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Challenges, Risks and Potential Solutions to Mitigate Heavy Metal Exposure:

A Roundtable Discussion

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Virtual roundtable discussion, "Challenges, Risks and Potential Solutions to Mitigate Exposure to Heavy Metals"

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About IFT

The Institute of Food Technologists (IFT) is a global organization of over 11,000 individual members from more than 90 countries committed to advancing the science of food. Since 1939, IFT has brought together the brightest minds in food science, technology, and related professions working in academia, government, and industry to solve the world's greatest food challenges. IFT works to ensure that its members have the resources they need to learn, grow, and innovate to advance the science of food as the population and the world evolve. IFT believes that science and innovation are essential to ensuring a global food supply that is sustainable, safe, nutritious, and accessible to all. For more information, please visit ift.org.

EXECUTIVE SUMMARY

For over 80 years IFT has engaged experts in food science and technology and related disciplines from academia, government, and industry to advance the science of food and its application. On May 2, 2023, IFT hosted a virtual roundtable discussion on, "Challenges, Risks and Potential Solutions to Mitigate Exposure to Metals". The goal was to convene experts in food and nutrition science, food toxicology, public health, and epidemiology to discuss challenges, risks, and potential solutions to mitigate heavy metal exposure with a focus on vulnerable populations. Another goal of this discussion was to develop a follow-up white paper to serve as a reference for other food scientists, government agencies, policy makers, and other stakeholders.

The US Food and Drug Administration (FDA) has been monitoring heavy metals in the food supply for decades due to concerns about the presence of heavy metals in foods, particularly for vulnerable populations such as pregnant women, infants, and children. Heavy metals such as arsenic, mercury, cadmium, and lead are found at trace levels in many different foods because of natural presence, human-caused contamination in the environment in which the food was grown or raised, and/or processing, handling, packaging of the food. Consumers are also exposed to these heavy metals through other routes, including the trace amounts in air and water. If exposed to sufficient cumulative amounts through these different routes, these metals can build up in the body over time, and if exposure levels are high, result in health issues including organ damage, cognitive and behavioral problems, and impaired growth.

While most studies and reports suggest intake levels of heavy metals in the US food supply are below acceptable thresholds, the potential exposure to heavy metals is not considered in national dietary guidance. Further, federal nutrition programs are required to provide foods aligned with US dietary guidelines. Thus, it is unclear what potential exposure to heavy metals may be realized for individuals participating in federal nutrition programs, those whose diets are challenged due to socio-economic issues, and those consuming diets more aligned to national recommendations.

Due to the health-related concerns about heavy metals in foods, many mitigation strategies have been identified, including:

- Agricultural technologies – soil amendments, phytoremediation, crop genetics
- Processing technologies – washing in alkali, sorting, adsorption
- Nutritional approaches – improving iron/zinc status, dietary fiber, diet diversity

However, more research, collaborations and improvements in consumer communication are still needed:

- Research – better methods for determining exposure, better biomarkers of intake and status
- Collaborations – interdisciplinary across the supply chain (academics, government, crop breeders, food scientists, small and large corporations, non-profits, healthcare professionals)
- Communications – clear and concise risk communications; avoid inciting fear; partnering with healthcare professionals, schools, public health organizations

Much progress has been made in monitoring and mitigating heavy metals in the US food system. For example, FDA has reported an approximately 30 percent reduction in inorganic arsenic in infant rice cereal from 2012 to 2018 (1). However, there continues to be opportunities to further reduce heavy metal content and exposure, particularly for the most vulnerable in the population. Through collaboration, communication and continued research, we can improve the safety of our food and consumer confidence in our food system.

