Use-Related Methamphetamine Contamination in Managed Housing

Current Knowledge and Standards and Future Policy Directions

PREPARED BY
BIG WATER CONSULTING

National American Indian Housing Council
"A Tradition of Native American Housing"
NAIHC

SKHA

seven sisters
COMMUNITY DEVELOPMENT GROUP, LLC

Acknowledgements

We would like to acknowledge the efforts of staff members and experts we spoke to at the following agencies and organizations: United States Environmental Protection Agency, United States Department of Agriculture Rural Development, National Alliance for Drug Endangered Children, Rocky Mountain Tribal Epidemiology Center, University of Washington Environmental and Occupational Health Sciences, Massey University, National Center for Healthy Housing, and all of the staff members at the public and tribal housing authorities who shared their policies and experiences.

We would also like to acknowledge Denisse Sanchez Lozano for her support in providing information on New Zealand's process of policy changes surrounding methamphetamine contamination.

This material is based upon work supported by funding under an award with the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. Neither the United States Government, nor any of its employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately-owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. Opinions expressed in this document are those of the authors and do not necessarily reflect the official position of, or a position that is endorsed by, HUD or by any HUD program.

Photo: Staff of Salish & Kootenai Housing Authority (Salish & Kootenai Housing Authority, 2021)

Prepared by Rachel Kramer and Kevin Klingbeil

March 2021

Photo on cover: Salish & Kootenai Housing Authority Building (Salish & Kootenai Housing Authority, 2021)

Table of Contents

Acronyms and Abbreviations

ADHD - Attention Deficit Hyperactivity Disorder

ADI - Acceptable Daily Intake

EPA - Environmental Protection Agency

HA - Housing Authority

HNZ – Housing New Zealand

HUD - Department of Housing and Urban Development

LOAEL - Lowest Observed Adverse Effect Level

RfD - Reference Dose

Meth - Methamphetamine

PHA - Public Housing Authority

NOAEL - No Observed Adverse Effect Level

NOEL - No Observed Effect Level

SF - Safety Factor

SKHA – Salish & Kootenai Housing Authority

TDHE - Tribally Designated Housing Entity

UF - Uncertainty Factor

USEPA - United States Environmental Protection Agency

Units of Measure Used to Describe Methamphetamine Exposure and Contamination

µg/100 cm^2 – Micrograms of methamphetamine per 100 square centimeter area of a household surface

µg/kg-day – Micrograms of methamphetamine ingested per kilogram of body weight per day

Types of Exposure

First-hand exposure – methamphetamine that is taken directly by a person by smoking, ingesting, or injecting

Second-hand exposure – methamphetamine that is absorbed or ingested by a person who is in the vicinity of someone using or manufacturing

Third-hand exposure - Methamphetamine contamination to surfaces from second-hand smoke or fumes that is then absorbed by a person who is in a contaminated space or touches a contaminated surface and absorbs that contamination

Executive Summary

Introduction and Background

There is little scientific research available on the health effects of contamination from former methamphetamine labs in residential spaces, and even less is known about the risks of contamination from meth use. The limited research that does exist has been used to create guidance for how to clean and remediate former meth labs, though many jurisdictions--especially tribal housing providers--apply these recommended standards to all cases of methamphetamine contamination out of an abundance of caution. The high rates of use-related contamination in tribal housing, in combination with the high cost to remediate spaces contaminated with methamphetamine, mean that this application of meth remediation guidance is not financially sustainable, and many operators of managed housing are seeking more research on the issue in order to best protect their staff and residents. This report does not contain any novel research or science and is meant to provide a summary of existing research and standards that may be helpful to providers of managed housing, especially providers of managed housing in Indian Country.

This report is the result of a project that was funded by HUD's Office of Native American Programs in response to a request for Training & Technical Assistance (T&TA) submitted by the Salish & Kootenai Housing Authority (SKHA). T&TA providers Big Water Consulting and Seven Sisters Community Development Group served as coordinators of the project. Big Water Consulting conducted extensive research on the current scientific knowledge surrounding household contamination due to methamphetamine use in residential spaces, as well as the range of standards applied by jurisdictions in the United States and abroad. Seven Sisters Community Development Group then provided assistance to the leadership of SKHA as they updated their policy regarding methamphetamine contamination in their managed units.

Methamphetamine and Methamphetamine Contamination

Methamphetamine (meth) is a stimulant drug that is available as a controlled substance prescription medication. Due to its addictive nature, meth has a high rate of abuse and dependence and is often manufactured and sold illegally. Methamphetamine can be manufactured using over-the-counter ingredients, which led to the rise of small methamphetamine manufacture operations, or clandestine laboratories, especially in rural parts of the United States and on Indian reservations. In 2006, the United States began restricting the sale of the key ingredients used in manufacturing meth, which resulted in a shifting of methamphetamine production to Mexico with Mexican cartels serving as its primary distributors.

Methamphetamine abuse and addiction is an acute issue in Indian Country due to the legal and social dynamics present on reservations, including inadequate levels of law enforcement and insufficient health care resources, high rates of poverty and lack of economic opportunity, and the complexities of prosecuting non-tribal members on reservation lands.

Both the smoking and cooking of methamphetamine create contamination when meth fumes are absorbed into household surfaces. Manufacturing methamphetamine also releases other toxic byproduct chemicals, which can also contaminate residential spaces. Contamination has been known to cause negative health effects to those living in spaces used as clandestine meth labs, especially children (Messina et al. 2014). This contamination must be cleaned and remediated by trained experts due to the presence of toxic chemicals, and remediating a residential space often involves tearing out and replacing carpeting, furniture, dry wall, counters, and even HVAC systems, which is costly and disruptive in a managed housing setting.

Existing Standards and Scientific Knowledge

To address the rising issue of methamphetamine lab contamination, the U.S. Congress passed the Methamphetamine Remediation Research Act of 2007, which established a course of research to create guidelines and policy intended to protect the health of residents of contaminated spaces. However, the EPA did not receive the expected funding for this project. As a result, the EPA only released a set of voluntary guidelines for cleaning up meth labs but was not able to conduct the research needed to establish quantitative standards for safe and acceptable levels of methamphetamine contamination. States, tribes, housing authorities, and other local jurisdictions have created their own standards to address contamination from the limited scientific research available. Because contamination from use is rarely mentioned in the existing guidelines and reports concerning the negative health effects of methamphetamine exposure, some jurisdictions—including many tribal housing authorities—use the existing manufacture guidelines for all methamphetamine contamination cases. In other jurisdictions, contamination is only investigated if a lab is discovered or suspected to have been operated in the space, and contamination from use is not addressed at all. The lack of concrete data and policy does not mean that exposure to use-related methamphetamine contamination is not dangerous or unhealthy, just that more research addressing this specific issue is needed.

This report describes the two primary studies which serve as the scientific basis or rationale for most existing quantitative standards for methamphetamine contamination in residential spaces: a 2009 study used to establish the "California standard" and a 2007 study used to establish the "Colorado standard." Both standards were written to address contamination from clandestine lab environments and specifically take into account the unknown number and quantity of toxic byproduct chemicals that may be present. The California standard was created using toxicology data from early clinical trials of prescription methamphetamine and utilized EPA processes and exposure models to create a suggested remediation standard of 1.5 $\mu g/100\ cm^2$ (micrograms per 100 square centimeters). This standard is meant to prevent any effect of the drug over an extended period of time on infants and toddlers, considered the most sensitive population due to contact exposure-increasing behaviors such as crawling and putting hands or feet in mouth. The California standard is considered a toxicological standard because it seeks to prevent all reactions to the drug rather than just negative health effects.

The Colorado standard is a technology-based standard, which means that the standard itself was chosen based on the cost and feasibility of detecting drug residue using available equipment and detection methods. However, the research used to select the specific technology standard was a health-based approach, which is meant to ensure that the most sensitive populations (also infants and toddlers) would not be put at risk of negative health effects at the surface contamination levels allowed by the chosen state remediation standard. The Colorado study used EPA processes and exposure models similar to those used in the California study, but used these processes to select from predetermined contamination limits, rather than using the exposure model as a formula to choose the highest remediation standard that would not put residents at a health risk.

Many states have adopted the California or Colorado standards, and various other states have implemented their own more conservative technology-based standards. State standards, which are usually suggested or voluntary and not legally enforceable, range from 0.01 μg/100 cm^2 to 3.2 μg/100 cm^2, though many states have not adopted any methamphetamine standards at all. Outside of the United States, New Zealand and Australia have also utilized the California and Colorado studies in determining their own methamphetamine remediation standards. Australia applied the existing science more conservatively and adopted a remediation standard of 0.5 μg/100 cm^2, while New Zealand used these studies as the basis for their recently adopted standards of 15 μg/100 cm^2 for use-related contamination and 1.5 μg/100 cm^2 for lab-related contamination. New Zealand is one of the few jurisdictions that treats the two types of contamination, use-related and lab-related, with separate health-based standards and the report goes into more detail about how the California and Colorado studies were used to create these standards.

Salish & Kootenai Housing Authority

Study coordinators presented an overview of existing science and standards to the management staff and board of SKHA. The housing authority had previously been implementing the California standard, but it was applying it to cases of contamination from both manufacture and use. Management used a risk assessment process to balance the array of potential harms resulting from both the unknown risks of methamphetamine contamination, as well as the harms resulting from the high costs to both tenants and the housing authority of remediating units contaminated by meth use. At the conclusion of this process, the housing authority amended their policy to more closely align with the intended application of the California study, which is to address contamination from former clandestine lab environments.

Conclusion

The current scientific knowledge regarding the health effects of methamphetamine contamination leaves large amounts of uncertainty that pose substantial hurdles for policymakers who are trying to balance the potential harm caused by meth contamination in housing units with the wide range of needs and health concerns of their community, including the substantial health risks associated with homelessness and housing instability, drug use, and other drug-related crime. More research and funding are needed before housing providers can create scientifically-informed and health-based standards to address methamphetamine contamination from meth use and implement situationally-appropriate policies and procedures that ensure the safety of their staff and residents and are financially sustainable.

Introduction and Background

This report was funded by HUD's Office of Native American Programs (HUD ONAP) in response to a request for Training & Technical Assistance (T&TA) submitted by the Salish & Kootenai Housing Authority (SKHA). The T&TA request was approved by HUD in December 2019 and the project was administered by the National American Indian Housing Council (NAIHC). NAIHC selected Big Water Consulting, a T&TA provider for HUD ONAP and NAIHC, to conduct a review of the existing research and knowledge concerning use-related methamphetamine contamination in managed housing. The housing authority sought a summary of available research regarding the health effects of use-related meth contamination and associated "safe" levels of use-related meth contamination in housing to help them assess their methamphetamine testing and remediation policy.

Methamphetamine addiction and dependence continues to be a devastating problem in Indian Country, and subsequently, methamphetamine contamination has been a major challenge in tribal housing. Tribal housing authorities spend millions of dollars each year testing and remediating units that methamphetamine has been smoked in, depleting already cost-burdened housing budgets (Big Water Consulting 2019a). There is no federal guidance that sets or recommends quantitative standards for testing and remediation, and there is limited existing research on the health effects related to exposure to contamination from methamphetamine use, also known as third-hand exposure. Tribal housing authorities are left sifting through this limited research to develop policies and procedures to keep their residents and staff safe from possible harms related to methamphetamine contamination. The knowledge and standards that do exist were written to address methamphetamine manufacture, which involves other toxic chemicals and contaminants. Due to the limited information available on the subject of methamphetamine contamination and its possible health effects--which tends to be anecdotal beyond the studies of exposure modeling presented in this report--policymakers in Indian Country often take a precautionary approach to methamphetamine contamination of any kind in managed housing. This report outlines the existing research, standards, and uncertainties that pertain to third-hand methamphetamine exposure, and methamphetamine exposure more generally. After the results of this research were summarized and presented to SKHA management and board of commissioners, another T&TA provider, Seven Sisters Community Development Group, worked with the leadership of SKHA to revise their methamphetamine remediation policy in a manner that was consistent with the scope, application, and findings of the research presented.

Brief History of Methamphetamine and Role of Meth Use/Abuse in Indian Country

Methamphetamine (meth) is a schedule II non-narcotic stimulant that is available as a prescription drug (Desoxyn) to treat obesity, narcolepsy, and Attention Deficit Hyperactivity Disorder (ADHD). Schedule II indicates that the drug is a controlled substance available as a prescription with a high potential for abuse and dependence (U.S. Department of Justice n.d.).

Amphetamines were first synthesized in the late 1800s, and methamphetamine, which is chemically related, was synthesized shortly thereafter. Before methamphetamine became a public health and law enforcement issue, both amphetamines and methamphetamines were widely available and used to treat narcolepsy, depression, obesity, alcoholism, and ADHD. Amphetamines and methamphetamine were given to military personnel during World War II to increase performance and to decrease fatigue (Foundation for a Drug Free World n.d.). Post-war, methamphetamine abuse and addiction began to emerge, even as it continued to be prescribed as a diet aid and antidepressant. The United States made methamphetamine illegal for most uses in 1970 with the Controlled Substances Act, after which a black market for production and distribution of the drug emerged, mostly controlled by motorcycle gangs (Drug Times 2020).

