A DEFENSE TO RAISE THE MINIMUM LEGAL SALE AGE OF NICOTINE PRODUCTS TO 21 IN LANE COUNTY

by

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A THESIS

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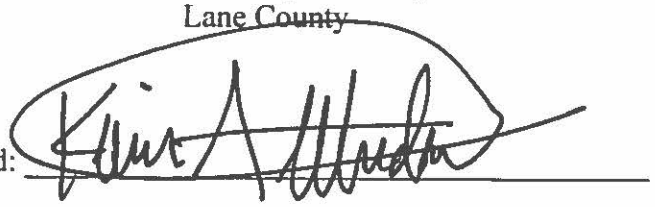
Approved: 

Kevin Alltucker, PhD

Nicotine is one of the most addictive substances around the world, and it is the responsibility of community leaders to advocate for the regulation of it and the protection of our youth. The tobacco industry has long fought the research on the negative health outcomes of tobacco and nicotine exposure, so policymakers have incredible power and accountability in preventing youth from using addictive substances. Making changes now can powerfully impact future generations from devastating health outcomes and the financial costs associated with them. Because smoking among adolescents has almost doubled from 2013 to 2015, all outcomes associated with smoking will likely increase and have an adverse impact on the community and its residents.

This thesis delves into how nicotine itself acts in the body at different developmental stages in adolescence to highlight the addictive properties of nicotine. It also explores both the immediate and long-term effects of nicotine use. The data and purpose is specific to Lane County, OR.

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1. Policy Brief written in conjunction with Lane County Public Health Prevention Section titled Raising the Minimum Legal Sale Age to Reduce and Delay the Onset of Tobacco and Nicotine Use in Youth

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Introduction

Smoking tobacco is the leading cause of preventable death, illness, and disability around the world (CDC, 2015). About 1 in every 5 to 6 people in the U.S. has acquired a disease caused by smoking or secondhand smoke, and about half a million die each year in this country. Youth are a particularly vulnerable population; the more exposure a child has to a substance, the more likely they are to use it (Escobar-Chaves and Anderson, 2008). About 90% of adults who smoke initiated before age 18. According to the CDC, 16.3% of the adult population of Oregon (approximately 476,000 people) smoke cigarettes. Of teens between ages 12 and 17, 9.7% (1 in 10) smoke. Oregon ranks 11th among all states for adult smoking and 16th for youth smoking rates (Oregon Health Authority).

Oregon experiences at least 7000 deaths from tobacco use and secondhand smoke every year. Smoking and use of nicotine products have a detrimental effect on Lane County's population and economy. Lane County accounts for about 10% of total tobacco-related deaths in Oregon. In 2014, in Lane County, there were 720 tobacco-related deaths and 14,068 people with a serious tobacco-related illness (Oregon Health Authority, 2014), which cost approximately $143.5 million in tobacco-related healthcare costs and an additional $115 million in lost productivity due to early tobacco-related deaths.

Unlike prior years, smoking in the underage population increased likely due to the introduction of new nicotine products which are appealing to youth. From 2013 to 2015, nicotine use among 11th graders in Lane County almost doubled, from 17.2% to 29.3% (Oregon Healthy Teens Survey, 2015). Of the 29.3%, three quarters use a

flavored tobacco product or an inhalant device. The brain isn't fully developed until age 26, and nicotine interferes with its development by preventing acetylcholine from binding with its receptors; acetylcholine is vital in brain and body development in prenatal, infant, and adolescent periods. The nature of nicotine addiction in adolescents, the introduction and availability of these new products, in conjunction with the predatory marketing practices of the tobacco industry, will increase the population of people who smoke in Lane County over time, thereby increasing the number of people affected by tobacco-related illness and death and the costs associated with tobacco related healthcare.

Flavored tobacco embodies the favorite foods and flavors of youth, like strawberry, licorice, and mint. Almost 9 in 10 tobacco retailers sell at least one type of flavored tobacco, including smokeless and vaping products (Lane County Retail Assessment, 2014). Price also affects the availability of these products. A "high price is the single greatest deterrent for smoking initiation in youth as they are a very price-sensitive group; offering tobacco products that are cheap makes them more accessible" (Lane County Retail Assessment, 2014). The tobacco industry spends more than 90% of their marketing budget on price discounts; it "markets its products heavily, deliberately targeting non-smokers and keeping prices low until smoking and local economies are sufficiently established to drive prices and profits up" (Gilmore, et al., 2015). In Oregon, the tobacco industry spent more than $112 million promoting tobacco products in 2012 (Oregon Health Authority, 2014). Youth are especially vulnerable if they come from a low income community, where price acts as a sensitive barrier to affordability, and therefore accessibility. More than 50% of children are eligible for the Free and

Reduced Lunch Program in Lane County (Lane County Status Assessment, 2015), a strong indicator of price sensitivity.

