Comment on HUD's proposed rule
Instituting smoke-free public housing
Docket No. FR 5597-P-02

Center for Tobacco Control Research and Education
University of California, San Francisco*

January 12, 2016

Overview of proposed rule

The proposed rule requires all public housing agencies (PHAs) to implement a policy prohibiting "lit tobacco products" in all living units, indoor common areas in public housing, and in PHA administrative office buildings (i.e., a smoke-free policy for all public housing indoor areas). "Lit tobacco products" are defined as "those that involve the ignition and burning of tobacco leaves, such as cigarettes, cigars, and pipes." Because of this narrow definition, the rule does not include e-cigarettes or other electronic smoking devices, hookah or waterpipe smoking, or marijuana.

The smoke-free policy must extend to all outdoor areas up to 25 feet from the buildings. PHAs may create designated smoking areas outside the 25-foot buffer zone or may make entirely smoke-free grounds. The proposed rule would prohibit smoking on balconies and porches if they are part of the building or within 25 feet of the building. The proposed rule would not include public housing units in mixed-finance projects or Section 8 housing ("affordable housing"), and does not extend generally to multi-unit housing that does not receive federal funding.

The smoke-free policy must be included in PHA plans and tenant leases. While the proposed rule includes suggestions for compliance and enforcement, enforcement of the policy would be the responsibility of the PHA. Less comprehensive smoking restrictions already in existence must be updated to meet the proposed HUD policy must be updated, and PHAs are free to make more stringent requirements, including establishing entirely smoke-free grounds.

HUD's stated purpose for the rule is to "improve indoor air quality in the housing, benefit the health of public housing residents and PHA staff, reduce the risk of catastrophic fires, and lower overall maintenance costs."

* Lauren Lempert JD MPH, Rachel Barry MA, Elizabeth Cox BA, Margarete Kulik PhD, Wendy Max PhD, Anne Peterson RN PhD, Suzaynn Schick PhD, Gideon St. Helen PhD, Maya Vijayragavan MD, Valerie Yerger ND, Stanton Glantz, PhD

Exposure to secondhand smoke in multiunit housing is a serious health hazard, so HUD's proposed rule is a necessary step to protect children and adults

It is important to emphasize that federal laws do *not* provide a "right to smoke."[1] Secondhand smoke is dangerous to anyone who breathes it and has the potential to impact the most vulnerable residents in public housing MUHs. Indeed, since the proposed rule would give individuals who are members of low socioeconomic groups the opportunity to enjoy healthy living environments and the same protection from unwanted secondhand smoke that more economically advantaged homeowners or renters enjoy, it should be applauded as a form of social justice, rather than an unfair restriction of freedom.[1]

Exposure to secondhand smoke in multiunit housing creates a serious health hazard for residents and workers. Secondhand smoke is a complex mixture of more than 7,000 chemicals, gases and fine particles that are emitted by burning cigarettes and other tobacco products (called "side stream smoke") and from the smoke exhaled by smokers (called "mainstream smoke"). ***There are no safe levels of exposure to secondhand smoke for children, adults, or the elderly, yet even those who choose to not smoke to protect their own or their loved ones' health are regularly exposed to this health hazard.***[2] According to the Centers for Disease Control and Prevention (CDC), more than 41,200 adult nonsmokers die every year in the United States from heart disease and lung cancer caused by exposure to secondhand smoke.[3]

The Surgeon General's 2006 report on the health consequences of exposure to involuntary smoking (secondhand smoke) concluded:

- Secondhand smoke exposure causes disease and premature death in children and adults who do not smoke.
- Children exposed to secondhand smoke are at an increased risk for sudden infant death syndrome (SIDS), acute respiratory infections, ear problems, and more severe asthma. Smoking by parents causes respiratory symptoms and slows lung growth in their children.
- Exposure of adults to secondhand smoke has immediate adverse effects on the cardiovascular system and causes coronary heart disease and lung cancer.
- The scientific evidence indicates that there is no risk-free level of exposure to secondhand smoke.[2]

The scientific evidence on the health risks associated with exposure to secondhand smoke is clear and not disputed (other than by the tobacco companies, their allies, and front groups). The research continues to mount, and was reconfirmed in the Surgeon General's 2014 Report on the Health Consequences of Smoking[3] (Figure 1). Secondhand smoke causes lung cancer, heart disease, low birth-weight, chronic lung ailments, as well as other health problems. The Surgeon General's 2014 report found that "***[e]xposure to secondhand tobacco smoke has been causally linked to cancer, respiratory, and cardiovascular diseases, and to adverse effects on the health of infants and children.***"[3] In a new finding, the report also concludes that secondhand smoke exposure increases the risk of stroke in nonsmokers.

The 2014 Surgeon General's report confirmed its 2006 finding that exposure to secondhand smoke can cause Sudden Infant Death Syndrome (SIDS) and concluded:

- Infants who are exposed to secondhand smoke after birth are also at greater risk for SIDS.
- Chemicals in secondhand smoke appear to affect the brain in ways that interfere with its regulation of infants' breathing.
- Infants who die from SIDS have higher concentrations of nicotine in their lungs and higher levels of cotinine (a biological marker for secondhand smoke exposure) than infants who die from other causes.[3]

The Surgeon General reports also concluded that secondhand smoke could cause other serious health problems in children:

- Studies show that older children whose parents smoke get sick more often. Their lungs grow less than children who do not breathe secondhand smoke, and they get more bronchitis and pneumonia.
- Wheezing and coughing are more common in children who breathe secondhand smoke.
- Secondhand smoke can trigger an asthma attack in a child. Children with asthma who are around secondhand smoke have more severe and frequent asthma attacks that can put a child's life in danger.
- Children whose parents smoke around them get more ear infections. They also have fluid in their ears more often and have more operations to put in ear tubes for drainage.[2]

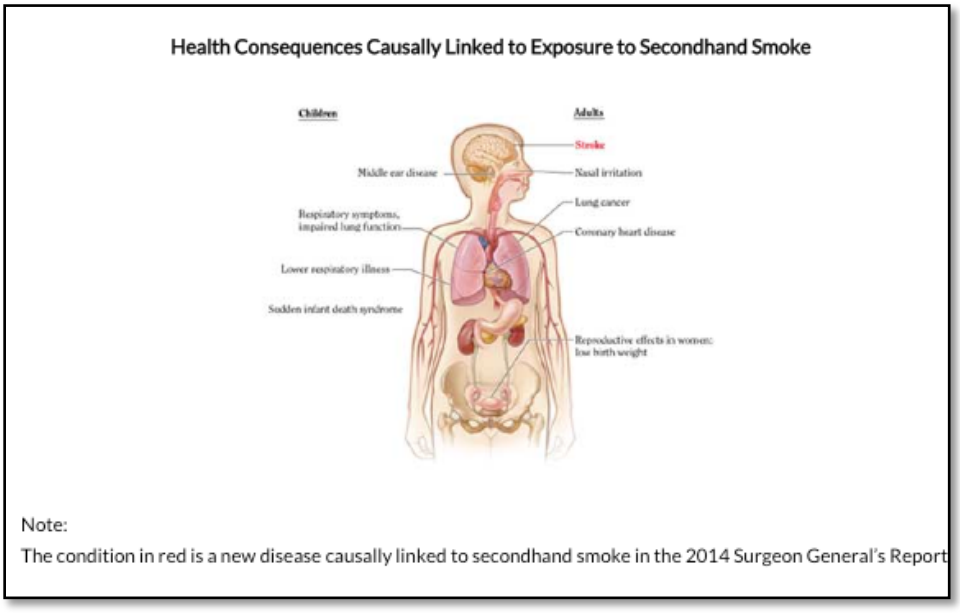

Figure 1. Health consequences causally linked to exposure to secondhand smoke.[3]