Methamphetamine can be taken orally as a pill, snorted, smoked, or freebased as a powder, or injected as a liquid form. Prolonged use can cause sleeplessness, loss of appetite, anxiety, paranoia, psychosis, and aggression. There are hundreds of street names for meth, but the most common names are “speed,” “ice,” “crystal,” “crank,” or “glass.” Methamphetamine production is simple and can be done using household items and over-the-counter ingredients. Black market methamphetamine is typically available as a pill or powder, or as “crystal meth,” an altered version that is particularly addictive. Crystal meth rose in popularity in the 1990s, especially in rural areas of the United States. Rural areas of the Midwest and Southwest United States became a hotbed for meth use and production, likely due to lack of law enforcement coverage in remote areas and ease of access to precursor chemicals[1].

Law enforcement began to focus on shutting down clandestine meth labs, and, in 2006, the U.S. began mandated tracking and restrictions of ephedrine and pseudoephedrine sales, ingredients used in a popular cooking method which were previously unrestricted and available in over-the-counter cough suppressants. This stymied efforts to obtain supplies locally and led to a shift in meth production to Mexican cartels, who could access the precursor drugs more easily in Mexico. Cartels understood the unique social and legal dynamics of rural American Indian communities and moved into reservations to cook and sell the drug so as to create a locally-dependent market (Wagner 2007). High rates of poverty, lower paying jobs and limited employment opportunities, and inadequate law enforcement, healthcare, and mental health services led to a rise in meth abuse and addiction within tribal communities (The National Congress of American Indians 2006). While tribes are sovereign nations, determining state, federal or tribal jurisdiction over the criminal activities of non-Indians within reservations remains a complex and issue-specific task; for example, tribal law enforcement cannot arrest

1 Chemicals known to be used in illegal manufacture of narcotic or psychotropic substances

and prosecute a non-tribal member, even if the crime is committed on tribal land, making prosecuting crimes committed by non-Indians in Indian Country prohibitively difficult, a fact that cartels have taken advantage of (Smith 2013). While the US government acknowledged the impact of methamphetamine in rural communities generally, the crisis within tribal and reservation communities went widely unnoticed (Forcehimes et al. 2011). It wasn't until 2006 that the Omnibus Crime Control and Safe Streets Act of 1968 was amended to allow tribes access to existing funding to combat the methamphetamine crisis (McCain 2006; Committee on Indian Affairs 2006). By that time, the Substance Abuse and Mental Health Services Administration (SAMHSA) estimated that the rate of meth usage in the Native population was more than double that of the white population--around 1.7% for the Native population, compared to 0.7% among white Americans--and some reservations and rural Native communities reported meth abuse rates as high as 30% (The National Congress of American Indians 2006).

Methamphetamine abuse and addiction can lead to many negative health outcomes for both the user and their family. A survey of western tribes found that 70% of out-of-home child welfare placements were due to a parent's use of meth (Tribal Law and Policy Institute 2007) and meth abuse was also one of the leading causes of other crimes, such as theft, burglary, and domestic violence (The National Congress of American Indians 2006). In large and sparsely populated tribal areas with already higher-than-average crime rates, these numbers can be devastating. On some reservations, tribal law enforcement officers cover an average of 400 miles per shift, and, with as few as 2-3 officers working during each shift, communities and homes are left especially vulnerable to drug-related crimes. Healthcare and drug treatment options are similarly limited. Almost 70% of respondents to a Bureau of Indian Affairs survey indicated that their community had no tribally-operated meth rehabilitation centers, and the Indian Health Service, the main source of health care on Indian reservations, is significantly underfunded (The National Congress of American Indians 2006). Off-reservation meth rehabilitation can be cost-prohibitive and difficult to access.

Because methamphetamine can be manufactured using over-the-counter ingredients, the rise in small methamphetamine manufacturing operations, or clandestine laboratories, has led to numerous other environmental and health problems. Clandestine laboratories can be built almost anywhere, including RVs, hotel rooms, commercial properties, and most commonly residential dwellings. Methamphetamine manufacture involves a variety of dangerous chemical compounds and processes, so chemical explosions and other environmental hazards at the site of meth labs are frequent. Hazardous chemicals from meth labs can enter waterways or seep into soil when not properly handled or disposed of. There are also significant health risks to the persons in the vicinity of the manufacturing process, or "the cook," due to the high volume of methamphetamine and other byproduct chemicals that are released during the cooking process, contaminating the air and surrounding surfaces. Youth who are present during cooks or who live in spaces used as clandestine laboratories are at especially high risk. Children recovered by law enforcement from clandestine laboratory sites have been documented to be suffering from severe respiratory problems, nausea/vomiting, eye irritation, and headaches (Simpson 2006).

Difference Between Use-Related and Lab-Related Methamphetamine Contamination

Both smoking and manufacture of methamphetamine release methamphetamine into the air, which can cause contamination when meth is deposited on the surfaces within the immediate area, such as on the floors, walls, ceilings, furnishings, and ventilation systems, or absorbed into drywall or other permeable surfaces. With methamphetamine use, the amount of contamination is directly related to the frequency of methamphetamine use, the size and ventilation of the space, and the number of people smoking in the space. A simulated smoking study by Martyny suggests that a single smoking session by one person will produce immediate surface contamination levels of around 0.02 μg/100 cm^2, though this depends on how much of the smoke the user is able to inhale during a smoking session (Martyny et al. 2008). Methamphetamine contamination is thought to dissipate over time, but precise rates of dissipation are unknown (Salocks 2009).

For a single meth cook session, simulated cook studies have produced contamination levels ranging from 0.1 μg/100 cm^2 to 160 μg/100 cm^2, depending on the method of cooking (Martyny et al. 2007). Contamination from cooking methamphetamine is typically many times higher than that of smoking. The level of methamphetamine surface loading at a cook site is usually used as an indicator of the level of other chemical contaminants. This is because there are many methods used to cook methamphetamine, and it is difficult to know which chemicals to test for at a cook site. The manufacturing of one pound of meth can produce up to 5-6 pounds of highly toxic waste and, as of 2007, the EPA had identified 75 chemicals associated with former meth labs, many of which require special hazardous waste disposal methods (Copper et al. 2011). The level of methamphetamine present is used as an indicator of the levels of all chemicals present as a safeguard to prevent accidental contamination from dangerous byproduct chemicals; if the amount of meth contamination allowed in a residential space is set sufficiently low, it is thought that this reduced contamination level will similarly protect against contamination from other toxic chemicals (Salocks 2009). In many cases, site inspectors have nothing on which to base their determination as to whether a housing unit has been used for manufacture or just for smoking other than the level of methamphetamine contamination present. Extremely high levels of methamphetamine contamination often signal the presence of a clandestine laboratory, though high levels could also be achieved through frequent smoking sessions by multiple people and high levels of contamination alone are generally not considered conclusive evidence of laboratory activity.

Health Effects from Contamination

When exploring the health effects of methamphetamine exposure on a person, it is important to understand the different types of potential exposure. First-hand exposure occurs when methamphetamine is taken directly by a person, whether by smoking, ingesting, or injecting. Second-hand exposure occurs when another person is in the vicinity of someone using or manufacturing methamphetamine and is ambiently exposed to the methamphetamine through the air. This is most likely to happen when a person is smoking methamphetamine and another person is present in the room. The person who is present in the room, but who is not using themselves, is exposed to “second-hand methamphetamine smoke.” Third-hand exposure to methamphetamine happens when meth is smoked or cooked in an indoor space, and that space becomes contaminated by meth residue from the fumes. In that scenario, the third-hand exposure happens when a person comes into contact with the residue and incidentally absorbs a portion of it.

A substantial body of literature has been developed on the effects of first-hand exposure to methamphetamine (National Institute on Drug Abuse 2020; American Addiction Centers 2020). A limited amount of research has also been published regarding the health effects on children of second-hand contamination caused by meth manufacture (Wang and Drummer 2015; Messina et al. 2014). However, the focus of the research summarized in this report is on third-hand exposure from contaminated surfaces in residential spaces, which most often impacts non-meth using tenants when meth has been used (or manufactured) in a residential unit by previous tenants, though it will also impact the meth user and those living with the user or guests who visit the unit.

Quite markedly, many of the various reports and studies concerning methamphetamine contamination note that at the time of their publication, there was no available evidence in scientific or grey literature (research produced outside of traditional publication channels) describing the health effects caused by third-hand methamphetamine exposure (Wright et al. 2017b; Gluckman, Bardsley, and Low 2018; Owens, Mason, and Marr 2017; Martyny et al. 2008). Published case studies outlining some of the negative health effects resulting from exposure to methamphetamine manufacture contamination have sought to establish a connection (Wright et al. 2017a; Copper et al. 2011; Thrasher, von Derau, and Burgess 2009), but none of these studies can be considered conclusive enough to establish a clear and definitive relationship between meth contamination and the health harms experienced by a person exposed to it. Martyny notes in his smoking simulation paper: “No published papers were identified regarding the relationship between children exposed to methamphetamine surface contamination or methamphetamine manufacture and any resultant health consequences. Anecdotal reports of increased asthma, pulmonary fibrosis, and upper respiratory complaints have been received but no documented health statistics appear to be available at this time. Many of the reports that have been received involved exposure to a clandestine manufacturing laboratory were reactions that could have been to the chemicals used to manufacture the methamphetamine and not to the methamphetamine itself” (Martyny et al. 2008). The lack of understanding of methamphetamine surface contamination and how it affects health creates a roadblock for those trying to prevent negative health effects, and anecdotal reports are insufficient evidence for understanding the mechanisms and direct causes of the reported health issues, especially when former lab sites contain unknown quantities of other potentially harmful contaminants.

In August of 2020, a paper published in Australia outlined 25 “opportunistic” case studies of residents who unknowingly occupied homes contaminated by methamphetamine and suffered from health effects possibly related to the contamination (Wright et al. 2020). Due to the “opportunistic” nature of the case studies, none of the cases presented constitute evidence of a clear and direct causal relationship between methamphetamine contamination and health effects but signal that negative health effects are possible and that the potential impacts identified in this report warrant further study. By "opportunistic," the authors are referring to the self-selection of the case study participants; only those who did experience negative health impacts participated in the study and authors warned that significant reporting bias[2] was expected. In essence, in addition to not being causal, the case studies are not a representative sample and the findings cannot be generalized. Of the 25 case studies presented, 10 of the units were deemed to have likely been contaminated from methamphetamine use, possibly representing the first published case studies of health effects from use-related contamination. Many of the other case studies involved known labs sites, and the underlying meth-related activity in some cases was unknown. The case studies deemed likely to have resulted from meth use were categorized as such because the sites contained no evidence of lab presence. Participants in the case studies varied widely in relation to a number of key factors: age, gender, time spent in unit, area of the property contaminated, contamination levels, and health outcomes. Participants who were able to do so gave hair samples and medical records and the results of wipe samples were also collected and analyzed. None of the participants had any history of illicit drug use. Due to the nature of the data collection, each case study was different in terms of the exposure scenario, testing equipment and procedures, and the method of assessing health claims. For most health claims, doctor or school nurse records from the time period of the health claim were used, which usually pre-dated and often triggered testing of the unit for contamination. In some cases, public attention to and fear of meth contamination led the tenant to request that the unit be tested. In all cases where the unit was thought to be contaminated due to meth use, the negative health effects dissipated within days or weeks of the tenant vacating the contaminated property, and there were no identified long-term or chronic health outcomes. There were no perceived patterns in the data, further underscoring that conclusions cannot be drawn from this paper about specific contamination levels or health outcomes, and that further research is warranted in order to understand how contamination is related to health outcomes and the specific contamination levels at which these health effects are at risk of occurring.

Current Guidelines Addressing Methamphetamine Contamination

No federal standards, enforceable or otherwise, currently establish limits on the amount or level of methamphetamine contamination that can be present in residential spaces or require owners or managers of residential spaces conduct testing to determine contamination levels. In 2013, the United States EPA published "Voluntary Guidelines for Methamphetamine Laboratory Cleanup," but, as the title suggests, the guidelines focus on areas used to manufacture methamphetamine, though the publication mentions that the guidelines "may be useful for cleaning up all sites contaminated by meth." The document notably is "not intended to set, establish, or promote quantitative cleanup standards" (United States Environmental Protection Agency 2013), which means that the role of setting specific numerical limits or restrictions on meth contamination levels falls first to states, and then to more localized jurisdictions. Tribal sovereignty gives tribes the authority to set policy limits within their tribal lands. At the time of

2 Reporting bias refers to a phenomenon in research which involves the selective reporting of some outcomes but not others, depending on the nature and direction of results. In this paper, only participants who experienced negative health effects were selected as case studies, and negative health effects may have been over-reported by the participant due to the nature of the study.

this publication, 26 states have established guidelines or recommendations for contamination limits in residential spaces, but 25 of those state guidelines pertain only to labs and most of the standards are not legally enforceable. Just one state, Minnesota, even addresses use-related contamination in their guidelines; this state has separate standards for use-related contamination and lab-related contamination.