Policy that restricts sale of nicotine products would drastically reduce the number of people impacted and money spent on nicotine and nicotine-related health outcomes. Because the tobacco industry directly markets to children in local tobacco retail stores frequented by youth, adolescents are particularly vulnerable to the messages of the tobacco industry, as exposure to tobacco increases the likelihood a child will experiment with it (Smoke Free Oregon, 2016). Such marketing practices include price discounts, individual cigarillos, strategic placement of advertisements and products, and flavors; these practices are appealing to youth. Because of their appeal, raising the minimum legal sale age (MLSA) of nicotine products would help counteract those predatory practices by removing access to the key social source of tobacco. Over 140 localities across the U.S., including the State of Hawaii, have passed policies restricting nicotine sales to those 21 and older; the Institute of Medicine (2015) concluded enacting such policy will likely prevent and delay the onset of nicotine use by adolescents. Raising the MLSA of nicotine products to 21 in Lane County will result in better overall health outcomes and an enriched local economy.

Relevance

The Lane County Board of Health/County commissioners requested a policy information on why the county should raise the MLSA of nicotine products to 21. This thesis will act as an extensive source of organized information for the commissioners to use when deciding how to regulate nicotine products. The recent and drastic increase in

underage smoking will have an adverse influence on the number of people affected by tobacco-related diseases and deaths and the associated costs.

At least two people die a day in Lane County due to tobacco-related causes (Brian Johnson, personal communication, 2015). Approximately $143.5 million is spent on tobacco-related healthcare costs, plus $115 million in productivity losses. Cigarette smoking in Lane County is higher than the rest of Oregon, and smoking among pregnant women is also higher in Lane County than Oregon overall. Teen pregnancy is also higher in Lane County than Oregon, and it is likely some of these teen mothers make up the population of pregnant women who smoke.

However, it is not just the individual choices of people who smoke, but the manner in which those people are targeted that influence smoking rates in Lane County. In Lane County, one in three retailers displayed tobacco ads at the eye level of a three to four-year old child, and 66% of tobacco retailers displayed tobacco products or advertising in a manner that appeals to children (Lane County Retail Assessment, 2014). The overwhelming majority of retailers sold flavored tobacco products, which are the most commonly used tobacco products (along with inhalants) for eighth and eleventh graders that use nicotine produces. Advertisements also increase likelihood for impulse purchases in adults trying to quit tobacco and relapse for former people who smoke (Smoke Free Oregon, 2016).

Youth are most likely to obtain a tobacco product from a friend who is of-age in their social group (Jansen, et al., 2011). Raising the MLSA would push the age to purchase nicotine products outside of the average age of peer circles under and at age

18, making it less accessible by trade and by furnishing. It is not common for 21-year olds to travel in high school social groups (Tobacco 21, 2016).

Furnishing: supplying someone with something; in legal terms, furnishing is supplying a minor with an otherwise illegal product.

An underage person who attempts to purchase tobacco utilize a number of strategies, which include wearing makeup or growing out facial hair to appear older, fondling car keys, or acting confident. Another option is for a youth to purchase tobacco from a friend who works at a retailer. This usually occurs when the friend working is a part of a youth's social group at school; using individuals who are under 21 to sell tobacco may result in more illegal tobacco sales (Jansen, et al., 2011) if the legal age remains 18.

It has long been argued that the tobacco industry markets directly to youth. The World Health Organization (2000) explains "the tobacco industry associates cigarette smoking with athletic prowess, sexual attractiveness, professional success, adult sophistication, independence, adventure and self-fulfillment. This constant barrage of misleading messages appeals to young people and encourages them to take up behaviors harmful to their health." Tobacco products and advertising are strategically placed within three feet of the floor and within 12 inches of products sold to youth, such as candy. These specific placements are at the average height of a three to four-year old child, and allow the messages of the tobacco industry to infiltrate the minds of children at a younger age and influence the likelihood of tobacco experimentation.