After conducting a comprehensive review of the scientific literature, the California Environmental Protection Agency issued a report in 2005 that led the California Air Resources Board to list secondhand smoke as a toxic air contaminant[4] ***to which children and infants are especially sensitive***.[4] (A toxic air contaminant in California is similar to a federal hazardous air pollutant.) In this comprehensive report, CalEPA reiterated and strengthened many of its previous findings regarding the harms caused by secondhand smoke, including effects on children, such as sudden infant death syndrome, induction and exacerbation of asthma, increased respiratory tract infections, increased middle ear infections, developmental toxicity resulting in lower birth weight, and impaired lung function. For adults, CalEPA reiterated and strengthened its prior findings for adults including lung cancer and heart disease. ***In an important new finding, the report concluded that exposure to secondhand smoke causes nasal sinus cancer and breast cancer in younger, primarily premenopausal women.***[5]

In October 2014, the U.S. Public Health Service's National Toxicology Program issued its 13th Report on Carcinogens, which unambiguously concludes, based on a thorough review of the available scientific and medical evidence including the CalEPA report, that:

> Environmental tobacco smoke is known to be a human carcinogen based on sufficient evidence of carcinogenicity from studies in humans. Studies support an association of environmental (passive or secondhand) tobacco smoke with cancer of the lung and, in some cases, the nasal sinus [citations omitted]. Evidence for an increased cancer risk from environmental tobacco smoke stems from studies examining non-smoking spouses living with individuals who smoke cigarettes, exposure of nonsmokers to environmental tobacco smoke in occupational settings, and exposure to parents' smoking during childhood [citations omitted]. Many epidemiological studies, including large population-based case-control studies, have demonstrated increased risks for developing lung cancer following prolonged exposure to environmental tobacco smoke. . . Increased risk of lung cancer appears to be most strongly related to exposure to environmental tobacco smoke from spousal smoking or exposure in an occupational setting.[6]

Secondhand emissions from hookah, electronic cigarettes, and other new tobacco products also contain gases and fine particles, including nicotine, that are also be dangerous to non-smokers.[7-9] Marijuana smoke contains at least 33 chemicals found in tobacco smoke that are known as human or animal carcinogens (cancer-causing agents). Some of the known carcinogens present in marijuana smoke are: acetaldehyde, arsenic, benzene, chromium, formaldehyde, isoprene, lead, mercury, nickel, and quinoline.[10]

Establishing a 100% smoke-free environment is the only effective way to fully protect nonsmokers from secondhand smoke

The Surgeon General's 2006 report concluded that, "Eliminating smoking in indoor spaces fully protects nonsmokers from exposure to secondhand smoke. ***Separating smokers from nonsmokers, cleaning the air, and ventilating buildings***

cannot eliminate exposures of nonsmokers to secondhand smoke.[2] [emphasis added]" In particular, the report concluded that:

- Conventional air cleaning systems can remove large particles but not the smaller particles or the gases found in secondhand smoke.
- Current heating, ventilating, and air conditioning systems alone do not control secondhand smoke exposure. In fact, these systems may distribute secondhand smoke throughout a building.
- Even separately enclosed, separately exhausted, negative-pressure smoking rooms do not keep secondhand smoke from spilling into adjacent areas.[2]

The World Health Organization (WHO) issued a report in 2007 based on scientific evidence that reached the same conclusion and made the following recommendation:

> ***Remove the pollutant—tobacco smoke—by implementing 100% smoke-free environments.*** This is the only effective strategy to reduce exposure to tobacco smoke to safe levels in indoor environments and to provide an acceptable level of protection from the dangers of secondhand smoke exposure. ***Ventilation and smoking areas, whether separately ventilated from nonsmoking areas or not, do not reduce exposure to a safe level of risk and are not recommended.***[11] [emphasis added]

HUD's proposed rule would help protect vulnerable populations from unwanted exposure to smoke in their homes, but leaves out some important vulnerable populations

Certain vulnerable populations who live in HUD multiunit housing (e.g., elderly, disabled, mentally disabled individuals, and those individuals living with low income) are disproportionately impacted by exposure to secondhand smoke and related adverse health outcomes. Smoke-free policies in public housing would directly address such disparate impact on these most vulnerable people (Figures 2 and 3).

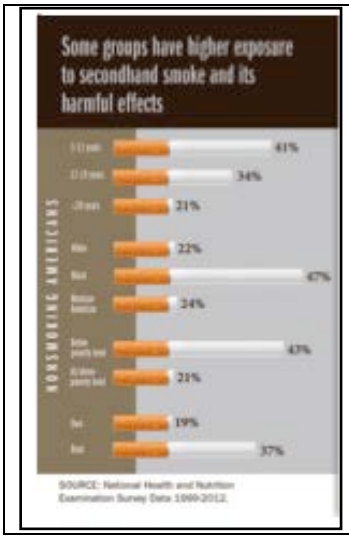

Figure 2. Chart detailing the higher exposure rates to second hand smoke of certain groups of nonsmoking Americans. Nonsmoking Americans ages 3-11 years 41% higher exposure rate, ages 12-19 years 34% higher exposure rate, age 20 years and older 21% higher exposure rate. Nonsmoking white Americans 22% higher exposure rate, black 47% higher exposure rate, Mexican American 24% higher exposure rate. Nonsmoking Americans below the poverty level 43% higher exposure rate, at the poverty level 21% higher exposure rate. Nonsmoking Americans who own their home 19% higher exposure rate, renters 37% higher exposure rate.[12]

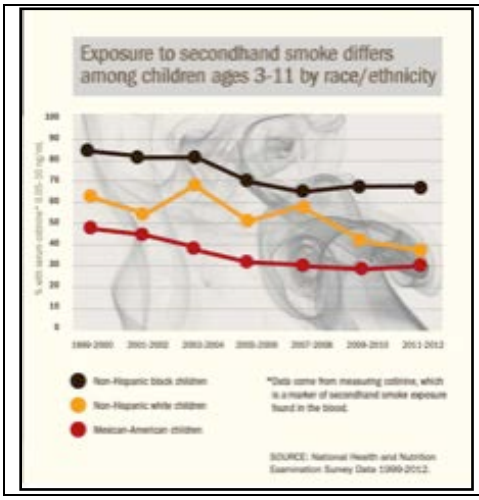

Figure 3. Graph detailing how exposure to secondhand smoke differs among children ages 3-11 by race and ethnicity. Graph shows that non-Hispanic black children have the highest exposure compared to non-Hispanic white children and Mexican-American children.[12]

A 2015 CDC report found that although secondhand smoke (SHS) exposure dropped by half between 1999 and 2012, one in four non-smokers (58 million people) are still exposed to secondhand smoke.[13] Exposure remains especially high for certain groups, with 2 in 5 children ages 3 to 11 (approximately 15 million children) exposed to SHS.[12] Nearly 50 percent of black nonsmokers are exposed to SHS, including 7 in 10 black children.[12] More than 1 in 3 nonsmokers who live in rental housing are exposed to SHS, and more than 2 in 5 nonsmokers who live below the poverty level are exposed to SHS.[12] In 2014-2015, 52 percent of households in public housing in New York were black/African American, and 41 percent were Hispanic or Latino. [12]