The different state meth contamination standards and suggested quantitative limits range from Alaska's standard of 0.01 μg/100 cm^2 to New Mexico's standard of 1.0 μg/ft^2 (which translates to 3.2 μg/100 cm^2).

TABLE 1 | Current Standards*: U.S. States

Standard	State
None	Alabama, Delaware, D.C., Florida, Georgia, Illinois, Iowa, Kansas, Louisiana, Maine, Maryland, Massachusetts, Mississippi, Missouri, Nevada, New Jersey, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, South Carolina, Texas, Vermont, Wisconsin
0.1 μg/100 cm^2 or less	Alaska, Arkansas, Connecticut, Hawaii, Idaho, Kentucky, Minnesota (production), Montana, Nebraska, New Hampshire, North Carolina, Oklahoma, South Dakota, Tennessee, West Virginia
0.5 μg/100 cm^2	Colorado (per room), Indiana, Michigan (lab only, specifically notes does not apply to use), Oregon
1.0 μg/100 cm^2	Utah
1.5 μg/100 cm^2	Arizona (possibly being updated), California, Colorado (painted surfaces), Minnesota (use), Washington, Virginia, Wyoming
Higher than 1.5 μg/100 cm^2	Colorado (4.0 for attics & crawl spaces), New Mexico (3.2)

* Unless otherwise noted, all standards pertain to the manufacture of methamphetamine and do not mention or pertain to structures where meth was used but not manufactured

All but one of the existing meth testing and remediation guidelines adopted by states, as well as the voluntary guidelines set forth by the EPA, apply to dwellings or residential properties that have been used as clandestine methamphetamine laboratories (Owens, Mason, and Marr 2017). This is due to the prevalence of clandestine methamphetamine labs in the 1990s and early to mid-2000s, when most of the methamphetamine being distributed in the United States was made locally and usually in small batches. The well-documented dangers associated with methamphetamine labs are, in large part, caused by the byproduct chemicals produced during the cooking process. Additionally, many of the current standards are "technology-based" standards, which means they are based on the detection limits of available testing technology. Many wipe tests can only detect methamphetamine down to a concentration of 0.1 μg/100 cm^2, and technology-based standards typically are set so that any area included in a wipe sample that tests positive must be remediated until it tests negative. Technology-based standards represent the most conservative approach to addressing contamination; for policy writers concerned with the health outcomes of methamphetamine contamination, technology-based standards provide minimal guidance, and remediating down to the lowest levels detected by current technology can be prohibitively expensive.

The prevalence of clandestine methamphetamine labs has declined in recent years (United States Drug Enforcement Administration n.d.) as meth manufacture has moved across the border into Mexico, where large-scale manufacture and distribution is controlled by cartels (U.S. Department of Justice and Drug Enforcement Administration 2020). Most meth contamination being addressed by tribal housing providers contacted for this study is now attributed to the smoking of methamphetamine in housing units. Additionally, many of the newer methods for manufacturing methamphetamine are "cleaner" in the sense that the chemical processes are contained in bottles or other sealed vessels, limiting the release of meth and associated byproduct chemicals, as well as subsequent surface contamination.

Even though federal guidelines and most quantitative state guidelines specifically address meth laboratories and meth manufacture in housing, these guidelines have been applied widely to all forms of methamphetamine contamination, including use-related contamination, in which surface contamination comes from methamphetamine that has been smoked in the area. In the simulated smoking study by Martyny referenced above, the authors acknowledge that "it may be unreasonable to compare methamphetamine surface contamination levels in areas where only smoking has occurred, to levels in areas where a cook has been conducted since the other chemicals associated with the cook are not present in the smoking-only area" (Martyny et al. 2008). Contamination from meth manufacture involves many other chemicals, but because contamination from use is rarely mentioned in the existing guidelines and reports of negative health effects, some jurisdictions—including many tribal housing authorities—use the existing manufacture guidelines for all methamphetamine contamination cases. In other jurisdictions, contamination is only investigated if a lab is suspected to have been operating in that space, and contamination from use is not addressed at all in policy or procedure.

Weighing of Risks in Setting Methamphetamine Contamination Standards

As stated previously, the absence of any federal law or policy on methamphetamine testing and remediation means that state and local jurisdictions are left to determine their own policies and legislation. On Indian reservations, tribal sovereignty enables tribes to establish their own laws, policies, and procedures with respect to their housing and their housing programs. When establishing a testing and remediation guideline, a housing authority or local jurisdiction must balance the known and potential harms associated with applying the policy itself (e.g., costs of testing and remediation, and impacts of meth-related eviction) with the potential harms or health risks caused by use-related meth contamination in its housing units. The lack of published or reliable data describing the true risks present to those living in properties contaminated by meth use makes it difficult to conduct a risk assessment process, which involves weighing the specific risks associated with the possible outcomes or effects of each proposed contamination level policy.

Policies that establish an acceptable amount of methamphetamine contamination in a residential space are intended to protect residents from negative short- and long-term health impacts, especially vulnerable members of the population such as children or the elderly. The health effects of methamphetamine labs are more well-known and well-documented, and the standards written for former labs are meant to address these known harms. However, as previously stated, there are no published studies or reports that outline the negative health effects associated with various levels of third-hand methamphetamine contamination. Health risks associated with this type of exposure are difficult to ascertain and randomized control trial research studies are not ethically feasible, which is likely why there is a gap in the research and other published literature on contamination. It is difficult to conclude definitively that a health concern of a tenant living in a unit contaminated by methamphetamine use came from the methamphetamine itself without controlling for the variety of other housing-related health risks that may have been present during the test or study, such as mold, mildew, lead paint, asbestos, area pollution, or any pre-existing condition or health outcome associated with low socioeconomic status or poverty. The lack of concrete data does not mean that third-hand exposure to methamphetamine is not dangerous or unhealthy, just that more research is needed. In addition, many local jurisdictions may face political pressure to proactively deal with the community's methamphetamine problem and its effects on crime. This political pressure, in combination with the practical need to protect tenants and staff from both crime and health hazards within their units and the possibility of legal liability stemming from contamination-related harms to tenants, may lead housing authorities to adopt punitive policies and procedures in response to these potential risks.

The risks of setting a contamination level that is too low, which may trigger costly unit remediation and result in eviction of the tenant, are more defined, but they are nonetheless difficult to accurately or fully quantify. If the contamination level in a unit exceeds the level set forth in housing authority policy, the resident is usually subject to eviction proceedings or, in some, they may be allowed to enter into a "second-chance" agreement that seeks to change their behavior by requiring strict adherence to specific additional conditions or requirements. The tenant may be barred from future tenancies at the housing authority, either for a set amount of time or permanently. Many tribal housing authorities charge tenants for the testing and remediation of meth contamination for which the tenant is deemed responsible, and it is typically this outstanding debt that prevents tenants from becoming eligible for tribal housing or associated services. Known health hazards associated with eviction have been identified, including physical and mental health harms (Vásquez-Vera et al. 2017), harms associated with homelessness ("Homelessness as a Public Health Problem" n.d.), and in the case of drug addiction and abuse, relapse (Damon et al. 2019). In tribal areas, people experiencing homelessness are likely to be temporarily housed in the homes of community members or family, increasing overcrowding and frequently leading to methamphetamine contamination in the dwellings that they move into following their eviction. The homes of friends or family that these evicted tenants move into are often also managed by public or tribal housing authorities, potentially subjecting the other tenants and their families to eviction either as a result of allowing an evicted tenant to stay with them or as a result of new meth use by the previously evicted tenant in their units.

In addition, testing and remediation for methamphetamine can be extremely expensive, which reduces the amount of the already-limited Indian Housing Block Grant funding that can be used for the development of new housing and the routine maintenance and operation of existing housing. Remediating a dwelling can involve varying amounts of labor and material cost, including fully replacing all materials down to the building studs. While most housing authorities study coordinators spoke to have policies that pass this cost along to the former tenant, the majority of this cost burden ultimately falls on the housing authority itself, as most managed housing tenants cannot afford to pay off the balance of the remediation costs. Salish & Kootenai Housing Authority (SKHA) in Montana implements a policy stating that tenants are responsible for remediation costs, yet, despite spending over $5.2 million on testing and remediation since beginning regular meth contamination testing in 2014, the housing authority has recouped only $12,000 of their costs from the tenants responsible for contaminating these units. SKHA, like many tribal housing authorities, tests every unit after the tenant moves out to establish a baseline meth level prior to the next tenant's move-in date. Of the 124 units tested by SKHA in 2019 and 2020, 45 tested positive and were above SKHA's existing limit of 1.5 $\mu g/100\ cm^2$. Of those 45 units that were above the contamination threshold, 22 were above 15 $\mu g/100\ cm^2$. SKHA's costliest year for meth remediation was 2016, when remediating contaminated units cost the housing authority over $1.5 million. For context, remediation of meth-contaminated units cost the housing authority 34% of its IHBG funding for the FY 2016. IHBG funding is intended to be used to not only maintain and operate existing units, but also to develop new units to address the housing shortage on the reservation. With more than a third of their funding expended on remediation in some years, new development and routine maintenance was not financially feasible. Prior to beginning regular testing for meth contamination, SKHA had a 5-year maintenance plan for their units, but remediation costs have forced the housing authority to abandon that plan due to a lack of available funds. The housing authority began meth testing in 2014 in response to rising concern over the possible contamination of units. Prior to doing regular meth testing, SKHA had a savings account that covered approximately seven months of operations. Currently, the housing authority operates with the minimum-required three-month operating reserve.

A survey of tribal housing authorities in the HUD ONAP Northern Plains region conducted by Big Water Consulting in partnership with the United Native American Housing Association in 2019 found that of the 23 responding tribal housing authorities, 19 conducted meth testing and remediation on their units. Reasons for not testing were cited as lack of certified staff or funds for testing and remediation, as well as focusing on meth prevention. 44% of the 3,090 units tested were positive for methamphetamine (Big Water Consulting 2019a). The meth-positive units accounted for 15% of all units managed by survey respondents. The median amount spent per year by responding TDHEs was $26,145 for testing and $37,500 for remediation. Across surveyed TDHEs, a total of 337 meth-related evictions had been carried out over the prior five years (Big Water Consulting 2019b).

History and Context of Zero-Tolerance Policies

Within the context of managed housing and other programs, “zero-tolerance” refers to policies that require specific and often serious responses to misconduct. While zero-tolerance drug policies may make sense as a drug deterrent in a community riddled with drug-related crime, addiction, and abuse, there are also many unintended consequences of zero-tolerance housing policies that extend beyond the person who engaged in the drug use. Many zero-tolerance drug policies in public or tribal housing require that every occupant be evicted from the unit where the drugs were used, possessed, or sold--not just the drug user. Even if the drug user is the only tenant evicted, family members of the drug user may need to assist and provide shelter for their evicted family member. Evictions from any type of housing usually cause the evicted tenant or tenants to have difficulties securing future housing, and, on reservations, there may not be other alternatives to tribal housing or staying with family members. Even if an eviction does not result in “homelessness” as it is typically defined in urban areas--living in shelters, tent encampments, or on the street--it can result in long-term residential instability that has negative health and mental wellness impacts on the tenant and their family members, especially for displaced children (Martson 2016).

Zero-tolerance policies have a deeply rooted history in American public housing and in federal policy more generally. The “One Strike and You’re Out” policy implemented in the late 1990s by HUD under President Clinton and HUD Secretary Andrew Cuomo seemed like a promising solution to rising drug-related crime in and around public housing entities, especially in urban areas. The theoretical underpinning for this policy was that removing drug dealers and users from public housing communities, regardless of whether the criminal activity actually took place on housing authority property, would make the community safer for everyone. This public housing policy came in the wake of a general trend toward zero-tolerance drug policies at the federal level and gained legal traction through bills such as the Anti-Drug Act of 1988, National Affordable Housing Act of 1990, Public and Assisted Housing Drug Elimination Act of 1990, and Housing Opportunity Program Extension Act of 1996. Zero-tolerance policies are still the controlling drug policy in operation at most public housing entities, and any housing entity that utilizes HUD funding, such as the Housing Choice Voucher (formerly Section 8) program or the public housing program is required to retain the ability to evict tenants involved in drug-related incidents within their housing policies (Sen. Cranston 1990). These mandatory policies tend to be rather flexible, but many public housing authorities implement their own more stringent drug and alcohol policies (Curtis, Garlington, and Schottenfeld 2013).