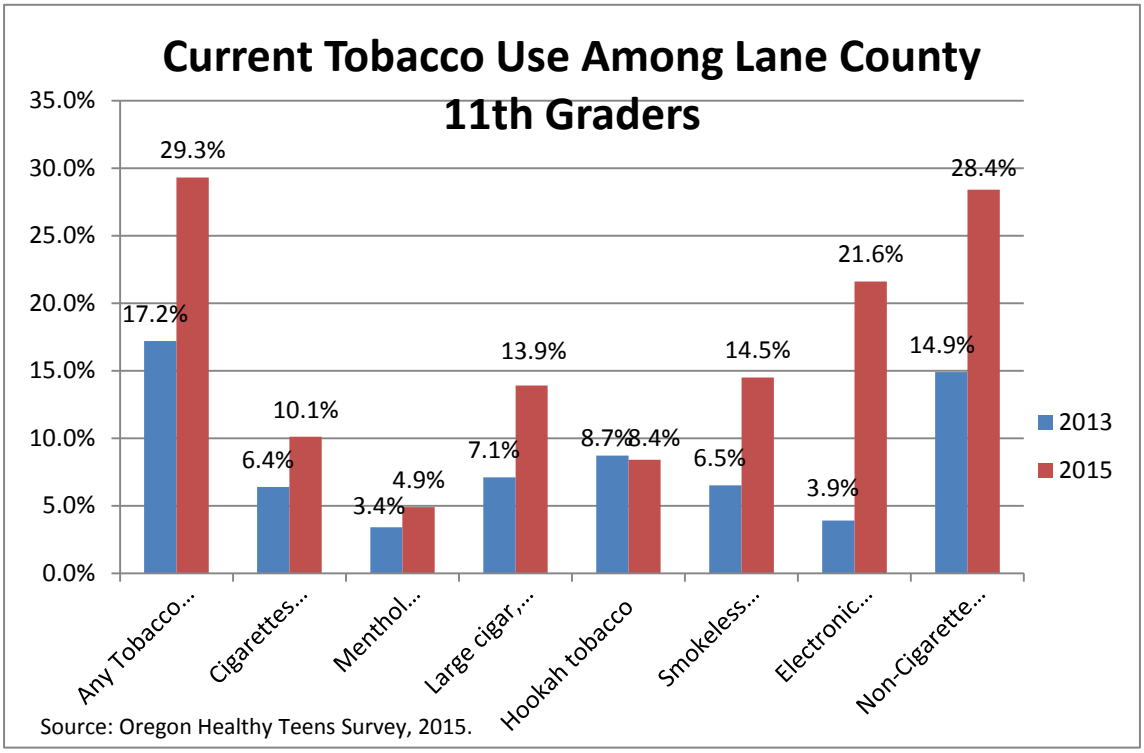

Figure 1: Tobacco Increase Among 11th Graders (2013-2015)

The negative health outcomes from using nicotine are well documented. However, the evidence is not related to decreasing tobacco use by underage youth in Lane County. The majority of adult smokers began before age 18, and the number of youth smoking in Lane County is rising likely due to new flavored and vape products. More young people who smoke results in more adults who smoke, which results in a higher rate of negative nicotine-related health outcomes and more money spent on tobacco products and tobacco-related healthcare. The chemistry of addiction in adolescents in conjunction with predatory marketing practices necessitates policy.

Momentum

Over 140 municipalities, and the State of Hawaii, have raised the MLSA of nicotine products to 21. On September 30, 2015, federal legislation was introduced to Congress. The new policy is commonly referred to as Tobacco 21, and has been "endorsed by the American Academy of Pediatrics," among other big-name organizations (CounterTobacco.org, 2016) such as:

Campaign for Tobacco Free Kids

American Heart Association

American Lung Association

American Medical Association

Institute of Medicine

American Academy of Family Physicians

Society for Adolescent Health and Medicine

Counter Tobacco

Action on Smoking and Health

Tobacco Control Legal Consortium

Clearway Minnesota

Oral Health America

A number of other small groups also endorse Tobacco 21 policy (Tobacco 21, 2016).

