ml to 1000ml per hour is the maximum, and this cannot be maintained for many hours per day. Awareness of hydration has led many people to assume that they should be drinking 1500ml to 2000ml of water per day (or six to eight cups). This does not include liquids with caffeine, high amounts of sugar or other ingredients, which many people consume while at work. Ballantyne, C. (2007, June 21). *Strange but true: Drinking too much water can kill you. Scientific American.* https://www.scientificamerican.com/article/strange-but-true-drinking-too-much-water-can-kill/

[10] "Hyponatremia, a word cobbled together from Latin and Greek roots, translates as "insufficient salt in the blood." Quantitatively speaking, it means having a blood sodium concentration below 135 millimoles per liter, or approximately 0.4 ounces per gallon, the normal concentration lying somewhere between 135 and 145 millimoles per liter." Ballantyne, C. (2007, June 21). *Strange but true: Drinking too much water can kill you. Scientific American.* https://www.scientificamerican.com/article/strange-but-true-drinking-too-much-water-can-kill/

Conclusion
This is one example based on one test of an individual's urine. What is promising is the potential that drinking urine over many years does not lead to higher HM levels. This short example serves as a starting point to further examination, discussion and research into the effects and affects of urine practices. This first research note serves to disrupt assumptions that regular drinking of fresh urine might have a negative effect on HM and toxin levels in individuals.

Further lines of inquiry coming from this first research note include:

- Do HMs in urine behave differently than HMs in water?
- Do HMs bind or conjugate in the body such that the HM species observable in urine are generally no longer toxic, or at least less bioavailable for re-uptake?
- How do HM concentrations in urine compare to established thresholds for toxicity in biological systems, not just water?
- What is the bioavailability and absorption potential of HMs when urine is ingested — especially in their metabolized or chelated forms?
- Are the forms of HMs excreted in urine biologically active, or are they already bound to proteins or excretory compounds?
- Does repeated consumption of one's own urine alter HM excretion patterns over time?
- What anecdotal or documented evidence exists regarding toxicity symptoms among long-term uropathy practitioners?
- How do dietary, lifestyle, or environmental factors influence HM content in the urine of urine therapy practitioners?
- What are the limitations of comparing a biological fluid with a regulated environmental fluid (urine vs. drinking water)?
- What would a multi-subject comparative study (urine HM levels across different practitioners and non-practitioners) reveal about variation and risk?
- How do urine-based HM tests correlate with blood HM levels in urine therapy practitioners and non-practitioners?
- Are HMs in urine in an altered state because of the chemical processes in the body?

The range of topics relevant to understanding how urine and toxins function in the body is vast. These questions have not been addressed by clinical research. A goal of the work undertaken by the Urine Therapy Research Initiative is to promote the importance of studying whole urine and the health benefits reported by practitioners.

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