Zero-tolerance drug laws have been falling out of favor in recent years in response to mounting evidence of their failure to actually reduce drug use and drug-related problems, as well as their tendency to disproportionately affect people of color. In 2019, the First Step Act was signed into law to address some of the effects of zero-tolerance drug legislation, including shortening mandatory minimum sentences for non-violent drug offenses. However, the effects of Nixon’s “War on Drugs” declaration in 1971 were far-reaching and outdated and invalidated policies remain slow to change. Federal-level funding restrictions and drug-related requirements were just one mechanism to enforce the nation’s overall drug policy tactics and these requirements continue to be enforced today, even as drug enforcement policies are loosening overall. These zero-tolerance drug policies in housing, and the federal-level zero-tolerance policies they stem from, disproportionately affect already-marginalized communities, as noted by a Harvard Law Review publication on the racialized impact of drug-based housing policy: "…the disparities in housing exclusion are not merely a consequence of the disparities within the criminal justice system. Instead, when it comes to housing, those already deep disparities are compounded by historic inequality and systemic segregation, creating, as others have observed, a 'double disparate impact' that has contributed to the disproportionate displacement and segregation of low-income people of color. As a result, policies excluding people with drug-related offenses from accessing housing perpetuate patterns of segregation" (Williams 2019). Zero-tolerance policies are being replaced with newer concepts and approaches, such as harm reduction[3], restorative justice[4], and housing first[5]. Many of these new approaches emphasize stable housing as a key feature in a person's ability to deal with chemical dependency or other mental health issues, further underscoring the connection between stable housing and the ability to overcome drug abuse or addiction. Voluntary supportive services in tandem with stable housing have been shown to be successful in preventing ongoing homelessness, increasing long-term housing retention, and discontinuing substance use (National Alliance to End Homelessness 2016a).

History of Methamphetamine Contamination Policy in the United States

A 2006 Congressional Research Service report entitled "Methamphetamine Lab Clean-Up and Remediation Issues" gives a glimpse into the congressional awareness of this national concern. As addressed in the history of methamphetamine section earlier in this report, meth labs rose to prominence in the United States in the late 1990s and early 2000s. Most of these were "small toxic labs" that produced less than 10 pounds of methamphetamine in a 24-hour period and were primarily used for local distribution and consumption, as opposed to "super-labs" that could create more than 10 pounds in a 24-hour period and were intended for broader distribution. In just a three-year span of time, the number of small toxic labs identified by the DEA almost doubled, from 9,000 in 2000 to over 17,000 in 2003. By 2004, however, many states and retailers had begun to restrict access to pseudoephedrine, a precursor chemical found in over-the-counter cough syrup, and small toxic lab site numbers started to decline (Simpson 2006). Meth production has continued to shift from small toxic lab sites to super-labs--primarily in Mexico--such that, despite the presence of fewer lab sites, there are still large amounts of methamphetamine being distributed in the U.S. (Office of National Drug Control Policy 2019).

The Methamphetamine Remediation Research Act of 2007 established a plan that required the EPA to create cleanup guidelines based on the limited available scientific research on the chemical. The Act also required a program of research to revise these guidelines as more information became available through new research and commissioned a study by the National Academy of Sciences on the "status and quality of research on the residual effects of

---

3 Harm reduction is aimed at reducing the negative consequences associated with drug use and does not center abstinence as the only successful approach to reducing harm (National Harm Reduction Coalition n.d.)

4 Restorative Restorative justice is an approach to criminal justice that focuses on rehabilitation of offenders through directly repairing harm with victims and the community at large, rather than punitive approaches (Centre for Justice and Reconciliation: A Program of Prison Fellowship International n.d.)

5 Housing First is an approach to homelessness assistance that prioritizes providing permanent housing as a platform from which other goals can be more easily obtained (National Alliance to End Homelessness 2016b)

meth laboratories” (Committee on Science and Technology 2007). Despite the specific steps laid out by the Methamphetamine Remediation Research Act, the EPA was unable to carry out these steps to completion due to funding issues. A 2011 progress report noted that, while the EPA had been authorized $3.5 million in funding for the purposes of implementing the Act, the money was never appropriated (Copper et al. 2011). The EPA had to redirect funding from other programs and was able to implement many, but not all, of the requirements. The EPA’s Voluntary Guidelines for Methamphetamine Laboratory Cleanup document was one result of these efforts. Additional research needed to develop health-based cleanup guidance was delayed, as was all other research on the issue.

Existing Standards

EPA Definition of Reference Dose (Acceptable Daily Intake) and How it is Calculated

While a very limited amount of research has been conducted concerning the health effects of third-hand meth exposure, the United States Environmental Protection Agency (EPA) utilizes a standard process for developing safe exposure levels to hazardous chemicals in residential settings. This process incorporates EPA scientific models to assess the risk of (non-cancer or genetic) health effects from ongoing or chronic chemical exposure (United States Environment Protection Agency 1993). This process involves establishing an "acceptable daily intake" (ADI) level of the chemical for use as a reference dose or value, commonly defined as "the amount of a chemical to which a person can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect." The acceptable daily intake level is frequently derived from the "no-observed-adverse-effect level" (NOAEL) in an experiment. The NOAEL is an experimentally determined dose at which there was no indication of a toxic effect in any subject, while a LOAEL ("lowest-observed-adverse-effect level") is the lowest experimentally determined dose at a toxic or adverse effect does occur. If a NOAEL has not been derived from an experiment, the LOAEL can be used. The NOAEL (or LOAEL if there is no available NOAEL) is then divided by a safety (or uncertainty) factor (SF). The safety, or uncertainty, factor consists of multiples of 10 or 3, each representing an area of scientific uncertainty. Common safety factors include translation from animal studies to human studies, variability within humans, and lack of available research on a topic or chemical of interest. The final safety factor consists of each individual area of uncertainty multiplied together, typically resulting in a safety factor above 100.

FIGURE 1 | EPA equation for Acceptable Daily Intake

> **"Acceptable daily intake (ADI) is a very import[ant] concept in chemical risk assessment. It is defined as the maximum amount of a chemical that can be ingested [or absorbed] daily over a lifetime with no appreciable health risk."**

$$\text{Acceptable Daily Intake (human)} = \frac{\text{No-Observed-Adverse-Effect Level (highest dose in an experiment)}}{\text{Safety Factor (often multiples of 10, each representing a specific area of uncertainty)}}$$

source: (Chem Safety Pro 2018)

In a regulatory context, emphasis is placed on sensitive populations when creating an acceptable daily intake value. A range of exposures to a particular chemical can be tolerated by an individual, and, in order to protect the most sensitive individuals in a population, it is important to determine the lowest threshold[6] to the chemical of interest that exists in a population (United States Environment Protection Agency 1993). For methamphetamine, most papers refer to infants or toddlers as the most sensitive population (Salocks 2009; Hammon and Griffin 2007; Gluckman, Bardsley, and Low 2018), though pregnant women and immunocompromised members of the general population are also noted as potentially sensitive populations. Infants are more commonly used, however, due to age-specific behaviors, such as crawling and putting hands, feet, or household objects in the mouth, which increases exposure to methamphetamine in a contaminated environment.

While this process has worked well and brought consistency to how reference doses are created across the scientific community, the use of the term “safety factor” and the resulting ADI can be misleading, as acknowledged by the EPA: “In practice, the ADI is viewed by many (including risk managers) as an ‘acceptable’ level of exposure, and, by inference, any exposure greater than the ADI is seen as ‘unacceptable’ This strict demarcation between what is ‘acceptable’ and what is ‘unacceptable’ is contrary to the views of most toxicologists, who typically interpret the ADI as a relatively crude estimate of a level of chronic exposure which is not likely to result in adverse effects to humans” (United States Environment Protection Agency 1993). As the EPA reference dose guidelines point out, “awareness of the ‘softness’ of the ADI estimate…argues for careful case-by-case consideration of the toxicological implications of individual situation…in addition, the ADI is only one factor in a risk management decision and should not be used to the exclusion of other relevant factors.” While the ADI is an important tool in creating a scientifically defensible contamination limit, the EPA guidelines caution against using this tool as a fixed or immutable indicator of safety.

In the current body of published methamphetamine literature, only two papers have gone through the full process of creating an acceptable daily intake value and subsequent reference dose to support the development of testing and remediation guidelines. The California EPA created a reference dose using the U.S. EPA’s guidelines as stated above. The paper written to create Colorado’s guidelines used a slightly modified process to arrive at their ADI. Both studies will be explored in greater depth below. It is important to note that most other jurisdictions and research papers have borrowed either California or Colorado’s ADI to develop their own testing and remediation guidelines. Many jurisdictions have adopted California or Colorado’s standards entirely, so it is important to explore each of their processes in order to better understand the underlying mechanics of the remediation standards applied both nationally and internationally.

6 The dose at which toxicity first appears is called the “threshold dose” (LaMorte 2019). To protect the population as a whole from a particular chemical or drug, it is important to consider the persons who may be the most sensitive to the chemical—i.e., have the lowest threshold dose.

California Study

One of the primary research papers that many jurisdictions have used as the basis for their methamphetamine remediation guidelines was produced and published by the California Environmental Protection Agency (EPA) in 2009 (Salocks 2009). The study, entitled "Assessment of Children's Exposure to Surface Methamphetamine Residues in Former Clandestine Methamphetamine Labs, and Identification of a Risk-Based Cleanup Standard for Surface Meth Contamination," or more colloquially referred to as "the California study," was the first of its kind in that it addressed surface contamination resulting from meth labs and the possible resulting levels of exposure for the most vulnerable and exposed population, young children. The study investigated two different exposure models typically used by the EPA for assessing pesticide levels in livable structures. The exposure population of interest was children from 6 to 24 months of age due to common age-specific behaviors, such as high contact with floors and surfaces and the likely high volume of hand-to-mouth transference of contaminants as a result of that contact. The study first reviewed a prior experiment where the EPA conducted "controlled cooks" using a variety of popular methods to manufacture methamphetamine. This study by Martyny (Martyny et al. 2007), which measured residue after the controlled cooks, was used to create some of the baseline inputs to the pesticide exposure models. The models estimated the amount of residue that would likely occur on a variety of surface types, including carpet, upholstery, painted surfaces, counters, floors, and other common household surfaces. Additional inputs were estimated, such as the amount of surface residue likely to be transferred to skin upon contact for each surface type, the amount of time spent with each surface, and the expected frequency of an infant putting objects or skin in their mouth.

The two EPA pesticide exposure models were then used to estimate oral and dermal exposure levels from residue on carpets, hard surfaces, and incidental ingestion from hand-to-mouth transfer. The "SOP" (Standard Operating Procedures for Residential Exposure Assessments) model is deterministic, which means that there is one output value that is fully determined by the input parameter values and initial conditions. The second model, "SHEDS-Multimedia" (Stochastic Human Exposure and Dose Simulation for multimedia) is a stochastic model, which means that the inputs produce a range of probabilistic outcomes rather than a single value. Both models utilize a number of input assumptions (a total of 17 for the SOP and 33 for SHEDS), or "default parameter values." In the absence of chemical-specific data on dermal absorption or transfer rates, the authors defaulted to using "very health protective" values for these model inputs. For example, there is no available data on how methamphetamine dissipates over time, so the conservative estimate used assumes that meth does not dissipate at all over time.

Outputs of the models were compared to a previously determined toxicological reference dose (RfD), also known as the ADI, for methamphetamine. A reference dose is typically the daily dose at or below which long-term adverse health effects are not likely to occur; however, the RfD that was used in this study was created by another California EPA study that accompanied the creation of cleanup standards (Salocks 2008), which took "a health-protective position that any effect induced by the drug is an adverse effect, and, potentially, a critical effect." The dosage data used to create this reference dose came from a 1961 study where prescription methamphetamine was given to pregnant women to reduce weight gain during pregnancy and was supported with additional data from a 1965 study in which methamphetamine was given to children to prevent bedwetting. The RfD paper also reviewed more recent double-blind studies where children were given prescription methamphetamine for ADHD. These studies are the only known randomized control trials where “high risk” populations (children and pregnant women) were exposed to methamphetamine and are therefore the most scientifically trustworthy data available to-date on the effects of methamphetamine in non-recreational users and for those populations who are most likely to be adversely affected by methamphetamine contamination in housing.

The reference dose was determined from the lowest dose that produced adverse effects in the studies--the LOAEL--as there was no observed NOAEL, or “no observed adverse effect level,” for the study. The lowest dose that produced an adverse effect in any of the studies was 0.08 mg/kg-day (milligrams of methamphetamine per kilogram of body weight per day). The resulting acceptable daily intake (ADI) of 0.3 µg/kg-day (milligrams of methamphetamine per kilogram of body weight per day) includes a built-in 300-fold uncertainty or safety factor. The components of the safety factor calculation were: 10x for the extrapolation from a “lowest observed adverse effect level” to “no observed effect level,” 10x for variation in individual sensitivity to methamphetamine, and 3x for incomplete literature on the effects of methamphetamine in the normal population (as opposed to studies on the long-term effects from methamphetamine addiction or recreational use).

The California study ultimately suggested 1.5 µg/100 cm^2 as a surface loading limit because it fell below the reference dose when compared with the 99th percentile of exposure from the stochastic SHEDS model, which is believed to be the more reliable of the two models. To translate into non-statistical terms, 99% of a population of infants would have a daily intake of methamphetamine under the reference dose for a surface loading of 1.5 µg/100 cm^2.