INTRODUCTION

As seen in the recent FDA Total Diet Study (TDS) and Closer to Zero (CZ) publications, Codex proceedings, scientific papers and other media, heavy metals in foods are increasingly a public health concern, particularly for infants and children (2-6). Heavy metals are ubiquitous in nature, and some can play important roles in biochemical and physiological functions. Some metals such as copper, iron and zinc are essential micronutrients, required for basic human metabolism (7). Other metals such as arsenic, cadmium, lead and mercury are not required for human health and can cause adverse health effects even at low concentrations. As such, the FDA identified dietary exposure to these specific heavy metals as a public health concern and established a working group of experts to reduce exposure of heavy metals in food, dietary supplements, and cosmetics (8).

Heavy Metals in the US Food Supply

Since 1962, the FDA has used the TDS to track nutrient elements (e.g., calcium, iron) in foods in the US, as well as contaminants such as arsenic and lead. This data, when evaluated in the context of What We Eat In America (WWEIA) data from the National Health and Nutrition Examination Survey (NHANES), can provide an estimate of the average daily consumption of nutrient elements and contaminants.

For the July 2022 TDS Report, heavy metals such as lead, arsenic, cadmium and mercury were evaluated in more than 3,200 food samples representing more than 300 different foods and beverages in the US marketplace (2). Cadmium was detected in the highest number of samples (61%), followed by arsenic (43%), lead (15%) and mercury (8%). The highest levels detected were 10,900 ppb (arsenic), 400 ppb (cadmium), 250 ppb (mercury), and 164 ppb (lead). Table 1 includes the top 5 foods with highest mean concentrations of certain heavy metals (2). Most of these metals come from naturally occurring or human sources in the environment where the food is grown (e.g., grown in locations with high inherent levels, contaminated water, soil). However, most of the foods in Table 1 are processed (e.g., baked, cooked). The processing and handling of foods can elevate or reduce the concentration of the metal.

Table 1. Top 5 foods with highest mean concentrations of heavy metals from (2).

Arsenic	Cadmium	Mercury	Lead
Baked cod	Sunflower seeds	Canned tuna	Baby food sweet potatoes
Canned tuna	Spinach	Baked cod	Baby food teething biscuits
Fish sticks	Potato chips	Baked salmon	Sandwich cookies
Baked salmon	Leaf lettuce	Pan-cooked catfish	White wine
Pre-cooked shrimp	French fries	Pre-cooked shrimp	Ranch salad dressing (low-calorie)

Heavy Metal Exposure and Health Effects

Heavy metal exposure can occur in many ways, and exposure through consumption with food is a significant route. Once absorbed, heavy metals such as arsenic, cadmium, lead and mercury circulate in the blood plasma and deposit in bone and soft tissue. In addition, these four heavy metals are found in the placenta of pregnant women and to varying degrees can transfer to the fetus (11). Exposure to heavy metals can also take place after birth through breastmilk (12). Infants are at pivotal stages of development and thus are especially vulnerable to the effects of heavy metals. Further, much of an infant's diet is made up of a small variety of foods. This lack of diversity poses a risk of greater exposure, particularly if consuming foods with higher levels of heavy metals on a regular basis (6).

High chronic exposure to heavy metals can lead to adverse health effects, particularly in vulnerable populations. Maternal health can be impacted by heavy metal exposure, increasing the risk of pre-eclampsia and gestational hypertension (13, 14). Heavy metal exposure can cause a variety of effects on fetal growth and development including pre-term birth and birth defects (15-17). Lead exposure has been shown to impact neurodevelopment in young children with potential impacts on behavior and cognition, and cadmium accumulation can result in kidney and liver damage (6, 18-22). Several other adverse effects have been postulated and are currently being researched (23).

Even with the knowledge of these adverse effects, there remain many challenges in measuring exposure to heavy metals, particularly in children. The invasive nature of blood collection makes it difficult to directly measure the presence of heavy metals in tissues of infants and children (24). In addition, determining heavy metal exposure from food can be difficult because there are other heavy metal exposure sources aside from foods,

e.g., contaminated air and water. Moreover, different nutrients in foods may modulate biomarker levels, adding another level of complexity to these measurements (25, 26). As such, improving the specificity and reliability of heavy metal biomarkers, as well as understanding of the interactions with other elemental nutrients, is critical.