Lane County has made a number of strides to reduce smoking and tobacco use. Some policies enacted since 2000 include:

2000 Smoke Free Workplace Ordinance (City of Eugene)

2004 Tobacco Sales banned on campus (University of Oregon)

2008 Smoke Free Olympic Track and Field Trials (Eugene)

2008 Smoke Free Affordable Housing (HACSA)

2012 Tobacco Free Campus (University of Oregon)

2014 Tobacco Retail Licensing Ordinance (Lane County)

The Threat of the Tobacco Industry

The tobacco industry has a history of documented comments relating to their marketing practices, specifically those targeted at children. The following are a few of those comments:

In a Philip Morris Tobacco Company Report from 1986, a representative was documented quoting that "raising the legal minimum age for cigarette purchase to 21 could gut out key young adult market (17-20) where we sell about 25 billion cigarettes and enjoy a 70 percent market share." (Assembly Committee on Governmental Organization, 2015).

The chairman of Liggett and Meyers Tobacco Company supports and mirrors Philip Morris by saying "if you are really and truly not going to sell to children, you are going to be out of business in 30 years" (State of Rhode Island Department of Health, 2016). The Lorillard Tobacco Company outlines an internal project to "determine the minimum level of nicotine that will allow continued smoking" (Smith 1980) (Government of Oklahoma), emphasizing the intent to create addicted youths that will continue on to become lifelong users of nicotine.

The tobacco industry markets directly toward youth, and does so knowing the nicotine content in their products is enough to establish dependence. As mentioned, two

out of three tobacco retailers in Lane County display tobacco advertising or products in a manner appealing to children. The industry has notoriously fought against tobacco control, with full knowledge of the negative health consequences associated with tobacco. The World Health Organization outlines some of the industry's tactics in preventing effective tobacco control, such as "lobbying, political donations, exploiting legislative loopholes, undermining or countering research, and funding groups or individuals to advance the tobacco industry's objectives" (The Lancet, 2012). The industry has a history of attempting to undermine research that exposes the negative health consequences of smoking. Camargo (2012) argues that the tobacco industry has two objectives: 1) to manufacture and sell tobacco products and 2) to "'foster doubt about criticism of tobacco products, encourage distrust of government, manipulate legislative processes, distract people from the negative effects, neutralize and harass opponents, coerce and coordinate allies, undermine scientific and common knowledge, and persuade people that smoking is normal, even helpful, human behavior.'" The industry also insures that tobacco products have enough nicotine to both satisfy the consumer and create a dependence. In both World Wars, "the provision of free cigarettes to soldiers serving in the military" contributed to the rise in smoking (Henningfield, 2008). The industry also catalyzed an increase in smoking among people with mental illness by encouraging providers to give away free cigarettes.

As early as the 1950's, the tobacco industry began funding scientific studies to counter the mounting research connecting tobacco to lung cancer and other negative health outcomes. Once countries began implementing restrictions to smoking, the industry launched a series of campaigns focusing on personal freedoms and the right to

choose. They countered the health community's stance on health with their own stance on freedom, and argued that freedom to choose what is best for one's own health held more power. However, "smokeless tobacco use in the USA increased shortly after the 1964 US Surgeon General's report on the health effects of smoking, until the 1986 Surgeon General's report on the health consequences of using smokeless tobacco" (Henningfield, 2008). The "tobacco industry's 'nicotine maintenance monopoly' is clearly put into perspective when considered against the wide variety of alternative forms of nicotine delivery" (Ferrence et al, 2000) and the population they target the most. When smoke-free policies gained popularity, the industry created a wider variety of smoke-free products so people could maintain their nicotine addiction.

Argument

Health Outcomes

Nicotine: a toxic colorless or yellowish oily liquid that is the chief active constituent of tobacco. It acts as a stimulant in small doses, but in larger amounts blocks the action of autonomic nerve and skeletal muscle cells. Nicotine is also used in insecticides, as well as in darts meant to bring down elephants. (Schwartz-Bloom & Gross de Núñez, 1974).

Any person who smokes tobacco or uses smokeless tobacco is at a higher risk to become addicted to other substances (Christy Inskip, personal communication, 2015) (Kandel & Kandel, 2014). Nicotine stimulates a process in the brain that lowers an individual's resiliency to addiction to other drugs (Kandel & Kandel, 2014). The brain is not fully developed until age 26; youth have a faster and more intense dependency on nicotine because of their underdeveloped brain (CDC, 2015), and are more likely to suffer from other addictions due to nicotine and have a more intense reaction to nicotine-related illness. Between 1992 and 1994, the FDA commissioner characterized nicotine addiction as a pediatric disease (Hilts, 1995), and given that 9 out of 10 adults who smoke began before age 18, smoking is very much a childhood epidemic.