Colorado Study

Another study frequently cited when jurisdictions create meth testing and remediation standards was conducted in Colorado in 2007, entitled “Support for selection of a methamphetamine cleanup standard in Colorado” (Hammon and Griffin 2007). Instead of using a toxicological reference dose like the California study, the Colorado study attempted to create a health-based reference value using a variety of toxicology studies of methamphetamine in non-human subjects, primarily rats. While California’s toxicological reference dose attempts to find a dose at which there will be no effects at all of the drug over an extended period of time, a health-based reference value attempts to find the lowest dose at which the onset of negative health effects may begin to occur in sensitive populations, taking uncertainties into account. The paper notes that their reference value is not a reference dose by the EPA’s definition, but that it was created using a similar process. The authors referenced 15 different animal studies and found the dose at which negative long-term or short-term health effects started to appear. Because the studies varied widely in terms of administration pathway and the amount of methamphetamine administered, the authors chose to use a range of dose values rather than a single point value as their LOAEL. The range of doses at which negative health effects began to appear in the study subjects was between 1.5 - 21 mg/kg. Their resulting reference value was calculated to be a range between 0.005 - 0.07 mg/kg-day (or 5-70 µg/kg-day to put it in the same unit of measurement as the California study's reference dose). Like the California study, the Colorado reference value also incorporated an uncertainty factor of 300 to account for interspecies variability between humans and the animals in the studies (10x), the variability of sensitivity within humans (10x), and limited toxicological data on methamphetamine (3x).

The Colorado study went on to use the EPA's "SOP" algorithm—the same one considered by the California study—to compare their health-based reference value to three proposed technology-based cleanup standards being considered by Colorado: 0.05, 0.1, and 0.5 µg/100 cm^2. All three daily intake values resulting from the three proposed standards fell well below the daily health-based acceptable daily intake value, and the study chose the highest proposed cutoff--0.5µg/100 cm^2--as the recommended remediation standard.

Summary and Comparison of California and Colorado Standards and Acceptable Daily Intake Values

TABLE 2 | Summary Table of California and Colorado Standards and ADI Values

	California	Colorado
Type of ADI	Toxicological Reference Dose	Health-based Reference Value
Definition of ADI	Highest dose at which no effects will occur over the lifetime	Lowest dose that negative health effects could start to show in sensitive populations
ADI (per kg of body weight per day)	0.3 µg/kg-day	5-70 µg/kg-day
Uncertainty/Safety Factor	300	300
"Critical" Studies Used to Calculate ADI	1961 study using methamphetamine to prevent weight gain in pregnant women	Fifteen (15) animal studies assessing toxicity of methamphetamine
Type of Standard	Toxicological Standard	Technology-based Standard
Standard	1.5 µg/100 cm^2	0.5 µg/100 cm^2
How Standard Was Chosen	What is the highest surface loading that will not exceed the ADI value?	Do surface loadings from the three proposed standards exceed the ADI value?
What Type of Contamination Does it Seek to Address?	Clandestine Laboratories	Clandestine Laboratories

The California and Colorado standards have been widely applied, but both have been mistaken for health-based standards, and both have been applied in cases where the manufacture of meth had not been identified nor was it even assumed to have occurred. While Colorado uses a health-based ADI, the standard itself is technology-based. Prior to the launch of the study, the state of Colorado put forward three standards that were based on cost and testing feasibility, and merely wanted to understand if implementing these standards would result in significant risk to the health of sensitive populations. In the words of the authors of the Colorado study, "The intent of this paper is to determine if the technology-based cleanup standards are above levels associated with the potential for adverse health effects" (Hammon and Griffin 2007). The California standard is also not a health-based standard, because the ADI attempts to prevent any and all expressions of the chemical rather than just negative health effects resulting from exposure to the chemical. Both standards were written to address contamination from meth labs, and neither report addresses if it is reasonable to apply the standards to contamination that is not lab-related. Additionally, neither standard addresses the key question: "What is the highest surface loading of methamphetamine that will not result in negative short- or long-term health outcomes?"

New Zealand: Case Study

The California and Colorado studies were both published prior to 2010, and little research has been done in the United States since those publications. However, New Zealand has continued to adapt their methamphetamine remediation standards using these two studies in recent years. Methamphetamine contamination policy in New Zealand began in 2010 with a Ministry of Health-suggested limit of 0.5 µg/100 cm^2 for spaces previously used as clandestine laboratories. In 2016, New Zealand's Institute of Environmental Science and Research (ESR) reviewed the available literature from California, Colorado, and Australia[7] and ultimately decided to adopt the California standard of 1.5 µg/100 cm^2 for non-lab environments and to maintain the 0.5 µg/100 cm^2 for spaces previously used as clandestine laboratories.

Dr. Kim Technical Commentary and Opinion

In response to heightened concern for the health and safety of staff and tenants, Housing New Zealand (HNZ), New Zealand's largest public housing authority, commissioned an independent review of New Zealand's existing (2010) methamphetamine contamination standards as they related to the housing authority. The 2016 review was conducted by Massey University toxicologist Dr. Nick Kim, who researches chemical contamination and environmental risk assessment (Kim 2016).

In his review, Dr. Kim noted that the Colorado study completed its goal of reviewing the three pre-defined remediation standards proposed by the state and ensuring that the standard adopted satisfied its health-based reference value, but that it did not explore any additional, potentially higher surface loading levels that would result in daily exposures that would still fall below their health-based reference value. Dr. Kim's report asks, "Is it possible to estimate the lowest surface concentration at which adverse health effects could become plausible?" which was not addressed in either the California study or the Colorado study when these states established their standards. Because the SOP algorithm is linear, one can directly compare inputs to outputs (e.g., a 2-fold increase in methamphetamine residue will result in a 2-fold

7 Australia's guidelines for clandestine lab environments utilize California's toxicology data and approach, but applied more conservatively. Australia's guidelines also consider the levels and toxicity of other individual chemicals typically present at a lab site (Wright 2009).

increase in exposure amount). Using the Colorado study's health-based reference value and outputs from their SOP model, Dr. Kim extrapolated three additional estimates for the daily intake of an infant based on surface loading levels of 5.0, 10.0, and 12.5 μg/100 cm². All three of these proposed remediation standards fell at or below the health-based reference value threshold applied in Colorado. The calculation results, shown below in the table taken from Dr. Kim's technical commentary, show that the lower end of Colorado's reference value range is reached at a surface loading of 12.5 μg/100 cm². Dr. Kim ultimately recommends a surface loading limit of 12 μg/100 cm², which would not meet or exceed the health-based reference daily intake dose for infants, who are considered the most sensitive receptors.

FIGURE 2 | Table of relationship between methamphetamine surface loading and estimated ADI of an infant. Reprinted from Kim (2016, page 22)

Surface loading (μg/100 cm²)	Infant intake dose (mg/kg body weight / day)
0.05	0.00002
0.1	0.00004
0.5	0.0002
5.0	*0.002*
10.0	*0.004*
12.5	*0.005*

Note: rows 1-3 from [**7**]; rows 4-6 (*italicised*) extrapolated from data in [**7**] based on the linear relationship between surface loading and estimated intake dose.

Dr. Kim, who contributed as an author of New Zealand's Methamphetamine Guidelines written in 2010, specifically notes that the intended context for the original guidelines was for use in testing and remediation of clandestine laboratories and that "it was not anticipated that the recommended remediation guideline for methamphetamine may also be applied to a multitude of cases where methamphetamine had merely been smoked within the walls of a dwelling." He also noted that it "is possible that the authors of the [New Zealand] Methamphetamine Guidelines may have opted for a higher remediation target had the potential relevance of smoking been foreseen" or if representative data about smoking residue had been available.

In his commentary, Dr. Kim goes on to outline the formation of "risk-based" guidelines and what they actually represent in practice. He outlines the differences between a toxicological reference dose and a health-based reference dose, as is outlined in this report, as well as the role of conservative or "precautionary" exposure inputs where hard data is limited. Most importantly, he explains that "exceeding a 'risk-based' guideline value by a marginal amount cannot (and should not) be taken to imply the onset of any genuine or measurable health risk." He also specifically mentions guidelines adopted in the United States, saying that "although over 20 states in the U.S. have/had established their own clean-up targets for methamphetamine residues from surfaces, these other values were/are not 'risk-based.' Rather they are based on levels that (a) can be measured down to using modern analytical instruments, and (b) are so low that they are 'believed to be set at sufficiently conservative levels to still be health-protective.'"

Housing New Zealand did not ultimately adopt Dr. Kim's recommendations, which included making a final decision using a toxicological reference group instead of relying on a single opinion. Instead, HNZ decided to wait until pending Ministry of Health guidelines were released. However, Dr. Kim's commentary offered a novel health-based alternative to existing guidelines using the same research and data.

Chief Science Advisor Report

New Zealand's Chief Science Advisor, Sir Peter Gluckman, released a report in 2018 entitled "Methamphetamine contamination in residential properties: Exposures, risk levels, and interpretation of standards," which became colloquially known as "The Gluckman Report" (Gluckman, Bardsley, and Low 2018). The report outlines the ESR process used to establish a "health-based" standard for methamphetamine exposure: A health-based risk assessment begins with a toxicological characterization of the substance in order to understand if the substance causes harm and under what circumstances. In the case of methamphetamine, there is no data or research outlining the specific harm caused to people residing in a dwelling contaminated with methamphetamine from smoking. There is more concrete evidence of harms from residing in former clandestine labs, as well as the short- and long-term health effects of recreational use. The toxicological characterization, once established, determines the numerical relationship between exposure and resulting health effects, known as a "dose-response assessment." For methamphetamine contamination, this is the acceptable daily intake and the reference dose or value. Then, an "exposure assessment" identifies the extent to which exposure occurs with the substance, which for methamphetamine contamination, takes the form of exposure modeling using established research on surface and skin transfer and absorption rates. Finally, a "risk characterization" determines the nature and extent of the risk and how to engage in risk management. This final step involves establishing a testing and remediation standard after weighing the risk of harms from both a standard set too high as well as a standard set too low.

As seen below in the figure from the Gluckman Report, New Zealand carefully considered both California's toxicological reference dose and Colorado's health-based reference value. The Gluckman Report utilized their own exposure models from New Zealand's Institute for Environmental Science and Research (ESR), comparing the outputs to the ADIs from both the California study and the Colorado study. The report concluded that a surface contamination level of 2 μg/100 cm^2 would reach California's reference dose for a young child. When using Colorado's health-based reference dose (also for a young child), the reference dose was reached with a surface contamination of 33 μg/100 cm^2 (non-carpeted dwellings) or 23 μg/100 cm^2 (carpeted dwellings).

FIGURE 3 | Process used by New Zealand to establish a health-based methamphetamine standard.
Adapted from Gluckman, Bardsley, and Low (2018, page 16)

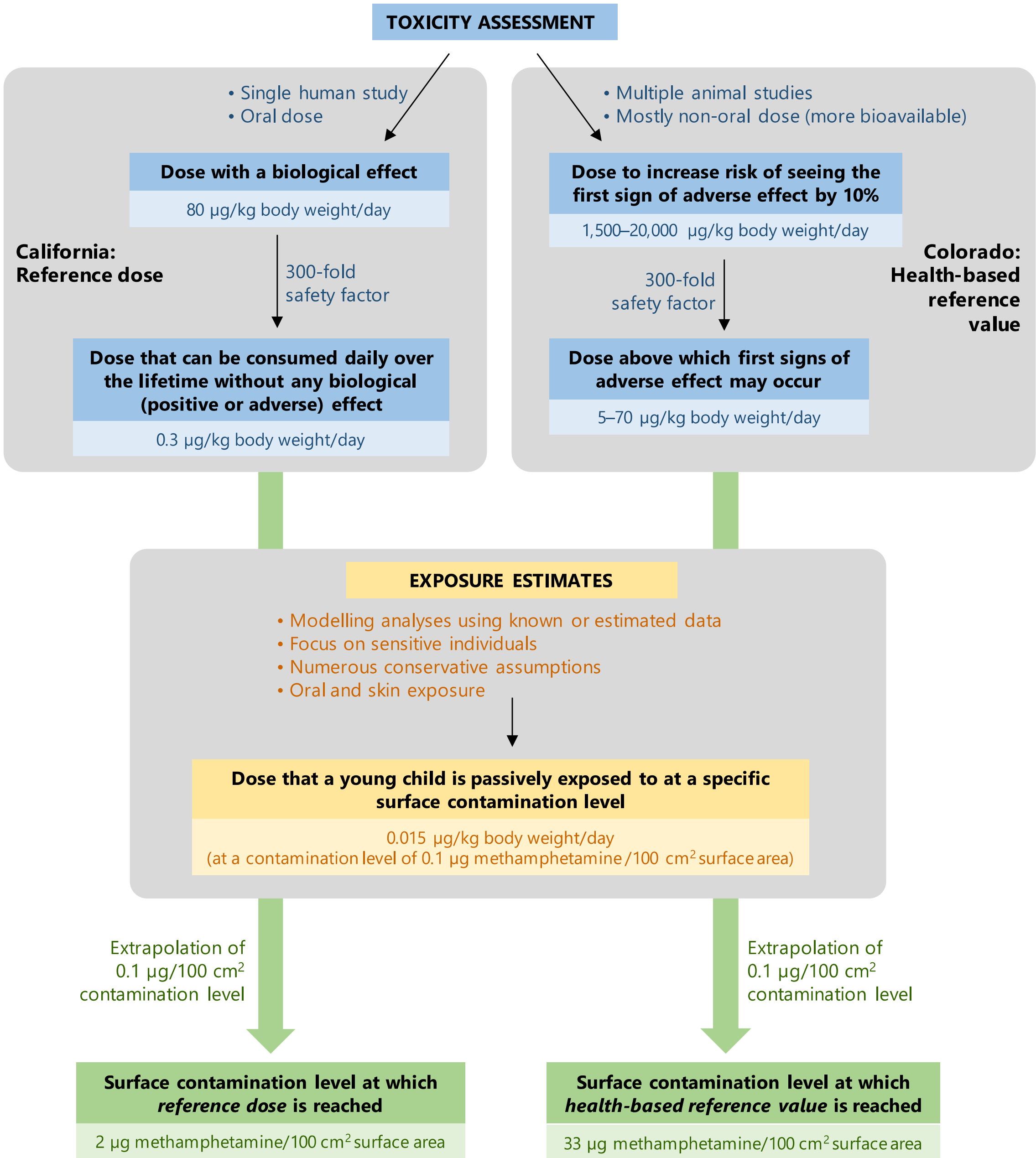

Figure 3: A highly simplified diagram showing the process of deriving health-based standards for methamphetamine. The exposure estimate for a young child, derived from New Zealand ESR modelling data, is based on a hypothetical surface concentration of 0.1 micrograms (µg) methamphetamine per 100 cm² surface area (Separate modelling analyses by California and Colorado [not shown] also used a level of 0.1 µg/100 cm² in their calculations. This selection was somewhat arbitrary as it was based on an early, non-health based clean-up standard adopted by the state of Washington.) The units µg/kg body weight/day refer to an ingested amount of methamphetamine measured in µg per kilogram (kg) of body weight per day. These doses represent a daily intake level that is protective (by a 300-fold safety buffer) against any effect (in the case of the reference dose) or against a 10% increased risk of the first signs of an adverse effect (in the case of the health-based reference value).