The Intersection of Heavy Metals and Federal Nutrition Recommendations and Programs

The Dietary Guidelines for Americans (DGAs) serve as the basis for nutrition recommendations in the US, providing advice on what to eat and drink to promote health and prevent disease (27). While the DGAs utilize various scientific resources and methodology, as well as federal data such as WWEIA to develop nutrition recommendations, potential exposure to heavy metals is not assessed within these guidelines. There are recommendations to consume seafood choices lower in mercury, but food pattern modeling does not consider possible heavy metal exposure.

Researchers have used WWEIA data to estimate potential heavy metal exposure across age groups and typically report intakes below threshold levels with the exception of cadmium (5, 6). However, results also depend on what standard is used, as thresholds differ across the globe (Table 2). Additionally, WWEIA represents what Americans typically consume, not what is recommended by the DGAs. In fact, most Americans fall quite short of meeting dietary guidelines (27).

Table 2: Reference values for heavy metal intake among different agencies. From (8,2,28).

Guidance Source	Arsenic	Mercury	Cadmium	Lead
US ATSDR / EPA	0.3 µg/kg bw/day 10 ppb in water	0.3 µg/kg/d	0.1 µg/kg/d (chronic exposure) 0.5 µg/kg/d (intermediate exposure)	No acceptable MRL
US FDA			0.21-0.36 µg/kg bw/day	2.2 µg/day IRL for children 2022 8.8 µg/day IRL for adult women 2022
WHO/JECFA	2.14 µg/kg bw/d**	0.23 µg/kg/d	0.83 vg/kg bw/d **	No minimum level acceptable
EU-EFSA	0.06 µg/kg bw/day * 11/2023	0.19 µg/kg/d	0.36 µg/kg bw/d	No minimum level acceptable

[1]ATSDR established Minimal Risk Levels for arsenic, mercury and cadmium; FDA established Interim Reference Levels for lead.

[2]WHO/JECFA and EFSA established Provisional Tolerable Weekly Intakes which were then divided by 7 for daily intake, ** revoked by WHO/JECFA pending new work

While the DGAs are intended to make healthy eating recommendations to all Americans, the DGAs are also integrated into the USDA's 16 federal maternal and child nutrition programs, including Special Supplemental Nutrition Program for Women, Infants and Children (WIC), School Breakfast Program (SBP), National School Lunch Program (NSLP) and Child and Adult Care Food Program (CACFP). The foods provided by these programs are required to align with the recommendations of the DGAs and the improvements in nutritional quality in these programs have been documented (29-31). However, there has been no investigation into potential heavy metal exposure from the foods provided in these programs; there is also some indication that exposures may increase, particularly as intakes of whole grains, vegetables, nuts and seeds increase (unpublished data). Therefore, evaluating the estimated heavy metal exposure levels due to food intakes based on these recommendations and programs is important to gain an accurate understanding of the significance to these consumers.

Possible Mitigation Strategies to Reduce Heavy Metals in Foods

Given the associated health effects due to heavy metals, there is a pressing need to mitigate occurrence within the food supply, thereby limiting the exposure to heavy metals, particularly for vulnerable populations. Below are different approaches to reducing the presence of heavy metal in foods. These approaches provide examples of mitigations that may be successful in reducing heavy metal concentrations in food. However, the practicality of implementing these mitigations must be considered before making recommendations, a process that should also consider the magnitude and health significance of the reductions compared to the resources required, i.e., a determination of whether the reductions in concentrations achieve a concomitant reduction in health risk to the consumers of the foods.