Many who live in public housing are especially affected by SHS, including children, the elderly, and people with disabilities who are particularly sensitive to the effects of secondhand smoke. As of 2012, 38 percent of households in public housing in the U.S. included disabled persons.[14] Home is the primary source of SHS exposure for children. Americans who live in multiunit housing can be exposed to unwanted SHS that seeps into their own smoke-free units from other units or common areas where smoking occurs. For example, a 2010 study of multiunit housing residents in New York State found that 73 percent of tenants did not allow smoking in their units, but 46 percent experienced unwanted secondhand smoke infiltration from other units during the past year. Overall, more than half of the residents (55.6%) supported a policy that bans smoking in all areas of their building, including residential units, and support was significantly higher among ethnic minorities and individuals who reside with children. [15]

The HUD RAI says (page 36) that the data on voluntary smoke-free homes focus on younger, healthier individuals not representative of the public housing tenant population. This is incorrect. Data from the TUS-CPS focusing on individuals living below federal poverty line who may be more likely to live in public housing.[16] The actual data shows that those who had a smoke-free home were more likely to have reduced consumption and increased quitting (3 month abstinence) compared to those without a smoke-free home. In fact the level of quitting was similar to those living above the federal poverty line, so, in effect, smoke-free homes could reduce this disparity in quitting by income level.

That the rule exempts dwellings in mixed-finance developments and includes only HUD's government-owned public housing. It also does not appear to apply to supportive housing for formerly homeless adults as these tend to be in mixed finance buildings or in private rental properties that are contracted with supportive services agencies. These are the people who have among the highest rates of tobacco use, but also the highest burden of mental illness/substance use which may make implementation/enforcement harder. Such a limitation is discriminatory against people living in other forms of public housing and should be dropped.

At the same time, population groups with a lower socioeconomic status are often difficult to target and reach. Implementing smoke free policies in multi-unit housing would provide a great opportunity to successfully do so. It would also reduce inequalities in smoking-related health outcomes and deaths. Inequality reduction in health outcomes is an important goal in public health debates, but often not a primary focus when it comes to tobacco control policies whose effectiveness is most often measured in terms of overall decreases in smoking prevalence or a reduction in the number of cigarettes smoked

The proposed rule should include marijuana

The fact that marijuana use is illegal under federal law is not preventing people from being exposed to it, and this situation is likely to worsen as more states move to legalize its use. . Similar to social influences associated with cigarette use, those with parents or peer marijuana users are more likely to permit marijuana use in their homes and cars. Positive perceptions of cigarette smoking and marijuana are also associated with indoor tobacco and marijuana use in cars and homes.[17]

Despite emerging scientific evidence on the adverse health risks of marijuana smoke, many people think that marijuana smoke is less toxic than tobacco smoke[18, 19, 20] or even benign.[21] While the psychoactive substance in marijuana is tetrahydrocannabinol (THC) rather than nicotine, marijuana smoke is still the result of biomass combustion and contains many of the same toxins as tobacco smoke,[22] including fine particles that cause cardiovascular morbidity and mortality.[23-25]

The chemicals in marijuana smoke (polycyclic aromatic hydrocarbons, carbon monoxide, cyanide, benzene) cause cancer and reproductive toxicity.[26] Likewise, combustible marijuana use[27, 28] and secondhand marijuana smoke are associated with adverse cardiovascular effects. Secondhand marijuana smoke significantly impairs blood vessel function, similar to tobacco, in ways that would increase the risk of atherosclerosis, heart attack, and stroke.[29] Marijuana smokers are also at an increased risk of respiratory problems[30]including chronic bronchitis,[31] inflammation of the large airways, and increased airway resistance and lung hyperinflation.[28, 32] Marijuana smokers also report increased rates of respiratory infections and pneumonia than nonsmokers.[33]

We recognize that marijuana is already prohibited in public housing under federal law, which appears to be the justification for not including it in the proposed rule. Even medical marijuana use is prohibited for new admissions to HUD housing, and existing users may be subject to termination or to denial of assistance, subject to the discretion of

PHAs to make exceptions on a case-by-case basis.[34] In addition, the prohibition against marijuana still exists in public housing exists in states like Colorado that have legalized marijuana.[35] Including marijuana in the policy now will avoid future difficulties that will arise if marijuana gets legalized at the federal level in the future, just as the proposed rule e prohibits cigarettes which are legal at the federal level.

Responses to HUD's specific questions

1) What barriers could PHAs encounter in implementing smoke-free housing? What costs could PHAs incur? Are there any specific costs to enforcing such a policy?

The costs of implementing a smoke-free policy are negligible, and the benefits of implementing smoke-free housing in PHAs greatly outweigh the costs and nominal barriers. Smoke-free policies have substantial benefits for both non-smokers and smokers; they protect non-smokers from unwanted secondhand smoke exposure from drifting smoke between units, and also increase quitting among smokers.[36, 37] Cost savings include greatly reducing the cost of rehabilitating a unit where someone had smoked, which can be several thousands of dollars more compared to a non-smoking unit.[38] Smoke-free policies eliminate the risk of fire from unattended or dropped cigarette butts, which can save lives as well as save money. The CDC estimated annual cost savings of $153 million for public housing.[39] (This number is the cost savings for public housing; higher numbers are associated with prohibiting smoking in subsidized housing, but this proposed rule does not include all subsidized housing.)

Smoke-free policies enjoy a high level of support, and most people (including public housing residents) do not smoke and do not want to be exposed to smoke.[40] A 2014 review summarizing the scientific literature on smoke-free multiunit housing[41] (MUH) found that a majority of residents preferred a smoke-free building in six of eight studies assessing residents' preferences.[37, 42-46] Although support for smoke-free MUH buildings was stronger among non-smokers than smokers in seven studies examining support by smoker status, many smokers were supportive of such policies,[44] with as many as 41% of smokers expressing support in one study.[45] Among current smokers, those who intended to quit within six months were more likely to support in-unit smoke-free policies.[44]

Public housing authority (PHA) surveys demonstrate that residents in MUH prefer smoke-free housing. For example, 82% of Boston Housing Authority (BHA) residents surveyed after implementation of BHA's smoke-free policy supported the policy.[47] The Cambridge (Massachusetts) Housing Authority surveyed its residents and found that 77 percent approve of inside and outside smoking bans. Seventy-nine percent of residents surveyed would prefer to live in smoke-free housing. Even among smokers, 29% supported smoke-free indoor rules.[48] More than 50% of the surveyed residents in subsidized MUH in Columbus, Ohio supported 100% smoke-free indoors.[49]A statewide survey in Oregon showed that more than 90% of renters in that state prefer smoke-free housing.[50] A survey in Douglas County, Nebraska found more than 90% of renters would choose smoke-free housing over housing that allowed smoking indoors.[1]

MUH operators also expressed support for smoke-free policies, especially among operators of government-subsidized units.[44, 49, 51]