FIGURE 4 | Comparison of California and Colorado ADIs used by New Zealand to establish a health-based methamphetamine standard. Adapted from Gluckman, Bardsley, and Low (2018, page 18)

Summary of methamphetamine toxicity assessments

	California (OEHHA)	Colorado (CDPHE)
Measure of toxicity	Reference dose	Health-based reference value
Definition	The dose at or below which adverse health effects are unlikely to occur	Lowest dose at which an adverse effect may occur
Study population and effects	Reduced weight gain in pregnant women	Developmental and reproductive toxicity in laboratory animals
Calculated dose (µg/kg body weight/day)	0.3	5–70

These values can also be placed in perspective by comparison with the recommended doses for therapeutic purposes (Figure 3).

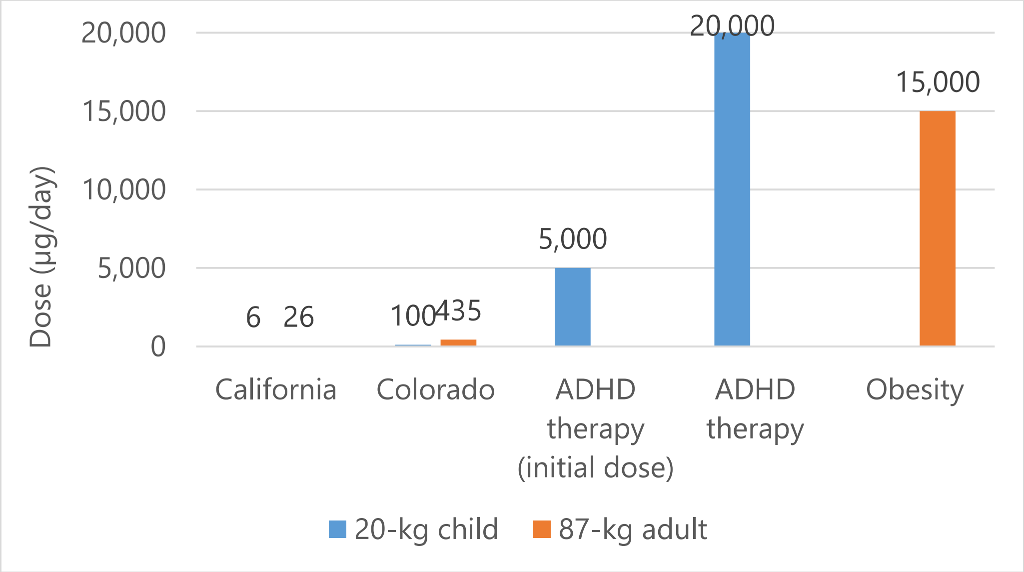

Figure 4: Therapeutic daily doses for ADHD treatment in a six-year-old child of average weight, or for obesity treatment in an adult, compared with the maximum daily exposure doses indicated for these two individuals by the California and Colorado guidelines. The lower end of the recommended ADHD therapy dose (20,000 µg/day) for a six-year-old child is shown. Obesity treatment dose assumes that three meals are consumed daily. The exposure doses calculated from the California and Colorado guidelines in this figure are higher than those referred to in text; this is because this figure relates to individuals undergoing methamphetamine treatment, rather than the sensitive groups of infants and non-obese adult women, who would have lower body weight.

The values resulting from the California and Colorado studies contain 300-fold safety buffers, and the report notes that "from a health perspective, none [of the existing remediation guidelines] should be interpreted as a specific 'threshold' that if exceeded--and particularly by a small margin--is likely to result in an adverse effect. The second point is that all of the guidelines can be considered to be very conservative as they are deliberately based on factors assuming 'worst case' scenarios that are unlikely to reflect a real-world situation." This point underscores the U.S. EPA's caution that those applying it should regard the acceptable daily intake value as a soft estimate rather than a definitive safety cut off. The large safety factors and conservatively estimated inputs to the exposure models used by California and Colorado reflect a precautionary approach to the many uncertainties in the methamphetamine contamination body of knowledge, which while protective of health and safety, do not necessarily consider all the real-world factors that must go into a balanced risk assessment process.

Using the output from their ESR exposure models, the Gluckman report provides a final set of recommendations using both California's and Colorado's acceptable daily intake values. The report emphasizes that if the dwelling was used only for smoking methamphetamine, negative health effects are unlikely to result from surface contamination levels under 15μg/100 cm^2. The report recommends testing only where meth lab activity or very heavy use is suspected. For heavy use, 15 μg/100 cm^2 is the suggested cutoff. For former labs and manufacture-related contamination, the report recommends applying the existing Ministry of Health guideline of 1.5 μg/100 cm^2. Essentially, the Gluckman report used California's more conservative reference dose to establish their recommendation for lab-related contamination levels and the Colorado health-based reference value in developing their recommended levels concerning contamination caused by meth use.

Housing New Zealand and Kāinga Ora Response to the Gluckman Report

In October of 2019, New Zealand's parliament voted to combine all of the major government housing entities in the country, including Housing New Zealand, into a single entity called Kāinga Ora. Kāinga Ora, which is a Māori phrase that roughly translates into English as "wellbeing through places and communities," is New Zealand's largest residential landlord, serving over 180,000 people. 37% of their tenants identify as Māori, the indigenous people of New Zealand, and the housing authority places great significance on understanding and involving the Māori perspective when it comes to urban development (Housing New Zealand 2019). Kāinga Ora's high proportion of indigenous tenants makes this case study especially relevant for reviewing the meth testing, remediation, and occupancy policies of both public housing authorities as well as tribal housing authorities.

Prior to the formation of Kāinga Ora, Housing New Zealand published a report in the fall of 2018 in response to the Gluckman Report called "Methamphetamine Contamination: Housing New Zealand's Response" (Housing New Zealand 2018). The report discussed the historical development of Housing New Zealand's policies and processes in relation to methamphetamine in its managed properties. In 2017, prior to the release of the Gluckman Report, Housing New Zealand announced that it would stop the termination of tenancies for methamphetamine contamination, except when there was clear evidence of manufacture, and that these cases would be considered a drug addiction issue to be addressed with rehabilitation services and support. This policy shift came about as part of a larger shift in the way the housing authority was dealing with illegal activities, from a zero-tolerance approach to a “sustaining tenancies” approach that focused on providing higher levels of support for people experiencing drug addiction and drug-related harm.

After the release of the Gluckman Report in 2018, Housing New Zealand decided to raise their threshold for remediation of use-related contamination to 15μg/100 cm^2 from their prior threshold of 1.5 μg/100 cm^2. Under the new policy and procedures for meth testing, when a unit tests above that level, the tenant is moved to another property rather than being evicted from the housing authority’s properties altogether. HNZ will also help tenants seek rehabilitation services and other support.

Housing New Zealand also used the report to acknowledge that their previous policy regarding methamphetamine use and contamination resulted in hardship and adverse outcomes for their tenants. One concrete result of this acknowledgment was the creation of the Meth Assistance Programme to support tenants and their families who had been affected by the previous policy. Housing New Zealand refunded methamphetamine remediation-related payments from tenants and has actively sought out these affected tenants to help them find new housing or reimburse them for moving costs and household good replacement (Kāinga Ora 2020).

New Zealand and The United States: A Shared Methamphetamine Problem

There are many parallels between the methamphetamine contamination problem in the United States and New Zealand, which make each country’s progress in addressing contamination particularly relevant to the other. Both countries share a high prevalence of use among Indigenous or Native populations, and in poor or rural areas more generally. Some key factors to consider about New Zealand’s risk assessment process may or may not carry over to the United States, depending on the area. First, New Zealand imposed restrictions on the sale of solvents and precursor chemicals that caused a major shift in the primary method for home manufacture of methamphetamine. A popular current cooking method involves using contained vessels that do not emit fumes, vastly reducing the potential for contamination and resulting health effects from the methamphetamine and the byproduct chemicals produced and emitted during the cook. This trend parallels the United States, which also restricted the sale of methamphetamine precursor chemicals, bringing about a shift in the drug economy away from labs containing a myriad of unknown toxic chemicals.

Second, the remediation industry in New Zealand has been heavily involved in setting the national tone and contributing to the development of guidelines regarding methamphetamine testing and remediation. Approximately half of the panel that determined New Zealand’s initial 0.5 μg/100 cm^2 contamination limit were members of the remediation industry, despite a potential conflict of interest related to their financial stake in the outcome of those standards (Sanchez Lozano, Wilkins, and Rychert 2020). The influence of the remediation industry in Indian Country in the United States is similarly strong, as training and information on methamphetamine contamination is often provided by the remediation industry itself. While likely more informed on issues related to toxicology and the health impacts of contaminants than most government agency staff whose roles do not encompass or address environmental health, remediation companies are not neutral parties, as they generate business and obtain profit from the testing and cleaning services that they provide, especially when housing entities choose to implement their more stringent recommended testing and remediation standards. Additionally, remediation experts rely on the same research presented in this report, namely the California and Colorado studies. The remediation industry may offer cutting edge cleaning technologies, but, other than anecdotal evidence based on their own experience, remediation professionals are not in possession of any novel or independent research regarding the risks and health outcomes related to the contamination itself. Housing authorities with high rates of contamination in both countries are similarly influenced by a for-profit industry that appears to be thriving in part due to the many uncertainties and fear surrounding the issue of methamphetamine contamination in managed housing. The continued work by toxicologists and policy experts in New Zealand may provide helpful direction to small jurisdictions in the United States, which are not able to fund additional research on the scale needed to make meaningful progress on the issue locally.

Agency Outreach

Public Housing Authority Policies

The coordinators of this study contacted numerous public housing agencies across the country, including the Missoula, Butte, and Ronan Housing Authorities in Montana, the Longmont and Denver Housing Authorities in Colorado, the Seattle, King County, Spokane Housing Authorities in Washington, the Housing Authority of the City of Los Angeles and the City of Redding in California, the Minneapolis Public Housing Authority in Minnesota, the Pittsburgh Housing Authority in Pennsylvania, and the Houston Housing Authority in Texas. Housing authorities were chosen based on their relevance to the tribal housing entity participating in this study (SKHA) and its policy-related decision-making process--a number of entities in Montana were chosen due to the location of SKHA, California and Colorado entities were included based on the fact that the states in which they are located were leaders in setting remediation standards, and several other cities chosen represent a variety of perspectives in terms of location, population, politics, and rates of methamphetamine use.

Of the public housing authorities contacted, only the housing authorities in Missoula, Helena, Los Angeles, King County, and Seattle responded and provided their methamphetamine policies as well as answers to the questions submitted to them by project coordinators. The questions submitted to the public housing authorities were as follows:

> Does [HA] test managed housing units for methamphetamine contamination? If so, under what circumstances? If not, why not?
>
> Has [HA] established a level of methamphetamine contamination above which one of its units would need to undergo remediation? If so, how was this level established by housing authority policymakers? If not, why not?
>
> Does [HA] differentiate between use and manufacture of methamphetamine in their response to contamination?
>
> Is methamphetamine contamination in its housing units a concern for [HA]?

Seattle Housing Authority's (SHA) meth-related policy only mentions meth labs, does not mention a specific contamination limit, and does not require testing unless there is a reason to suspect meth contamination. If a unit is tested and the test is positive for meth contamination, SHA responds by alerting the local Public Health Authority and deferring to their policies and procedures. The SHA operations contact noted that methamphetamine contamination is not a prevalent issue for the housing authority.