Agricultural Technologies

One way to minimize heavy metals in food crops is to grow crops in areas with lower levels of heavy metals in the soil. This can be particularly challenging when the heavy metals are naturally occurring due to the local geology and there is limited agricultural land. However, there is greater opportunity to mitigate heavy metals in the soil resulting from human activities, such as industry leaching or farming practices.

Additional technologies have been developed to minimize heavy metals in the soil and limit their uptake by plants. Following established best practice guidance and establishing new guidance for heavy metal mitigation for particular crops (e.g. rice, wheat, leafy greens, sweet potatoes) as identified in the TDS data, is also warranted. Because heavy metals can persist in soil for extended periods, strategies such as soil excavation or soil washing can help reduce heavy metal levels in the ground (32). Other routes include focusing on what is added to the soil, such as fertilizer and lime. Since some heavy metals such as cadmium occur in phosphate fertilizers, reducing the occurrence of heavy metals in fertilizers can lessen heavy metal levels in agricultural land, and thereby food crops. Additionally, soil amendments to change the soil pH like lime can reduce the uptake of heavy metals by plants (33). Phytoremediation is another option for removing or containing heavy metals (34). This process uses vegetation and associated microbiota, soil amendments and agronomic techniques to reduce heavy metal levels or render them less bio-accessible in soil.

Another option involves harnessing crop genetics to develop new breeds of plants that minimize heavy metal uptake while growing (35). Given that oats and corn do not have significant heavy metal levels, examining the mechanism behind this lack of heavy metal uptake could provide insights that may be applied to other food crops. Modifying crop genetics to create plants that are resistant to heavy metal uptake can occur through traditional plant breeding, genetic engineering, or CRISPR technology. However, cost, consumer acceptance and nutritional equivalence need to be considered when using these technologies.

Methods to Modify Crop Genetics to Reduce Heavy Metal Uptake

Traditional Plant Breeding

Multi-year (often 10+ years) process to grow and assess various plant varieties over growing seasons using crossbreeding of varieties to develop particular traits (like less heavy metal uptake).

CRISPR Technology

CRISPR (**clustered regularly interspaced short palindromic repeats**) is a tool used by plant researchers to edit (move or remove) specific genetic sequences identified as contributing to a known challenge. It can shorten the multi-year process of plant breeding when a known genetic sequence (e.g., preferential lead uptake) can be edited out of a plant variety.

Plant Genetic Engineering

Plant Genetic Engineering differs from CRISPR technology in that it inserts genetic sequences from another plant species vs. editing within the existing plant genetics.

Processing Technologies

Since heavy metals are stable, their levels persist throughout food harvesting and transport. However, food processing may increase or reduce heavy metal concentrations. Re-engineering processing procedures and using alternative methods have been shown to reduce heavy metal concentrations. For example, industrial washing with an alkaline solution has been shown to remove more than 95% of cadmium in rice after two washings (36). Sorting technologies, including coarse sorting by pre-testing materials for metals and or electromagnetic radiation tools (rapid spectrophotometric analysis) could help identify and sort ingredients with heavy metals (37). Other processes such as adsorption have been shown to filter out heavy metals from contaminated water as well as peanut skins (38, 39). Adsorption refers to surface adsorption of heavy metal ions, usually from a liquid to a solid substrate, such as activated carbon, and can allow for the capture of heavy metal ions. With some adsorption materials, this can be done selectively to target specific types of ions. There is substantial literature regarding the ability to remove heavy metals from water using adsorption processes that can be applied to liquid foods, but requires further research work to evaluate how well the technology applies, considering potential to also remove beneficial metals such as iron, zinc, etc. Adsorption has several additional advantages, since the process requires little to no energy and can use by-products from oil seed manufacturing, reducing food waste. These methods have shown promise; however, they have not yet been explored on an industrial scale that would be required to process food for consumer consumption.