MUH operators interested in smoke-free buildings cited a better environment for residents, improving residents' health, fewer conflicts between residents, lower maintenance costs, lower smoke-related damage to units, and the ability to attract "better" residents or non-smokers.[44, 49, 52, 53] MUH operators cited many factors that motivated them to implement smoke-free policies, including decreased maintenance costs, decreased management time, ability to charge increased rent, decreased fire and insurances costs, reduced resident turnover, free advertising of smoke-free units by local health organizations, ability to attract more non-smokers, fewer residents conflicts,[53] and better resident health.[44, 49, 54-56]

MUH operators' *perceived* barriers to implementing smoke-free building policies include implementation and enforcement issues, objections from existing residents, concerns about limiting the potential pool of residents, concern about legality and liability, increased vacancy, increased turnover, and increased staff time.[44, 49, 55-58] In contrast, surveys taken of MUH operators with smoke-free building policies in effect found generally neutral or positive effects.[44, 49, 55, 56, 58]

In particular, MUH operators generally reported that policies did not affect vacancy rates, turnover rates, rental costs, maintenance costs, or management time.[44, 49, 58] One study reported that about half of MUH operators believed the policy decreased staff time to manage the building[44, 49] In another study, a majority of operators with a smoke-free building policy reported that they "never" receive complaints about the policy. In one study, all MUH operators with smoke-free building policies reported it was likely they would keep them.[55]

Although MUH operators without policies thought a smoke-free policy would increase their legal costs, only one operator had to enforce their lease against a non-compliant tenant, and none reported any legal action against them.[49] Smoke-free policies could help operators avoid legal actions taken by tenants who are bothered by secondhand smoke infiltration into their units, including actions under the Fair Housing Act.[55-57] Advance notice of planned policies is recommended to mitigate most of these concerns.[58]

Misperceptions about the proposed rule's intention and effect could be avoided by meaningful engagement with HUD MUH residents. According to a study of the citywide implementation of Richmond, CA's smoke-free MUH policy revealed that low income, black focus group participants thought that they were being targeted because of their socioeconomic status. Had these residents been educated about the policy prior to its implementation and had they known that the policy was to be implemented in ***all*** MUH properties in the city, they would have been more supportive of the policy and more likely to comply.[59] It should be communicated to residents that the PHA smoke-free policy applies to all properties.

For successful implementation, PHAs must engage residents and provide accurate information about the policy.[1, 60] Providing onsite cessation counseling and referrals to health care providers for medications for cessation is also helpful.[46]

HUD's Regulatory Impact Analysis (RIA) overstates the costs and understates the benefits of the proposed rule. In particular, as detailed in a separate comment on the RIA:[61]

- HUD's RIA improperly ignores the large benefits to smokers who will quit smoking as a result of its adoption, or to governmental entities that would otherwise incur costs to treat such smokers.
- HUD ignores the rapid benefits of eliminating secondhand smoke exposure in terms of almost immediate drops in heart attacks, strokes, asthma and other respiratory conditions, as well as reductions in complications of pregnancy.
- HUD's RIA underestimates the benefits of smokefree housing to children, including reduced school absenteeism rates, lower Medicaid expenditures for emergency department visits, and reduced rehospitalizations for children with asthma.
- The RIA does not consider savings to the mental health or education systems, which incur substantial costs because of long-lasting effects on mental capacity (including ADHD) for children exposed to secondhand smoke.
- HUD's estimate of a 33-percent utility loss associated with the activity of smoking is erroneous because it ignores the fact that most smokers would like to stop smoking and regret ever starting.
- The RIA overstates the cost of the rule attributable to inconvenience to public housing residents who continue to smoke.
- The RIA excludes a value for the lives that would be saved or lengthened due to decreased SHS exposure.

2) Does the proposed rule adequately address the adverse effects of smoking and secondhand smoke on PHA and PHA residents?

No. The rule should be improved in the following ways:

1. The rule should be extended to include all federally-subsidized housing, including Section 8 housing and mixed-finance properties, which are the fastest growing area of affordable housing in the United States, especially for families with young children.
2. The rule should include designated smoke-free zones outdoors even if they are more than 25 feet from buildings, including especially playgrounds and other areas regularly used by children, to protect children and adults from the adverse effects of smoke.
3. The rule should provide that if designated smoking areas are provided, they must be at least 50 feet from designated outdoor smoke-free zones including playgrounds and other common outdoor areas.
4. Electronic cigarettes and other electronic smoking devices should be included in the rule and use of these devices should be prohibited in all areas where "lit tobacco products" are prohibited.

5. Hookah and waterpipes should be included in the rule and use of these devices should be prohibited in all areas where "lit tobacco products" are prohibited.
6. Marijuana should be included in the rule and smoking marijuana should be prohibited in all areas where "lit tobacco products" are prohibited.

3) Does the proposed rule create burdens, costs, or confer benefits specific to families, children, persons with disabilities, owners, or the elderly, particularly if any individual or family is evicted as a result of this policy?

As discussed above and in our separate comment that analyzes the Regulatory Impact Analysis (RIA) in detail,[61] there are numerous and significant benefits to the proposed rule, and its benefits greatly outweigh any costs or perceived burdens. In our separate comment, we highlight several published studies that quantify the costs of secondhand smoke exposure, including the costly health consequences of heart attacks, strokes, and lung problems attributable to that exposure. Smoke-free housing confers particular benefits on children, which translates to significant benefits and savings for the 760,000 children who live in public housing. Additionally, the costs of secondhand smoke exposure to the education system are not considered in the RIA. Of particular concern, while the RIA improperly exaggerates the "welfare impact on smokers," it completely ignores the welfare and health benefits of quitting, as well as the resulting cost savings. Reduced secondhand smoke exposure benefits not only non-smokers, but also smokers, and these benefits were not considered in the RIA. The RIA fails to appropriately quantify the benefits of smoke-free housing, and inappropriately uses the FDA's widely criticized cost/benefit model. It fails to consider the value of lives saved, and the significant improvements to the quality of life for both smokers and non-smokers that would be realized by implementation of the proposed smoke-free policy.

Since there are many elderly and disabled residents in HUD subsidized housing, these vulnerable groups will especially benefit from protections from exposure to hazardous secondhand smoke. Low-income, elderly, and disabled individuals have the same right to clean air as wealthier, younger, and more able-bodied people who do not live in public housing, so the proposed rule is a step towards realizing social justice for these people.[58]

Even among smokers, many prefer to live in smoke-free environments for aesthetic reasons and/or to protect their family members. In statewide surveys[62-65] a majority of tenants, including smokers, report preferring to live in smoke-free environments and the maintenance of smoke-free home rules.[66]

Smokers who choose not to quit may still smoke, but just not in the building or in designated smoke-free areas. Most smokers want to quit, and creating a smoke-free environment and providing cessation counseling on site helps smokers to quit. There is strong and consistent population-level evidence that a smoke-free home is associated with increased smoking cessation and decreased cigarette consumption in adult smokers.[59] Smokers who quit will benefit tremendously from the rule.

The goal of the smoke-free rule is not to evict tenants, but to eliminate the hazards of secondhand smoke and ensure a healthy environment for all residents, especially children, the elderly, and other vulnerable people. The proposed rule will also reduce inequalities in smoking-induced health outcomes. In fact, there is little evidence of evictions in MUHs that have adopted similar rules.[67] In lieu of evictions, PHAs could institute less stringent penalties for violations such as verbal warnings, fines, or decreased subsidies.