The Center for Disease Control and Prevention (CDC) (2015) also identifies a host of other health consequences caused by smoking, such as cardiovascular disease, coronary heart disease, stroke, a number of cancers, and Type 2 Diabetes. Smoking can also cause fertility problems, premature birth for pregnant women, low birthweight, asthma, sudden infant death syndrome (SIDS), and decreased immune efficiency (CDC,

2015). People who smoke are less likely to report positive feelings, such as happiness or enjoyment (Gallup.com, 2015). Even for those who don't smoke, "each year, more than 41,000 nonsmoking adults die from exposure to secondhand smoke" in the U.S. (CDC, 2013). Secondhand smoke increases risk for asthma, throat infection, and cancer. "Cigarettes are among the most deadly and addictive products ever produced by mankind. When used as intended by their manufacturers, they kill approximately one half of their users" (World Health Organization, 2006). The death toll is likely to rise due to the increase in teenage nicotine use.

The Chemistry of Nicotine

Nicotine "acts as a botanical insecticide in tobacco leaves" and "comprises about 95% of total alkaloid content" (Henningfield, 2008, p 30). Alkaloids are a group of chemical compounds that mostly contain basic nitrogen atoms. Nicotine is distilled through combustion and is carried on particulate matter which is inhaled by the user. When smoked, some nicotine is absorbed in the mouth tissue, but the majority is rapidly absorbed in the lungs, thought to be due to the large surface area, where it absorbs into the blood vessels lining the lung walls. It then travels to the heart, and through the blood to the brain. The average cigarette contains between 8 to 9mg of nicotine, but usually only 1mg is able to be absorbed. Nicotine absorption depends on factors such as depth of inhalation, number and intensity of puffs, and dilution with surrounding room air. Generally, smokers that switch from higher nicotine cigarettes to lower nicotine cigarettes change their habits to get more nicotine, i.e. they smoke more lower nicotine cigarettes to compensate for the lower density of nicotine (Henningfield, 2008, p 75); the biological reaction of the body when dependence is established determines the

threshold for nicotine need. After absorption, nicotine binds to different body tissues; the highest levels of nicotine in autopsy samples are found in the liver, kidney, spleen, and lungs. The lowest levels are found in adipose tissues, which are the cells that store fat. Nicotine ions also bind with brain tissue, and the nicotine receptor capacity increases the more an individual smokes. This increase in receptors explains why it is increasingly more difficult to quit after lifelong smoking or nicotine use. In pregnant women, "nicotine crosses the placental barrier easily, and there is evidence for accumulation of nicotine in fetal serum and amnionic fluid in slightly higher concentrations than in maternal serum" (Henningfield, 2008, p 34). Therefore, in women that smoke or use nicotine, the placenta absorbs more nicotine than the mother.

Nicotine binds to and activates the protein complex which is normally activated by acetylcholine, a chemical released by nerve cells to send signals to other cells. These receptors "regulate critical aspects of brain maturation during the prenatal, early postnatal, and adolescent periods" (Dwyer, McQuown, & Leslie, 2009). Because acetylcholine plays such a fundamental role in the development of the premature brain, adolescents are much more vulnerable to the influence of nicotine.

Prenatal and Postnatal Development

In prenatal development, acetylcholine receptors are vital to brain organization due to their role in sending signals, cell creation, and cell survival; acetylcholine receptors also regulate brainstem networks that influence cardiorespiratory responses. Nicotine can essentially desensitize these receptors, inhibiting brain and body growth (Dwyer, McQuown, & Leslie, 2009). This ultimately results in birth defects and abnormalities, such as low birth weight, SIDS, fetal alcohol syndrome, and death

(Ferrence, et al., 2000, p 77). In the postnatal period, vital areas of the brain are regulated by transient sets of acetylcholine receptors. Such areas include the hippocampus (the center of emotion, memory, and autonomic nervous system), the cortex (which plays an important role in consciousness), and the cerebellum (which coordinates and regulates muscular activity). The interference of nicotine in these brain functions can result in severe anxiety-like symptoms (Dwyer, McQuown, & Leslie, 2009). Cigarette smoking and smoking among pregnant women is higher in Lane County than Oregon overall. Teen pregnancy is also greater in Lane County than the rest of Oregon (Oregon Heath Authority). It is likely a number of pregnant teen girls make up part of the total number of pregnant women who smoke, and thus experience an adverse influence on their babies. Therefore, due to the increase in teenage smoking, their babies will experience the adverse consequences.