All heavy metal reduction through food processing techniques does not need to be at an industrial scale; cooking at home via boiling can also lower heavy metal exposure as heavy metals are leached into the cooking water (40, 41) but simultaneously may result in nutrient losses. While some food processing techniques may reduce exposure, methods that dehydrate foods (e.g., frying, baking, drying) may unintentionally increase the proportional concentration of heavy metals in foods. A good example is with potatoes, where the 2022 FDA TDS report data showed that a peeled and boiled potato (with leaching occurring) had an average Cd level of 25 ppb and Pb of none detected, a French-fried potato (partial water removal) had averages of 58 ppb Cd and 0.56 ppb Pb, while potato chips (most of water removed) had averages of 130 ppb Cd and 2.1 ppb Pb.

Nutritional Approaches

Micronutrient status plays a critical role in heavy metal exposure. For example, iron deficiency has been associated with higher blood levels of heavy metals (42, 43). The intestinal pathway for iron uptake is the primary mechanism for lead and cadmium absorption into the body while the zinc absorption pathway is a secondary route. Having a low iron or zinc serum level enhances intestinal uptake of these and other metals following the same pathway. As such, an iron or zinc deficient child is at increased risk for lead or cadmium exposure. Iron status is especially relevant for infants and babies since 1 in 5 US infants 6-12 months old have inadequate iron intake. As such, promoting iron-rich foods such as iron-fortified cereals, beans and meat may be a potential strategy for decreasing heavy metal exposure.

An individual's nutritional status as well as the nutrient combinations of foods they are eating also impacts heavy metal uptake. In animal models, dietary fiber has been shown to bind to heavy metals, promoting removal from the body (42). A recent observational study looking at National Health and Nutrition Examination Survey (NHANES) data supports these results showing that dietary fiber intake is inversely related to serum heavy metal concentrations among adults (43).

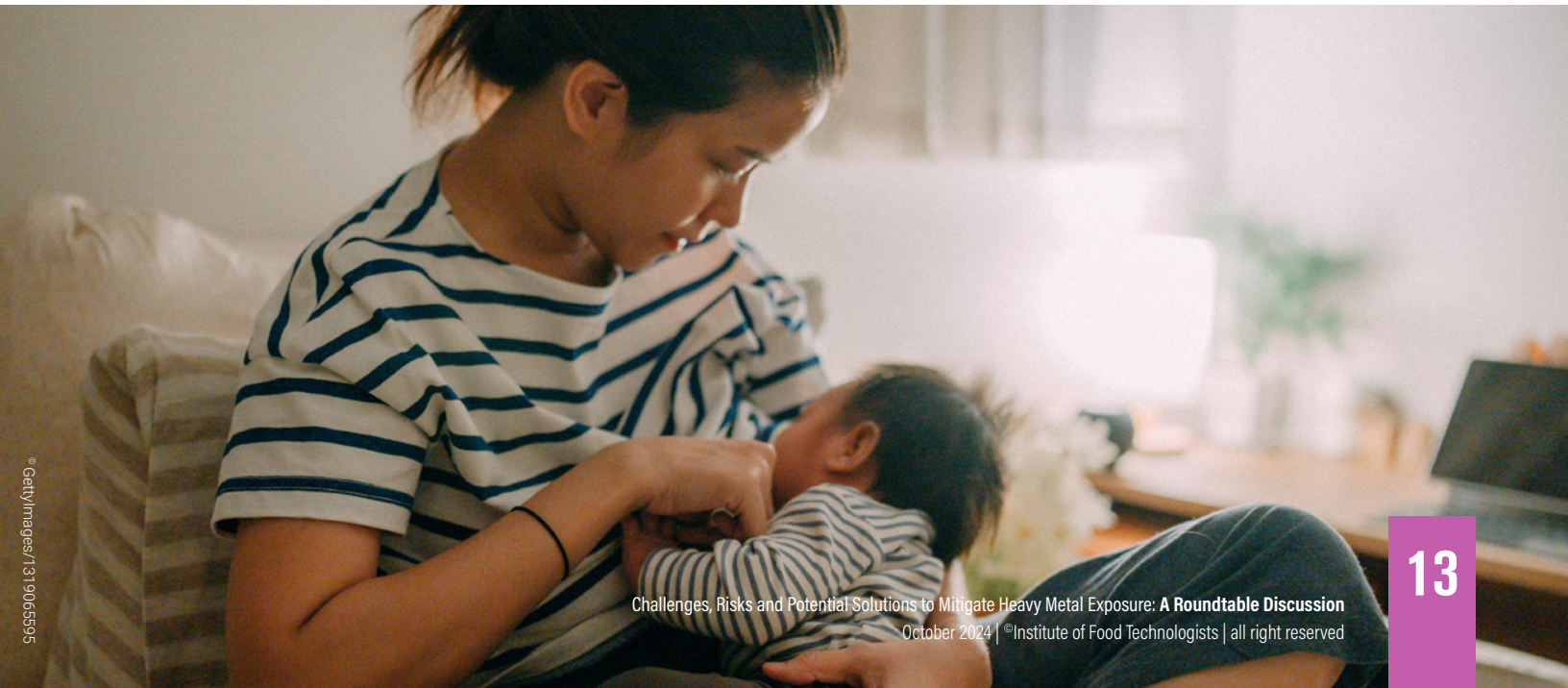
Another approach to reducing metal exposure through a nutritional lens is to continue to promote the consumption of a variety of foods, especially those with critical micronutrients with little to no heavy metal concerns, such as fruits, dairy and meats. Those foods of concern should be considered in the totality of the dietary pattern with an emphasis on variety (44). While vegetables are sources of important micronutrients, emphasizing the importance of eating a variety of vegetables can mitigate heavy metal intake. Additionally, focusing on the importance of multigrain foods instead of a single whole grain like wheat can further reduce heavy metal exposure.