4) For those PHAs that have already implemented a smoke-free policy, what exceptions to the requirements have been granted based on tenants' requests?

We are not a PHA, so cannot answer this question.

5) For those PHAs that have already implemented a smoke-free policy, what experiences, lessons, or advice would you share based on your experiences with implementing and enforcing the policy?

We are not a PHA, so cannot answer this question; there is relevant information in our response to Question 1.

6) For those PHAs that have already implemented a smoke-free policy, what tobacco cessation services were offered to residents to assist with the change? Did you establish partnerships with external groups to provide or refer residents to these services?

We are not a PHA, so cannot answer this question.

7) Are there specific areas of support that HUD could provide PHAs that would be particularly helpful in the implementation of the proposed rule?

HUD should provide the following resources to help PHAs implement the proposed rule:

1. Messaging for residents on the harms of secondhand smoke and the benefits of smoking cessation. Since public housing residents have a high burden of chronic disease, incorporating smoking cessation counseling and reduced exposure to secondhand smoke can send an important message of promoting health and wellbeing among the country's most vulnerable populations.
2. Signage that clearly designates smoke-free zones and availability of cessation resources, including information on available cessation counseling and health care providers for treatment of tobacco dependence, including state and national quote smoking telephone counselling services and www.smokefree.gov.

8) Should the policy extend to electronic nicotine delivery systems, such as e-cigarettes?

Yes.

While e-cigarettes are less polluting than conventional cigarettes, they still pollute the air and nicotine has been detected in the bodies of nonsmokers living with people who use e-cigarettes.[68] Allowing e-cigarettes, many of which look like cigarettes, will also greatly complicate implementation and enforcement of the proposed policy.

Studies have confirmed that significant levels of nicotine, respirable particulate matter, volatile organic compounds, and metals are deposited in the indoor environment after e-cigarette use and these constituents or their breakdown products have been measured in non-users exposed to the e-cigarette aerosols.[69-73]

Secondhand exposure to nicotine and other toxic and carcinogenic aerosol constituents is dependent on what the e-cigarette user exhales into the environment (indoor or outdoor) after puffing and on the leakage and spilling of e-liquid. While it has been shown that much nicotine is retained in the body during controlled puffing, some subjects retain less nicotine resulting in higher amounts being exhaled into the environment.[74] For example, one subject in the previously cited study inhaled 1.7 mg of nicotine from 15 puffs of an e-cigarette and exhaled 0.9 mg of nicotine, the equivalent of nicotine taken in from one tobacco cigarette. Systemic retention of vegetable glycerin and propylene glycol are lower than that of nicotine resulting in high levels being exhaled into the environment; systemic retention of other toxicants, respiratory irritants, and carcinogens produced by e-cigarettes such as formaldehyde, acetaldehyde, and acrolein and how much is exhaled into the environment have not been reported.

Of further concern is the environmental fate of exhaled e-cigarette aerosol constituents and their health effects. E-cigarette constituents deposited indoors (or outdoors) can undergo physical and chemical transformations over time resulting in the creation of secondary pollutants, or thirdhand smoke,[75] on various surfaces including floors where young infants may be exposed dermally while crawling or ingest from hand-to-mouth activities. In particular, research has shown that nicotine that is deposited on surfaces reacts to form carcinogens.[76-78]

Despite a lack of human health studies on the long-term health effects of thirdhand smoke exposure, recent studies show that thirdhand smoke is a potential source of carcinogen and toxicant exposure and animal and in vitro studies show that it has toxic effects on several organs, including liver and lungs, and is genotoxic.[79-81] E-cigarettes' contribution to thirdhand smoke is another reason to include e-cigarettes in HUD's proposed rule.

Since e-cigarettes, especially "cig-a-likes," are designed to look like cigarettes, to emit aerosols that look like cigarette smoke, and to allow users to mimic cigarette-smoking behaviors, any rule that does not include e-cigarettes could result in the renormalization of cigarette use. Further, because e-cigarettes may be virtually indistinguishable from conventional cigarettes, not including e-cigarettes would cause confusion for staff and residents and make enforcement difficult if not impossible.

9) Should the policy extend to waterpipe tobacco smoking? Does such smoking increase the risk of fire or property damage?

Yes and yes.

HUD should extend the smoke-free policy to waterpipe smoking. There is no rational scientific reason to exempt waterpipes (hookahs) from the proposed rule. Waterpipes are combustible and as such release sidestream smoke from the burning or smoldering charcoal and heated tobacco or nontobacco preparation as well as mainstream smoke from the user's exhaled breath. A typical waterpipe smoking session lasts 20-80 minutes. During that time the waterpipe smoker can inhale as much smoke as a cigarette smoker would inhale consuming 100 or more cigarettes.[82, 83]

Comparison of sidestream waterpipe and tobacco cigarette smoke showed that a single waterpipe session emits in the sidestream smoke approximately 4 times the carcinogenic polycyclic aromatic hydrocarbons (PAHs), 4 times the volatile aldehydes, and 30 times the carbon monoxide of a single tobacco cigarette.[84] The combustion of charcoal is the major source of sidestream carbon monoxide, PAHs, and benzene,[85, 86] so even the use of nontobacco preparations also results in exposure to these toxic chemicals.[87] Waterpipe smoke also includes toxic and carcinogenic compounds such as formaldehyde, acetaldehyde, acetone, acrolein, propionaldehyde, and butyraldehyde.[88]

Waterpipe smoking is associated with diseases such as lung cancer and esophageal cancer and cardiovascular effects[89, 90] among users, water pipe smoke causes DNA damage to lymphocytes, is cytotoxic, and has been shown to induce endothelial dysfunction through oxidative stress, inflammation, and impaired endothelial vasodilatory function.[91, 92] Exposure to waterpipe smoke is a serious health concern for nonsmokers and should be included in HUD's proposed rule.

Conclusion

All Americans -- not only the young, affluent, and able-bodied -- are entitled to breath smoke-free air in their homes, and this right should be guaranteed for residents of HUD public housing. HUD's proposed rule takes an important and necessary first step to benefitting both non-smoking and smoking residents and staff of PHAs by limiting their exposure to smoking and secondhand smoke.

The rule should be broadened to include all federally subsidized housing, including Section 8 housing and mixed-finance properties. Further, the rule should be made stronger by including electronic cigarettes and other electronic smoking devices, hookah and waterpipe, and marijuana. Additionally, the rule should include designated smoke-free zones outdoors, especially in areas frequented by children, and the buffer zone should be at least 50 feet between designated smoking areas and the buildings and other designated smoke-free areas.

The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), the organization that develops widely-used standards for ventilation systems issued an Addendum to its guidance on Ventilation for Acceptable Indoor Air Quality in January 2015 that said:

> This addendum clarifies the intent of the standard ***that provision of acceptable indoor air quality is incompatible with the presence of ETS, including cannabis smoke and cigarette emissions. The ventilation rates determined in accordance with the provisions of the standard apply only to spaces where these emissions are not present*** and that are adequately separated from spaces where they are present.[93] [emphasis added]

Addendum c to Standard 62.1-2013 defines

> environmental tobacco smoke (ETS): the "aged" and diluted combination of both side-stream smoke (smoke from the lit end of a cigarette or other tobacco product) and exhaled mainstream smoke (smoke that is exhaled by a smoker). ETS is commonly referred to as secondhand smoke. ***This definition includes smoke produced from the combustion of cannabis and controlled substances and the emissions produced by electronic smoking devices***. [93] [emphasis added]

ASHRAE Standard 62.1 is widely used to define building codes all over the United States (and the world). To the extent that housing covered by the HUD policy allows any smoking, including not only conventional cigarettes, e-cigarettes, and marijuana, the fact that the buildings were constructed and are maintained in accordance with Standard 62.1, occupants are not guaranteed "acceptable indoor air quality."