King County Housing Authority (KCHA) tests units after tenant move-out only if there was suspected meth use in the unit. The housing authority uses Washington state's recommended contamination limit of 1.5 μg/100 cm^2 and does not differentiate between meth use- and lab-related contamination. Similar to the other public housing authorities that responded to inquiries submitted by project coordinators as part of this project, KCHA does not consider meth contamination to be a concern and has only remediated 4-5 units in the past 5-10 years.

Contamination is also not a prevalent issue for the Housing Authority of the City of Los Angeles (HACLA). In the last 15 years, only one unit was reported for suspected methamphetamine manufacture. No evidence of manufacture was found, and contamination levels were consistent with what would be expected for a unit where meth had only been used, but HACLA remediated the unit anyway out of an "abundance of caution." HACLA does not have a policy specific to methamphetamine contamination, and it relies on guidance from the State of California Department of Toxic Substances Control concerning remediation levels and processes.

Missoula Housing Authority's (MHA) meth-related policy addresses a range of methamphetamine-related activities, including use, sale, and manufacture. It does not differentiate between the three, except in the case of meth manufacture, when state law mandates law enforcement involvement. MHA's policy lists 7 criteria to determine if a unit will be tested for methamphetamine. If 3 of the 7 criteria--which include written complaints, documentation, or footage of suspected methamphetamine use/manufacture/sale--are met, the unit is tested. Despite Montana's state suggested contamination limit of 0.1 μg/100 cm^2, Missoula Housing Authority's own policy applies a meth remediation standard of 1.5 μg/100 cm^2. The representative from the housing authority explained that the 1.5 μg/100 cm^2 level was recommended in their training on methamphetamine contamination, that this seemed to be the most scientifically validated standard, and that it was the standard that many other housing authorities had been writing into their policies. As discussed above, the standard adopted by MHA is the standard set forth in the "California study" that was adopted by the state of California and many other jurisdictions and entities around the country.

The Helena Housing Authority (HHA) in Montana voluntarily adopted California's 1.5 μg/100 cm^2 standard rather than follow their own state guidance (0.1 μg/100 cm^2), though the housing authority announced in January 2021 that it was repealing its methamphetamine policy entirely. HHA had previously tested every unit between tenants to establish a baseline meth contamination level. If a unit tested above the voluntary HHA threshold, HHA staff would alert local law enforcement, as well as Child Protective Services if there was a minor living in the unit. The tenant assumed full responsibility for the meth remediation costs. At the time of repeal, HHA had not detected a meth-positive unit in over a year and the executive director noted in the policy repeal announcement that "very few public housing authorities or other rental housing providers in the United States have voluntarily adopted or continue to implement similar meth testing policies" (O'Neil 2021).

Tribal Housing Authority Policies

Outreach to public and tribal housing authorities conducted by project coordinators to obtain and discuss their policies concerning methamphetamine contamination for this project was not exhaustive and many of the public housing authorities contacted did not respond. However, a theme that emerged from a comparison of policies is that, generally, tribal housing authorities have far more stringent methamphetamine policies and procedures than public housing authorities, which often do not address meth contamination from use in policy or practice. Many tribal housing authorities test every unit in between occupants to establish "baseline" numbers so that, if a unit does test positive, the contamination and related costs of testing and remediation can be attributed to a specific tenant. Methamphetamine policies were collected from six different tribal housing authorities located in various western and Midwest states. TDHEs are often reluctant to share the specifics of their meth policies, in part due to the inherent uncertainty of how to address contamination in policy and in part due to local tensions that may be caused by publicizing these documents. The Colville Indian Housing Authority and the Confederated Tribes of Umatilla Indian Reservation (CTUIR) Housing Department did not defer to their state standard. Colville instead remediates any unit that tests positive using housing authority-owned testing equipment. This would be considered a "technology-based" cleanup standard, as the practical contamination limit is dependent on the level at which the equipment can detect. CTUIR Housing Department uses 0.1 μg/100 cm^2, which is more stringent than Oregon's standard of 0.5 μg/100 cm^2. The states of Washington and Arizona both use California's standard of 1.5μg/100 cm^2, but Alaska has the most stringent state standard in the country at 0.01 μg/100 cm^2. All of the responding tribal housing authorities confirmed that tenants were responsible for remediation costs, and all of these entities test for meth contamination between every tenant to establish a baseline. While there are similarities across tribal housing authorities, many tribal housing entities are also applying creative problem-solving techniques to address the high prevalence of meth contamination and the high cost of remediation. Some housing authorities, like Colville, invest in their own equipment, as well as in training or certifying their own employees to avoid spending limited funds on expensive testing and remediation contractors. One TDHE has implemented policies that allow responsible tenants to help in the remediation effort if the unit tests below a certain threshold.

Case Study: Salish & Kootenai Housing Authority

Background and SKHA Maintenance Policy

A certified remediation expert remediates a Salish & Kootenai Housing Authority unit contaminated by methamphetamine (Salish & Kootenai Housing Authority, 2021)

The Salish & Kootenai Housing Authority serves the members of the Confederated Salish and Kootenai Tribes and the residents of the Flathead Indian Reservation in western Montana. The housing authority began testing its housing units for meth contamination in 2014, after a tenant refused to move into a unit because it was known to have been used as a meth house. The housing authority had the unit tested and remediated down to the state of Montana's limit of 0.1 µg/100 cm² using an outside contractor. Meth contaminated units became more frequent, so the SKHA maintenance manager began to investigate the available literature on meth contamination and remediation in order to create a scientifically informed policy without relying solely on remediation industry trainings. The housing authority decided to adopt the California standard of 1.5 µg/100 cm² for livable spaces, and Colorado's standard of 4.0 µg/100 cm² for crawl spaces and attics. However, even after adopting the higher California standard, SKHA found that they were still remediating a significant percentage of their units; 43% of tested units were above the housing authority's 1.5 µg/100 cm² limit in 2019.

At the start of the project that initiated this research and produced this report, the Salish & Kootenai Housing Authority applied a methamphetamine contamination policy similar to many other tribal housing entities. The policy required that, before a tenant moves into a unit, a methamphetamine contamination test must be done to establish a baseline contamination level for the unit. The unit would then be tested again when the tenant vacated the unit. Testing was done through a Meth Media Testing Kit, or standard wipe test of a 100 square centimeter area taken in a variety of locations within the unit that are most likely to be contaminated. If the unit came back with a meth contamination level above 1.5 µg within any tested 100 square centimeter area, the Housing Authority Inspector would write up a scope of work for the meth remediation work, which may include removal of drywall, cabinets and counters, woodwork, appliances, and any other contaminated areas of the unit. The extent of the scope of work would depend on where the contamination was located and the specific materials that had been contaminated. If meth had only been used in one room of a unit, remediation might be limited to that room, as opposed to a unit in which the contamination was present throughout the unit or had spread through the HVAC system. In some buildings, contamination could spread to neighboring units through the HVAC. Different surface types might require different remediation techniques, as more porous surfaces and upholstery or carpeting can absorb and retain contamination more readily than other surfaces, even after cleaning. Once the scope of work was established, SKHA hired an outside contractor who was certified as a meth remediation contractor through OSHA certification. After the remediation was complete, SKHA would perform a clearance test to ensure that the unit had been remediated down to the 1.5 µg/100 cm^2 minimum contamination standard. The unit would be remediated further until it passed the clearance test.

If the tenant was deemed responsible for the contamination, the tenant incurred all charges for the remediation of their contaminated unit. Tenants with an outstanding accounts receivable balance with SKHA are ineligible for services until the balance has been paid off. At the time of this report, SKHA had 57 tenants with outstanding accounts receivable resulting from the remediation of a meth contaminated unit. The outstanding balances ranged from $109 up to $28,185, with an average outstanding balance of $8,957. Tribal housing authority tenants are usually low-income, and as a result, balances are rarely paid off and tenants with outstanding balances are effectively barred from all housing services. According to the Maintenance Manager/Assistant Executive Director, these balances have created a new homeless population of community members who cannot afford other housing and are not eligible to receive housing authority services. Even if a tenant pays off the balance and becomes eligible for services again, the waiting list for a housing authority unit can be two years or more. Many of these tribal members suffer from substance abuse and dependency, creating a lasting cycle of instability that other tribal programs, such as the health department and law enforcement agencies, must also try to address with limited resources.

Recent Amendments to SKHA Policy

Results from the scientific research and literature review portion of this project, as described in this report, were presented first to the SKHA executive director and maintenance manager/assistant executive director, and then to SKHA management and the SKHA board of commissioners. SKHA is currently revising their methamphetamine remediation policy to reflect current research and remaining scientific uncertainties, as well as the realistic constraints of available housing authority resources.

In revising their policy, SKHA leadership is seeking to balance the lack of known or defined health risks from methamphetamine contamination with a number of other risk factors, including the risk of homelessness caused by eviction or outstanding accounts receivable, the budgetary impacts of meth remediation costs, and the resulting lost opportunity to develop additional needed housing in their community. The proposed amendment to the SKHA maintenance policy is to apply the meth testing and remediation policy only to units containing clandestine meth labs identified by law enforcement officials. The proposed revisions would make SKHA policies more consistent with the California and Colorado contamination standards, which were written with meth labs and manufacture in mind. While the California and Colorado standards were previously applied more broadly in the past to contamination from use out of an abundance of caution, SKHA staff and leadership acknowledge that this precautionary approach has caused harm to the housing authority and tenants as a result of tenant evictions, lengthy periods of tenant ineligibility for housing services due to outstanding accounts receivable balances related to meth remediation costs, and most importantly, the inability to develop much-needed housing due to the continuous expenditure of limited funds on meth remediation activities.

To address the specific harms associated with outstanding accounts receivable balances from meth remediation costs, SKHA plans to cancel court orders for tenants whose units were contaminated from meth use and will forgive outstanding balances for remediation costs. These actions will allow affected tenants to reapply for housing through SKHA.

SKHA recognizes the need to break the cycle of methamphetamine abuse in their community and may be open to considering a policy similar to Kāinga Ora's sustaining tenancies approach in the future. However, a policy that takes a sustaining tenancies approach ultimately involves several processes and programs that fall outside of the jurisdiction and purview of the housing authority, including tribal government, social service providers and the health department, and law enforcement agencies and tribal courts. Currently, there are no on-reservation facilities to support treatment and rehabilitation of chemical dependency and addiction, and a key aspect of the sustaining tenancies approach is to address methamphetamine contamination resulting from meth use as a drug addiction issue. Addressing methamphetamine contamination--as well as its root cause of drug abuse and addiction--will require significant additional resources, including federal support for testing and remediation efforts.

Conclusion

The gaps in current science and research regarding methamphetamine contamination, and particularly use-related third hand meth exposure, leaves housing authorities having to make vital policy decisions without complete information. Contamination of housing units from methamphetamine use may be dangerous or harmful to tenants, but the existing research cannot say definitively if and how it is harmful, at what levels, or to whom. Tribal housing authorities such as SKHA have been addressing contamination from meth use in policy and practice out of an abundance of caution for many years despite these gaps in knowledge. However, relying on the precautionary principle is not sustainable for TDHEs at current federal funding levels due to the extremely high cost of meth testing and remediation, as well as harms to low-income tenants that come from evictions or outstanding debts for remediation costs that make these tribal members ineligible for tribal housing. Policymakers in Indian Country and tribal housing are trying—with severely limited funding—to balance the potential of harm caused by meth contamination in housing units with a wide range of acute needs and health concerns of their community, including the substantial health risks associated with homelessness and housing instability, drug use, and other drug-related crime. Furthermore, testing and remediating for meth use contamination does not seem to be a priority in policy or practice for non-tribal public housing organizations, nor for lawmakers at the state or federal level. More research is needed before housing providers can create scientifically informed and health-based standards to address methamphetamine contamination from meth use. If third hand meth exposure from meth use does pose a health risk to residents, more federal funding is needed to support testing and remediation efforts of housing providers. More research and funding will allow managed housing providers to implement financially sustainable and situationally appropriate policies and procedures that ensure the safety of their staff and residents.

References

American Addiction Centers. 2020. “Dangers of Injecting, Snorting, or Smoking Meth.” February 3, 2020. https://americanaddictioncenters.org/meth-treatment/smoking-snorting-injecting.

Big Water Consulting. 2019a. “United Native American Housing Association (UNAHA) Meth Testing and Remediation Survey — Big Water Consulting.” 2019. https://www.bigwaterconsulting.net/projects-blog/2019/3/1/unaha-meth.

Big Water Consulting. 2019b. “United Native American Housing Association Meth Testing and Remediation Survey Presentation.”

Centre for Justice and Reconciliation: A Program of Prison Fellowship International. n.d. “Lesson 1: What Is Restorative Justice? .” Accessed January 27, 2021. http://restorativejustice.org/restorative-justice/about-restorative-justice/tutorial-intro-to-restorative-justice/lesson-1-what-is-restorative-justice/#sthash.XdINzRbN.dpbs.

Chem Safety Pro. 2018. “What Is Acceptable Daily Intake (ADI) and How to Calculate It.” 2018. https://www.chemsafetypro.com/Topics/CRA/What_Is_Acceptable_Daily_Intake_(ADI)_and_How_to_Calculate_It.html.