Next Steps

The complex nature of challenges with contaminants requires a variety of next steps. From developing a deeper understanding of the challenge and opportunities for mitigation through research, expanding understanding of the impact with improved assays and biomarkers, building collaborations across sectors for risk communication and mitigation and developing impactful resources and communications for consumers, healthcare professionals and scientists are all considerations. Throughout the next steps, it is essential to ensure communications are clear, transparent, and not unnecessarily alarming. Using consumer friendly language and avoiding emotionally charged words, like "toxic," were two recommendations participants suggested to apply throughout the recommended next steps. While the presence of these heavy metals in our foods is undesirable, their presence is unavoidable to some extent (as there is some level of presence due to natural sources). The focus should be to reduce and mitigate concentrations of heavy metals of concern, with attention to the most vulnerable populations.

Research Needs

Understanding the effects of heavy metal exposure requires improvements in research methodology and analyses, increases in funding for needed research, studies of the impact of processing and handling (both commercial and in the home), and collection of more exposure data for vulnerable populations, such as pregnant/lactating women, infants, and young children. These advancements will further research questions regarding risk/benefit calculations and assess the potential interactive effects between heavy metals and various nutrients.



Better Methods for Determining Intake Levels and Systemic Exposures

There are many ways to estimate heavy metal exposure from dietary sources. Currently, most of the measurements are deterministic, where exposure is calculated by multiplying the average intake by the average heavy metal level. This approach does not account for the complexity of eating patterns, differences in intestinal uptake, nutritional status, or the ranges of heavy metal levels in foods (45). For example, the use of simpler one- or two-day studies of eating patterns, such as in WWEIA, are likely insufficient to identify problematic longer-term patterns. By taking a probabilistic approach to determine exposure levels, this complexity and range can be accounted for, providing a more precise assessment of heavy metal exposure. Further, this method can be extremely helpful in providing more accurate exposure levels among vulnerable populations such as pregnant women, toddlers, and children. Also, this approach will be particularly relevant for individuals with specific dietary needs and those with health conditions that make it difficult to eat varied diets.