The proposed rule, strengthened as outlined in this comment, will increase the number or residents that are living in units with acceptable air quality.

REFERENCES

1. MSR Group. *Survey of Nebraska's Douglas County residents* 2005.
2. U.S. Department of Health and Human Services. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General, HHS, CDC, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2006. Available at http://www.surgeongeneral.gov/library/secondhandsmoke/report/fullreport.pdf. 2006.
3. U.S. Department of Health and Human Services. The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2014. Available at http://www.surgeongeneral.gov/library/reports/50- years-of-progress/index.html. 2014.
4. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment. Proposed Identification of Environmental Tobacco Smoke as a Toxic Air Contaminant, June 24, 2005. Available at http://www.arb.ca.gov/regact/ets2006/ets2006.htm 2005.
5. Office of Environmental Health Hazard Assessment. Memorandum: Environmental Tobacco Smoke as a Toxic Air Contaminant to Which Infants and Children May Be Especially Susceptible http://oehha.ca.gov/air/environmental_tobacco/etskids.html accessed 16 Dec 2015. 2006.

6. National Toxicology Program, Public Health Service, HHS. Report on Carcinogens, Thirteenth Edition, October 2014, http://ntp.niehs.nih.gov/ntp/roc/content/profiles/tobaccorelatedexposures.pdf. 2014
7. Kumar S, Davies S, Weitzman M, et al. A review of air quality, biological indicators and health effects of second-hand waterpipe smoke exposure. *Tobacco Control* 2015;24:i54-i9. Available at http://tobaccocontrol.bmj.com/content/24/Suppl_1/i54.long
8. Fernandez E, Ballbe M, Sureda X, et al. Particulate Matter from Electronic Cigarettes and Conventional Cigarettes: a Systematic Review and Observational Study. *Curr Environ Health Rep* 2015;2(4)(4)
9. Yu V, Rahimy M, Korrapati A, et al. Electronic cigarettes induce DNA strand breaks and cell death independently of nicotine in cell lines. . *Oral Oncology* 2016;52:58-65. Available at http://www.oraloncology.com/article/S1368-8375%2815%2900362-0/abstract
10. Reproductive and Cancer Hazard Assessment Branch, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. Evidence on the Carcinogenicity of Marijuana Smoke. 2009 [11 Jan 2015]; Available from: http://oehha.ca.gov/prop65/hazard_ident/pdf_zip/FinalMJsmokeHID.pdf.
11. World Health Organization. Protection from Exposure to Secondhand Tobacco Smoke: Policy Recommendations, WHO Press, 2007. Available at http://apps.who.int/iris/bitstream/10665/43677/1/9789241563413_eng.pdf. 2007.
12. Department of Housing and Urban Development. Multi-family tenant characteristics system, 2015. Available at https://hudapps.hud.gov/public/picj2ee/Mtcsrcr?category=rcr_familystatus&download=false&count=0 2015.
13. Centers for Disease Control and Prevention. Vital Signs – Secondhand Smoke, February 2015. Available at http://www.cdc.gov/vitalsigns/tobacco/. 2015.
14. ARC-PARC. Percentage of Households in Public Housing with a Resident who has a Disability, 2012. Available at http://centerondisability.org/ada_parc/utils/indicators.php?id=79&palette=3. 2012.
15. King B, Cummings K, Mahoney M, et al. Multiunit housing residents' experiences and attitudes toward smoke-free policies. *Nicotine Tob Res* 2010;12(6):598-605.
16. Vijayaraghavan M, Messer K, White M, Pierce J. The effectiveness of cigarette price and smoke-free homes on low-income smokers in the United States. *Am J Pub Health* 2013;103(12):2276-83. doi: 10.105/AJPH.013.301300. Epub 2013 Oct 17.
17. Padilla M, Berg CJ, Schauer GL, Lang DL, Kegler MC. Allowing cigarette or marijuana smoking in the home and car: prevalence and correlates in a young adult sample *Health Educ Res* 2015;30(1):179-91 first published online September 11, 2014 doi:10.1093/her/cyu051
18. Berg CJ, Stratton E, Schauer GL, Lewis M, Wang YW, Windle M, et al. Perceived Harm, Addictiveness, and Social Acceptability of Tobacco Products and Marijuana Among Young Adults: Marijuana, Hookah, and Electronic Cigarettes Win. *Substance Use & Misuse* 2015;50(1):79-89
19. Ramo DE, Delucchi KL, Liu H, Hall SM, Prochaska JJ. Young adults who smoke cigarettes and marijuana: analysis of thoughts and behaviors. *Addict Behav* 2014;39(1):77-84 (PMC 3858522)

20. Roditis ML, Halpern-Felsher B. Adolescents' Perceptions of Risks and Benefits of Conventional Cigarettes, E-cigarettes, and Marijuana: A Qualitative Analysis. *J Adolesc Health* 2015;57(2):179-85 (PMC 4515157)
21. Johnston L, O'Malley P, Bachman J. *Monitoring the Future national survey results on drug use, 1975-2001. Volume I: Secondary school students (NIH Publication No. 02-5106). Bethesda, MD: National Institute on Drug Abuse.* 2002.
22. Moir D, Rickert WS, Levasseur G, Larose Y, Maertens R, White P, et al. A comparison of mainstream and sidestream marijuana and tobacco cigarette smoke produced under two machine smoking conditions. *Chemical Research in Toxicology* 2008;21(2):494-502
23. O'Toole T, Hellmann J, Wheat L, Haberzettl P, Lee J, Conklin D, et al. Episodic exposure to fine particulate air pollution decreases circulating levels of endothelial progenitor cells. *Circ Res* 2010;107:200-3
24. Brook R, Rajagopalan S, Pope C, 3rd, Brook J, Bhatnagar A, Diez-Roux A, et al. Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. *Circulation* 2010;121:2331-78
25. Pope Cr, Burnett R, Krewski D, Jerrett M, Shi Y, Calle E, et al. Cardiovascular mortality and exposure to airborne fine particulate matter and cigarette smoke: shape of the exposure-response relationship. *Circulation* 2009;120:941-8
26. Health and Safety Code section 25249.8(b) and Title 27, Cal Code of Regs., section 25302 et seq. . 2009; Available from: http://oehha.ca.gov/prop65/hazard_ident/pdf_zip/FinalMJsmokeHID.pdf.
27. Thomas G, Kloner RA, Rezkalla S. Adverse Cardiovascular, Cerebrovascular, and Peripheral Vascular Effects of Marijuana Inhalation: What Cardiologists Need to Know. *American Journal of Cardiology* 2014;113(1):187-90
28. Volkow ND, Compton WM, Weiss SRB. Adverse Health Effects of Marijuana Use. *New England Journal of Medicine* 2014;371(9):879-
29. Wang X, Derakhshandeh R, Narayan S, Luu E, Le S, Danforth OM, et al. Brief Exposure to Marijuana Secondhand Smoke Impairs Vascular Endothelial Function. *Circulation* 2014;130:A19538
30. Roth MD, Arora A, Barsky SH, Kleerup EC, Simmons M, Tashkin DP. Airway inflammation in young marijuana and tobacco smokers. *American Journal of Respiratory and Critical Care Medicine* 1998;157(3):928-37
31. Tashkin DP. Effects of marijuana smoking on the lung. *Ann Am Thorac Soc* 2013;10(3):239-47
32. Aldington. Effects of cannabis on pulmonary structure, function and symptoms (vol 62, pg 1058, 2007). *Thorax* 2008;63(4):385-
33. Owen K, Sutter M, Albertson T. Marijuana: Respiratory Tract Effects. *Clinical Reviews in Allergy & Immunology* 2014;46(1):65-81
34. Metcalf D, Deputy Assistant Secretary for Multifamily Housing Programs, HUD. Use of marijuana in multifamily assisted properties. 2014 [11 Jan 2016]; Available from: http://portal.hud.gov/hudportal/documents/huddoc?id=useofmarijinmfassistpropty.pdf.
35. Lofholm N. Federal housing in Colorado remains off-limits to marjuana — for now (Jan 25, 2014). *Denver Post;* 2014; Available from: http://www.denverpost.com/marijuana/ci_24989650/federal-housing-colorado-remains-off-limits-marjuana-now.