Committee on Indian Affairs. 2006. “Second Session on the Problem of Methamphetamine in Indian Country.” April 5. https://www.govinfo.gov/content/pkg/CHRG-109shrg26930/html/CHRG-109shrg26930.htm.

Committee on Science and Technology. 2007. *Methamphetamine Remediation Research Act of 2007*. House of Representatives. https://www.congress.gov/110/crpt/hrpt8/CRPT-110hrpt8.pdf.

Copper, Carolyn, Steve Hanna, Roopa Batni, Tapati Bhattacharyya, Kate Kimmel, and Brooke Shull. 2011. “Progress on the 2007 Methamphetamine Remediation Research Act.” http://www.epa.gov/oig/hotline.htm.

Curtis, Marah A, Sarah Garlington, and Lisa S Schottenfeld. 2013. “Alcohol, Drug, and Criminal History Restrictions in Public Housing.” *Cityscape: A Journal of Policy Development and Research* 15 (3).

Damon, William, Ryan McNeil, M. J. Milloy, Ekaterina Nosova, Thomas Kerr, and Kanna Hayashi. 2019. “Residential Eviction Predicts Initiation of or Relapse into Crystal Methamphetamine Use among People Who Inject Drugs: A Prospective Cohort Study.” *Journal of Public Health (United Kingdom)* 41 (1): 36–45. https://doi.org/10.1093/pubmed/fdx187.

Drug Times. 2020. “Biker Gangs Mexican Drug Cartels And Supply And Demand - Methamphetamine.” Drug Times. December 16, 2020. https://www.drugtimes.org/methamphetamine/biker-gangs-mexican-drug-cartels-and-supply-and-demand.html.

Forcehimes, A A, K L Venner, M P Bogenschutz, K Foley, M P Davis, J M Houck, E L Willie, and P Begaye. 2011. “American Indian Methamphetamine and Other Drug Use in the Southwestern United States.” *Cultur Divers Ethnic Minor Psychol*. 17 (4): 366–76. https://doi.org/10.1037/a0025431.

Foundation for a Drug Free World. n.d. “The History of Crystal Methamphetamine.” Accessed January 27, 2021. https://www.drugfreeworld.org/drugfacts/crystalmeth/history-of-methamphetamine.html.

Gluckman, Peter, Anne Bardsley, and Felicia Low. 2018. “Methamphetamine Contamination in Residential Properties: Exposures, Risk Levels, and Interpretation of Standards.” The Office of the Prime Minister’s Chief Science Advisor. https://doi.org/10.17608/k6.OPMCSA.7723232.v1.

Hammon, Tracy L., and Susan Griffin. 2007. “Support for Selection of a Methamphetamine Cleanup Standard in Colorado.” *Regulatory Toxicology and Pharmacology* 48 (1): 102–14. https://doi.org/10.1016/j.yrtph.2007.02.002.

“Homelessness as a Public Health Problem.” n.d. American Public Health Association. Accessed January 27, 2021. https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/31/07/56/homelessness-as-a-public-health-problem.

Housing New Zealand. 2018. “Methamphetamine Contamination Housing New Zealand’s Response.” https://kaingaora.govt.nz/assets/Publications/Methamphetamine-contamination-response/Methamphetamine-Contamination-Housing-New-Zealands-Response-September-2018.pdf.

Housing New Zealand. 2019. “Housing New Zealand Annual Report 2018-2019.” https://kaingaora.govt.nz/assets/Publications/Annual-report/HNZ16284-Annual-Report-2019-v22b.pdf.

Kāinga Ora. 2020. “Making It Right - Methamphetamine Contamination in Our Homes.” 2020. https://kaingaora.govt.nz/tenants-and-communities/our-tenants-health-and-safety/making-it-right/.

Kim, Nick D. 2016. “Technical Commentary and Opinion Relating to the Nature, Health Significance and Persistence of Trace of Methamphetamine on Indoor Surfaces. .” https://kaingaora.govt.nz/assets/Publications/Methamphetamine-contamination-response/07.-Technical-commentary-and-opinion-relating-to-the-nature-health-significance-and-persistence-of-trace-methamphetamine-on-indoor-surfaces-13-June-2016-Dr-Nick-Kim.pdf.

LaMorte, Wayne W. 2019. “PH717 Module 2 - Exposure Assessment: Toxicology.” Boston University School of Public Health. 2019. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/PH717-QuantCore/PH717-Module2-ExposureAssessment/PH717-Module2-ExposureAssessment6.html.

Martson, Daniel C. 2016. “Unintended Consequences of ‘Zero Tolerance’ Policies.” The SES Indicator Newsletter. January 2016. https://www.apa.org/pi/ses/resources/indicator/2016/01/unintended-consequences.

Martyny, John W., Shawn L. Arbuckle, Charles S. McCammon, Nicola Erb, and Mike Van Dyke. 2008. “Methamphetamine Contamination on Environmental Surfaces Caused by Simulated Smoking of Methamphetamine.” *Journal of Chemical Health and Safety* 15 (5): 25–31. https://doi.org/10.1016/j.jchas.2008.02.004.

Martyny, John W., Shawn L. Arbuckle, Charles S. McCammon, Eric J. Esswein, Nicola Erb, and Mike Van Dyke. 2007. “Chemical Concentrations and Contamination Associated with Clandestine Methamphetamine Laboratories.” *Journal of Chemical Health and Safety* 14 (4). https://doi.org/10.1016/j.jchas.2007.01.012.

McCain, John. 2006. S.4113 - 109th Congress (2005-2006): *A Bill to Amend the Omnibus Crime Control and Safe Streets Act of 1968 to Clarify That Territories and Indian Tribes Are Eligible to Receive Grants for Confronting the Use of Methamphetamine*. https://www.congress.gov/bill/109th-congress/senate-bill/4113.

Messina, Nena, Patricia Marinelli-Casey, Kathleen West, and Richard Rawson. 2014. "Children Exposed to Methamphetamine Use and Manufacture." *Child Abuse & Neglect* 38 (11): 1872–83. https://doi.org/10.1016/j.chiabu.2006.06.009.

National Alliance to End Homelessness. 2016a. "Fact Sheet: Housing First." April 2016. https://endhomelessness.org/wp-content/uploads/2016/04/housing-first-fact-sheet.pdf.

National Alliance to End Homelessness. 2016b. "Housing First." April 20, 2016. https://endhomelessness.org/resource/housing-first/.

National Harm Reduction Coalition. n.d. "Harm Reduction Principles." Accessed January 27, 2021. https://harmreduction.org/about-us/principles-of-harm-reduction/.

National Institute on Drug Abuse. 2020. "What Are the Long-Term Effects of Methamphetamine Misuse?" https://www.drugabuse.gov/publications/research-reports/methamphetamine/what-are-long-term-effects-methamphetamine-misuse.

O'Neil, Michael M. 2021. "Re: Notice to Helena Housing Authority Tenants, HHA Meth Remediation Policy Repeal." Helena Housing Authority News & Updates. January 5, 2021. https://hhamt.org/news-updates/.

Office of National Drug Control Policy. 2019. "National Drug Control Strategy." https://web.archive.org/web/20190131231615/https://www.whitehouse.gov/wp-content/uploads/2019/01/NDCS-Final.pdf.

Owens, Clyde V, Mark M Mason, and David Marr. 2017. "Remediation of Manufactured Methamphetamine in Clandestine Laboratories. A Literature Review." *Journal of Chemical Health and Safety* 24 (5): 23–37. https://doi.org/10.1016/j.jchas.2017.01.004.

Salocks, Charles B. 2009. "ASSESSMENT OF CHILDREN'S EXPOSURE TO SURFACE METHAMPHETAMINE RESIDUES IN FORMER CLANDESTINE METHAMPHETAMINE LABS, AND IDENTIFICATION OF A RISK-BASED CLEANUP STANDARD FOR SURFACE METHAMPHETAMINE CONTAMINATION." https://www.gliha.org/wp-content/uploads/2019/11/California-Children-Exposure-Analysis-022709.pdf.

Salocks, Charles B. 2008. "Development of a Reference Dose (RfD) for Methamphetamine." https://oehha.ca.gov/media/downloads/crnr/methrfd010809.pdf.

Sanchez Lozano, Claudia Denisse, Chris Wilkins, and Marta Rychert. 2020. "Investigating the New Zealand Policy Response to Methamphetamine-Contaminated Houses." *Drug Testing and Analysis* 12 (6): 691–703. https://doi.org/10.1002/dta.2782.

Sen. Cranston, Alan. 1990. National Affordable Housing Act SEC-581 -- Public and Assisted Housing Drug Elimination. https://www.hud.gov/sites/documents/NAHA581.TXT.

Simpson, Michael M. 2006. "Methamphetamine Lab Clean-up and Remediation Issues." http://congressionalresearch.com/RL32959/document.php?study=Methamphetamine+Lab+Clean-up+and+Remediation+Issues.

Smith, Jane M. 2013. “Tribal Jurisdiction over Nonmembers: A Legal Overview.” www.crs.gov.

The National Congress of American Indians. 2006. “Methamphetamine In Indian Country.” https://www.justice.gov/archive/tribal/docs/fv_tjs/session_1/session1_presentations/Meth_Overview.pdf.

Thrasher, Dennis L., Katie von Derau, and Jefferey L. Burgess. 2009. “Health Effects from Reported Exposure to Methamphetamine Labs: A Poison Center-Based Study.” *Journal of Medical Toxicology* 5 (4): 200–204. https://doi.org/10.1007/BF03178267.

Tribal Law and Policy Institute. 2007. “Perceptions of Methamphetamine Use in Three Western Tribal Communities: Implications for Child Abuse in Indian Country.” www.tribal-institute.org.

U.S. Department of Justice. n.d. “Controlled Substance Schedules.” Accessed January 27, 2021. https://www.deadiversion.usdoj.gov/schedules/.

U.S. Department of Justice, and Drug Enforcement Administration. 2020. “Drug Fact Sheet: Methamphetamine.” https://www.dea.gov/sites/default/files/2020-06/Methamphetamine-2020.pdf.

United States Drug Enforcement Administration. n.d. “Methamphetamine Lab Incidents.” Accessed January 27, 2021. https://www.dea.gov/methamphetamine-lab-incidents.

United States Environment Protection Agency. 1993. “Reference Dose (RfD): Description and Use in Health Risk Assessments.” https://www.epa.gov/iris/reference-dose-rfd-description-and-use-health-risk-assessments.

United States Environmental Protection Agency. 2013. “Voluntary Guidelines for Methamphetamine Laboratory Cleanup.” https://www.epa.gov/sites/production/files/documents/meth_lab_guidelines.pdf.

Vásquez-Vera, Hugo, Laia Palència, Ingrid Magna, Carlos Mena, Jaime Neira, and Carme Borrell. 2017. “The Threat of Home Eviction and Its Effects on Health through the Equity Lens: A Systematic Review.” *Social Science and Medicine* 175 (February): 199–208. https://doi.org/10.1016/j.socscimed.2017.01.010.

Wagner, Angie. 2007. “How Meth Came to an Indian Reservation and Took Hold.” Seattle Times, May 1, 2007. https://www.seattletimes.com/nation-world/how-meth-came-to-an-indian-reservation-and-took-hold/.

Wang, Xin, and Olaf H. Drummer. 2015. “Review: Interpretation of Drug Presence in the Hair of Children.” *Forensic Science International* 257 (December): 458–72. https://doi.org/10.1016/j.forsciint.2015.10.028.

Williams, Emily Ponder. 2019. “Fair Housing’s Drug Problem: Combatting the Racialized Impact of Drug-Based Housing Exclusions Alongside Drug Law Reform.” *Harvard Civil Rights-Civil Liberties Law Review* 54. https://perma.cc/NH6J-8WZS.

Wright, Jackie. 2009. “Derivation of Risk-Based Investigation Levels Clandestine Drug Laboratory, Site Investigation Guidelines.” https://www.enrisks.com.au/wp-content/uploads/2012/12/Derivation-of-Risk-Based-Guidelines-for-Website.pdf.

Wright, Jackie, Michaela E. Kenneally, John W. Edwards, and G. Stewart Walker. 2017a. “Adverse Health Effects Associated with Living in a Former Methamphetamine Drug Laboratory — Victoria, Australia, 2015.” *MMWR. Morbidity and Mortality Weekly Report* 65 (52): 1470–73. https://doi.org/10.15585/mmwr.mm6552a3.

Wright, Jackie, Michaela E. Kenneally, Kirstin Ross, and Stewart Walker. 2020. “Environmental Methamphetamine Exposures and Health Effects in 25 Case Studies.” Toxics 61 (8): 1–32.

Wright, Jackie, Michaela E Kenneally, John W Edwards, and G Stewart Walker. 2017b. “Morbidity and Mortality Weekly Report: Adverse Health Effects Associated with Living in a Former Methamphetamine Drug Laboratory-Victoria, Australia, 2015.” http://www.pearsonclinical.com/education/products/100000658/behavior-.

Big Water Consulting

National American Indian Housing Council
"A Tradition of Native American Housing"
NAIHC

SKHA

seven sisters
COMMUNITY DEVELOPMENT GROUP, LLC