Greater Understanding of Cumulative Exposure

Exposure to heavy metals through food consumption is only one of many routes of exposure. To better understand where mitigation efforts will provide the greatest benefit in reduction in exposure to heavy metals, it is necessary to understand more about how exposure through food consumption compares to exposure through other routes (e.g. water, air, other environmental exposure) (45). Understanding the magnitude of reduction in exposure via different mitigation efforts will help prioritize mechanisms that will lead to the greatest reductions in cumulative heavy metal exposure.

Biomarker Needs

Another branch of research that needs further development is a better measure of heavy metal exposure via multiple biomarkers. Current biomarkers include measuring blood, urine, bone, nail, hair, and other tissues for heavy metal levels (46). While some of these markers have advantages, such as not being invasive, these biomarkers are not able to identify disease susceptibility or mitigate the development of a disease outcome. Next-generation biomarkers include measuring gene expression and protein regulation (i.e., beta-micro-globulin levels correlated with creatinine to assess levels of cadmium). Advancements in these approaches could provide a more accurate understanding of the role of heavy metals in adverse health effects.

Collaboration Needs

The food system is often siloed, making it difficult for advancements and long-term changes to take place. As such, a variety of cross-cutting collaborations across stakeholders such as academic institutions, scientific groups, government agencies, researchers, industry trade groups and leading companies can allow for these improvements to occur and be long-lasting.

Farm-to-fork Approach

Dietary heavy metal exposure starts on the farm and ends after consumption. This underscores that the challenge is farm-to-fork in nature and requires collaborative solutions across the food supply chain. Starting on the farm, assessing codes of practice and geographic soil challenges can help identify potential ways to lessen heavy metal intake. Soil scientists and bioprocess geoengineers can identify soil amendment options for minimizing heavy metal levels. Plant breeders can continue developing new crop breeds that take up fewer heavy metals and maintain nutrient quality. USDA is currently conducting this type of food systems work, looking at the intersection of agricultural changes and health outcomes (47). Using insights from this work to expand the effort could be used as a case study for farm-to-fork solutions in reducing heavy metals in the food supply.

Current segmented workstreams do not foster collaboration or consideration of heavy metals in dietary recommendations. Integrating food safety considerations, like heavy metals, into dietary guideline development, meal planning recommendations and subsequent government nutrition programs is essential for risk management. This panel discussion brought together an intersection of expertise across food safety, nutrition, government, academic, non-governmental organization (NGO). Continuing to foster similar collaborations in public health nutrition will help both in communications and risk management.

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Global Interdisciplinary Approach

Beyond advancements on the farm, interdisciplinary collaboration across stakeholders such as academic institutions, scientific groups, policy makers, governments, industry trade groups and leading companies is also needed. This type of collaboration can allow for shared data, resources, and learnings in areas of food safety, toxicology, food technology, nutrition, and public health. The presence of contaminants in food commodities, particularly heavy metals, is often related to the geographical area where the food is grown and produced. While local or national level actions are important, international collaboration and harmonization of standards is needed due to the significant level of global trade. The Codex Alimentarius has been working diligently to establish standards for heavy metal levels in many commodities in a way that protects consumer health and establishes a standard that facilitates trade of commodities. It is important to set heavy metal standards that reflect mitigation strategies in areas where the crop is grown and harvested. Farm and import/export checks by government regulators, as well as standardized methods of analysis and sampling would be put in place. A broadened, global Codex standard for heavy metals can also define terminology and develop codes of practice or guidance to help with industry compliance and can build trust through communication with the public on a global basis.

Communication Needs

Identified as one of the most essential and challenging next steps are communication needs. Risk communication is a balance of providing factual, meaningful, transparent, actionable communications and resources while simultaneously avoiding inciting fear and emotional responses that may lead to irrational reactions and bear unintended consequences. Substantial effort is needed to develop risk communications to the scientific community, as well as the general public and the media. One of the key communication considerations in the discussion centered around the terminology of "toxic elements," "heavy metals," and "contaminants". While scientifically these terms are used almost interchangeably, the consumer interpretation of "toxic elements" provokes fear and negative emotions. Using equally scientific and factual language, such as "natural contaminants", may be more neutral and better promote effective risk communication.