36. Zablocki R, Edland S, Myers M, et al. Smoking ban policies and their influence on smoking behaviors among current California smokers: a population-based study. *Prev Med* 2014;59:73-8. doi: 10.1016/j.ypmed.2013.11.018.
37. Pizacani B, Maher J, Rohde K, et al. Implementation of a smoke-free policy in subsidized multiunit housing: Effects on smoking cessation and secondhand smoke exposure. *Nicotine & Tobacco Research* 2012;14(9):1027-34. doi: 10.93/ntr/ntr334.
38. Natl. Ctr. For Healthy Housing. Reasons to Explore Smoke-Free Housing, (2009), available at http://www.nchh.org/portals/0/contents/nchh_green_factsheet_smokefree.pdf. 2009.
39. King B, et al. National and State Cost Savings Associated With Prohibiting Smoking in Subsidized and Public Housing in the United States. *Prev Chron Disease* 2014;11:140222 http://www.cdc.gov/pcd/issues/2014/pdf/14_0222.pdf
40. Mass. Tobacco Control Program. How to Go Smoke-free: A Toolkit for Multi-unit Housing, available at http://makesmokinghistory.org/smoke-free-environments/smoke-free-housing/how-to-go-smoke-free-a-toolkit- for-multi-unit-housing/.
41. Snyder K, Vick J, King B. Smoke-free multiunit housing: a review of the scientific literature. *Tob Control* 2016;25(1):9-20
42. Ballor D, Henson H, Macguire K. Support for no-smoking policies among residents of public multiunit housing differs by smoking status. *J Community Health* 2013;38:1074–80
43. Hennrikus D, Pentel P, Sandell S. Preferences and practices among renters regarding smoking restrictions in apartment buildings. *Tob Control* 2003;12:189-94
44. Hewett M, Sandell S, Anderson J, et al. Secondhand smoke in apartment buildings: renter and owner or manager perspectives. *Nicotine Tob Res* 2007;9:S39–47
45. Hood N, Ferketich A, Klein E, al. e. Individual, social, and environmental factors associated with support for smoke-free housing policies among subsidized multiunit housing tenants. *Nicotine Tob Res* 2013;15:1075–83
46. Licht A, King B, Travers M, et al. . Attitudes, experiences, and acceptance of smoke-free policies among US multiunit housing residents. *Am J Public Health* 2012;102:1868–71
47. Rokicki S, Adamkiewicz G, Fang S, et al. Assessment of Residents' Attitudes and Satisfaction Before and After Implementation of a Smoke-Free Policy in Boston Multiunit Housing. *Nicotine Tob Res* 2015:2015 Oct 26. pii: ntv239. [Epub ahead of print]
48. Department of Housing and Urban Development. Change is in the Air: An Action Guide for Establishing Smoke-free Public Housing and Multifamily Properties, October 2014. Available at http://portal.hud.gov/hudportal/documents/huddoc?id=SMOKEFREEACTIONGUIDE.PDF. 2014.
49. King B, Mahoney M, Cummings K, et al. . Intervention to promote smoke-free policies among multiunit housing operators. *J Public Health Manag Pract* 2011;17:E1–8
50. Campbell DeLong Resources Inc. *Smoking Practices, Policies and Preferences in Oregon Rental Housing. State of Oregon Department of Human Resources Public Health Division Oregon Tobacco Prevention & Education Program.* 2008.

51. King B, Travers M, Cummings K, et al. . Prevalence and predictors of smoke-free policy implementation and support among owners and managers of multiunit housing. *Nicotine Tob Res* 2010;12:159–63
52. Jackson S, Bonnie R. A systematic examination of smoke-free policies in multiunit dwellings in Virginia as reported by property managers: implications for prevention. *Am J Health Promot* 2011;26:37–44
53. Cox E, Barry R, Glantz S, Barnes R. Tobacco Control in California, 2007-2014: A Resurgent Tobacco Industry While Inflation Erodes the California Tobacco Control Program. San Francisco: *UCSF Center for Tobacco Control Research and Education;* 2014; Available from: http://www.escholarship.org/uc/item/4jj1v7tv.
54. Cramer M, Roberts S, Stevens E. Landlord attitudes and behaviors regarding smoke-free policies: implications for voluntary policy change. *Public Health Nurs* 2011;28:3–12
55. Sweda E. Lawsuits and secondhand smoke. . *Tob Control* 2004;13(Suppl 1):i61-i6
56. Ezra D. "Get your ashes out of my living room!": Controlling tobacco smoke in multi-unit residential housing. *Rutgers Law Rev* 2001;54:135–89
57. Schoenmarklin S. Infiltration of Secondhand Smoke into Condominiums, Apartments and Other Multi-Unit Dwellings:2009. A Law Synopsis by the Tobacco Control Legal Consortium, October 2009. Available at http://publichealthlawcenter.org/sites/default/files/resources/tclc-syn-condos-2009.pdf. 2009.
58. Winickoff J, Gottlieb M, Mello M. Regulation of smoking in public housing. *NEJM* 2010;362:362:2319–25
59. Mills A, Messer K, Gilpin E, et al. The effect of smoke-free homes on adult smoking behavior: a review. *Nicotine Tob Res* 2009;11:1131-41
60. Yerger V, Battle R, Moore R. Evaluating the implementation process of a citywide smoke-free multiunit housing ordinance: Insights from community stakeholders. *Am J Public Health* 2014;104(10):1889-91
61. Max W, Sung H-Y, Glantz S. *Comment on Regulatory Impact Analysis for HUD Proposed Rule Instituting Smoke-Free Public Housing Docket No. FR 5597-P-0. Tracking number 1k0-8nct-upuf (January 12, 2016)* 2016.
62. Smoke-Free Housing Coalition of Maine. *2004– 2006 Surveys. (Portland, ME: 2007).* 2007.
63. Washington State Department of Health, Tobacco Prevention and Control Program. *2003 Tenant Surveys. (Olympia, WA: 2003).* 2003.
64. Oregon Smoke Free Housing Project. *2006 Market Surveys. American Lung Association of Oregon. (Tigard, OR: 2006)* 2006.
65. National Center for Healthy Housing. Reasons to explore smoke-free housing. 2009; Available from: http://www.nchh.org/portals/0/contents/nchh_green_factsheet_smokefree.pdf.
66. ClearWay MinnesotaSM and Minnesota Department of Health. Tobacco Use in Minnesota: 2014 Update. ; January 2015. http://mnadulttobaccosurvey.org/. Minneapolis, MN.
67. Stein A, Baker L, Agans R, et al. The Experience With Smoke-Free Policies in Affordable Multiunit Housing in North Carolina: A Statewide Survey. *Am J Health Promot* 2015:2015 Aug 25. [Epub ahead of print].