In addition to aligning nomenclature with the needs of the public, understandable communications and partnerships must be developed on several topics as discussed below. Utilizing an interdisciplinary communication approach will help ensure the conversation around heavy metals is clear, concise, and factual. This proactive strategy will provide consumers with the information they need to make informed and science-based decisions.

Important Communication Questions

- What are heavy metals and where are they found?
- Why are heavy metals found in food?
- How do heavy metals affect health?
- Are there ways to reduce heavy metal levels in the food supply?
- What are some strategies for reducing heavy metal exposure from diet?
- What strategies are recommended to limit heavy metal exposure in a healthy diet without sacrificing key nutrient intakes?

Critical Communication Partners

To ensure clear and accurate communications, partnerships across the food and health system, from regulators to medical professionals to the media will be needed. At the federal level, agencies such as the FDA, the USDA Center for Nutrition Policy and Promotion (CNPP), and USDA's Food and Nutrition Service (FNS) would be critical partners for ensuring science-based dietary guidance and resources are available to the public. Under the USDA's Food and Nutrition Service (FNS), there are 16 federal nutrition assistance programs, including WIC, the Supplemental Nutrition Assistance Program and school meals. These programs serve over one in four Americans during a year. One main mission of these programs is to provide nutrition education that supports American agriculture and inspires public confidence.

Since parents visit their child's doctor at least a dozen times before their child turns four, medical professionals are key communication collaborators (48, 49). These individuals get multiple face-to-face touchpoints and are there to answer health questions for families. However, most medical schools in the United States teach less than 25 hours of nutrition over four years and less than 20 percent of medical schools have a single required course in nutrition (50). Even fewer receive food systems, food safety, or agricultural education.

Similarly, health communicators in the media are often a go-to source for consumers to receive information on food and nutrition related topics. Yet, some may lack the expertise to be able to interpret and report on scientific findings related to heavy metal exposure. Thus, partnering with healthcare professionals, Food is Medicine programs, food, nutrition, agriculture, and public health scientists, including related scientific societies, institutions, government agencies and consumer product goods manufacturers are all essential to provide continuing education resources and consumer-friendly materials that can offer the information needed to be effective communicators on these topics.

Conclusions

The IFT virtual roundtable, "Challenges, Risks and Potential Solutions to Mitigate Exposure to Heavy Metals," identified a variety of interdisciplinary challenges, needs and opportunities. The growing global scientific and regulatory concerns about heavy metals in foods suggest the US may need to further consider exposure to heavy metals in the development of dietary guidelines and federal nutrition assistance programs targeted to the most vulnerable in the population. The roundtable also emphasized the need for additional research to accurately determine exposure and health effects in all populations, and the importance of interdisciplinary collaboration on communications to avoid misinformation and inciting fear among consumers. A need for global standards for safe levels in foods was also discussed.

The roundtable identified several mitigation strategies already available to reduce exposure of vulnerable populations to heavy metals that range from the farm to the fork, and beyond. Agricultural technologies can minimize heavy metals in the soil and plants, processing technologies can reduce the presence of heavy metals in finished foods, and nutritional strategies, such as ensuring iron and zinc adequacy, can play a role in minimizing exposure. These strategies could be further optimized with additional research and investment. While the roundtable discussion focused primarily on US food production, it was acknowledged that these issues may be of even greater import in less developed countries where nutrient inadequacy is more frequent, and farmers may not have access to mitigation strategies.

Together, through research and technological advancements, improved collaboration, and science-based communications, heavy metal exposure and potential negative health impacts can be significantly reduced.

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