68. Ballbèa M, Martínez-Sáncheza JM, Suredaa X, Fua M, Pérez-Ortuñog R, Pascualg JA, et al. Cigarettes vs. e-cigarettes: Passive exposure at home measured by means of airborne marker and biomarkers ☆. *Environ Res* 2014;135:76-80
69. Schober W, Szendrei K, Matzen W, Osiander-Fuchs H, Heitmann D, Schettgen T, et al. Use of electronic cigarettes (e-cigarettes) impairs indoor air quality and increases FeNO levels of e-cigarette consumers. *Int J Hygiene Environ Health* 2014;217(6):628-37. doi: 10.1016/j.ijheh.2013.11.003
70. Ballbè M, Martínez-Sánchez J, Sureda X, Fu M, Pérez-Ortuño R, Pascual J, et al. Cigarettes vs. e-cigarettes: Passive exposure at home measured by means of airborne marker and biomarkers. *Environ Res* 2014;135:76-80
71. Schripp T, Markewitz D, Uhde E, Salthammer T. Does e-cigarette consumption cause passive vaping? *Indoor Air* 2013;23:25-31
72. Czogala J, Goniewicz M, Fidelus B, Zielinska-Danch W, Travers M, Sobczak A. Secondhand exposure to vapors from electronic cigarettes. *Nicotine Tob Res* 2014;16(6):655-62
73. Kosmider L, Sobczak A, Fik M, et al. . Carbonyl compounds in electronic cigarette vapors: effects of nicotine solvent and battery output voltage. *Nicotine Tob Res* 2014;16(10):1319-26
74. St.Helen G, Havel C, Dempsey D, Jacob Pr, Benowitz N. Nicotine delivery, retention, and pharmacokinetics from various electronic cigarettes. *Addiction* 2015:Epub 2015/10/03. doi: 10.1111/add.13183
75. Matt G. Thirdhand tobacco smoke: emerging evidence and arguments for a multidisciplinary research agenda. *Environmental Health Perspectives* 2013;119:1218-26
76. Sleiman M, Gundel L, Pankow J, et al. . Formation of carcinogens indoors by surface-mediated reactions of nicotine with nitrous acid, leading to potential thirdhand smoke hazards. *Proc Natl Acad Sci U S A* 2010;107(15):6576-81
77. Destaillats H, Singer B, Lee S, Gundel L. Effect of ozone on nicotine desorption from model surfaces: evidence for heterogeneous chemistry. *Environ Sci Technol* 2006;40(6):1799-805
78. Schick S, Glantz S. Concentrations of the carcinogen 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone in sidestream cigarette smoke increase after release into indoor air: results from unpublished tobacco industry research. *Cancer Epidemiol Biomarkers Prev* 2007;16(8):1547-53
79. Thomas J, Hecht S, Luo X, Ming X, Ahluwalia J, Carmella S. Thirdhand tobacco smoke: a tobacco-specific lung carcinogen on surfaces in smokers' homes. *Nicotine Tob Res* 2014;16(1):26-32
80. Martins-Green M, Adhami N, Frankos M, Valdez M, Goodwin B, Lyubovitsky J, et al. Cigarette smoke toxins deposited on surfaces: implications for human health. *PLoS One* 2014;9:1
81. Hang B, Sarker A, Havel C, Saha S, Hazra T, Schick S, et al. Thirdhand smoke causes DNA damage in human cells. *Mutagenesis* 2013;28(4):31-91
82. World Health Organization. *Waterpipe tobacco smoking: health effects, research needs and recommended actions by regulators.* Geneva, Switzerland 2005.
83. Shihadeh A, Azar S, Antonios C, Haddad A. Towards a topographical model of narghile water-pipe café smoking: a pilot study in a high socioeconomic status neighborhood of Beirut, Lebanon. *Pharmacology Biochemistry and Behavior* 2004;79(1):75-82

84. Daher N, Saleh R, Jaroudi E, Sheheitli H, Badr TRS, Sepetdjian E, et al. Comparison of carcinogen, carbon monoxide, and ultrafine particle emissions from narghile waterpipe and cigarette smoking: Sidestream smoke measurements and assessment of second-hand smoke emission factors. *Atmospheric Environment* 2010;44(1):8-14
85. Monzer B, Sepetdjian E, Saliba N, Shihadeh A. Charcoal emissions as a source of CO and carcinogenic PAH in mainstream narghile waterpipe smoke. *Food and Chemical Toxicology* 2008;46(9):2991-95
86. Olsson M, Petersson G. Benzene emitted from glowing charcoal. *Sci Total Environ* 2003;303(3):215-20
87. Shihadeh A, Salman R, Jaroudi E, Saliba N, Sepetdjian E, Blank MD, et al. Does switching to a tobacco-free waterpipe product reduce toxicant intake? A crossover study comparing CO, NO, PAH, volatile aldehydes,"tar" and nicotine yields. *Food and Chemical Toxicology* 2012;50(5):1494-98
88. Schubert J, Heinke V, Bewersdorff J, Luch A, Schulz TG. Waterpipe smoking: the role of humectants in the release of toxic carbonyls. *Archives of Toxicology* 2012;86(8):1309-16
89. Cobb CO, Sahmarani K, Eissenberg T, Shihadeh A. Acute toxicant exposure and cardiac autonomic dysfunction from smoking a single narghile waterpipe with tobacco and with a "healthy" tobacco-free alternative. *Toxicology Letters* 2012;215(1):70-5
90. Dar N, Bhat G, Shah I, Iqbal B, Kakhdoomi M, Nisar I, et al. Hookah smoking, nass chewing, and oesophageal squamous cell carcinoma in Kashmir, India. *Br J Cancer* 2012;107(9):1618-23
91. Rammah M, Dandachi F, Salman R, Shihadeh A, El-Sabban M. In vitro cytotoxicity and mutagenicity of mainstream waterpipe smoke and its functional consequences on alveolar type II derived cells. *Toxicology Letters* 2012;211(3):220-31
92. Rammah M, Dandachi F, Salman R, Shihadeh A, El-Sabban M. In vitro effects of waterpipe smoke condensate on endothelial cell function: A potential risk factor for vascular disease. *Toxicology Letters* 2013;2019(2):133-42
93. American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE). ANSI/ASHRAE Addenda a, c, j, k, q, r, and s to ANSI/ASHRAE Standard 62.1-2013 Ventilation for Acceptable Indoor Air Quality. 2015; Available from: http://bit.ly/1PFjEs1