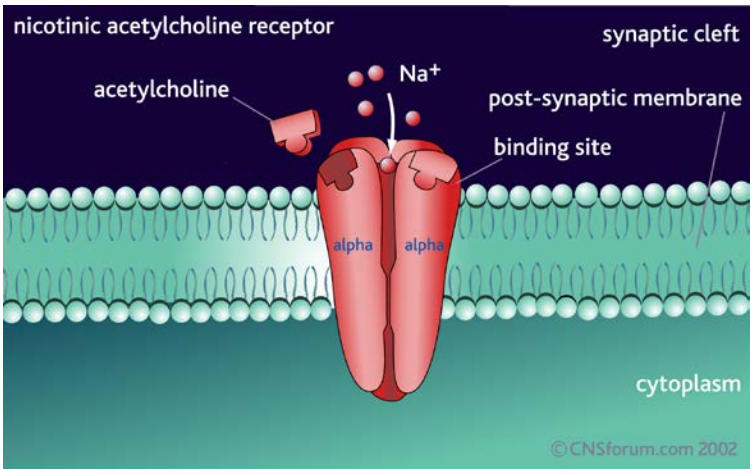

Figure 2: Acetylcholine Receptors and Nicotine

Nicotine replaces acetylcholine in their receptors, effectively blocking them from developing certain areas of the brain.

Adolescent Development

Response to prenatal nicotine consumption extends far beyond infancy. Dwyer, McQuown, and Leslie (2009) explain that "adolescent smokers whose mothers used tobacco during pregnancy" are at a higher risk of addiction to tobacco in youth and "also experience more severe memory deficits during nicotine withdrawal, potentially making quitting more difficult for adolescents who were exposed to tobacco during pregnancy." Adolescents undergo a period of development in which their behavior revolves around risk-taking, novelty-seeking, and increased social interaction; "studies have also linked prenatal nicotine exposure to hyperactivity, increased risk-taking behavior and deficits in learning and memory" (Mychasiuk, Muhammad, Carroll & Kolb, 2013). Nicotine use in adolescence has been shown to increase extracellular levels of dopamine, the reward chemical in the brain; youth are more sensitive to the dopamine levels released via nicotine, and have a higher risk of addiction. In a New

Zealand study, Ursprung and Difranza (2010) found that nicotine dependence according to the DSM definition occurs as early as 10-19 cigarettes, less than a standard pack.

About one third of people who smoke attempt to quit each year, but only between 15% and 49% are successful; relapse is common (Henningfield, 2008, p 144). In Oregon, 58% of people who smoke attempt to quit. Nine out of ten adults who smoke began smoking before age 18, and the rate of relapse and success are indicators of the impact of nicotine on the developing brain, i.e. the interference with acetylcholine. Nicotine activates the sympathetic nervous system, which contributes to anxiety, by increasing "heart rate, constrict[ing] some blood vessels…increase[d] myocardial contractility, and adrenal and neuronal catecholamine release" (Ferrence, et al., 2000, p 66). These hormones are responsible for the fight or flight response, and myocardial contractility is the heart's ability to contract; nicotine levels accumulate throughout the day to a level that slowly decreases but doesn't disappear overnight (Ferrence, et al., 2000). Nicotine is also "psychoactive [and] mood-altering" (Ferrence, et al., 2008, p 122). Not only does nicotine use have severe long term health outcomes, but can also cause immediate poisoning that can lead to death.

Symptoms of acute nicotine toxicity include:

Fine tremors

Nausea

Tachycardia

Elevated blood pressure

Symptoms of severe poisoning include:

Cholinergic excess (increased salivation, vomiting, diaphoresis)

Cardiac dysrhythmias

Seizures

Muscle fasciculations

Hypotension

Bradycardia

Lethargy

Respiratory failure/neuromuscular blockade

Nicotine poisoning can happen through inhalation or through dermal absorption of nicotine liquid. A “typical” nicotine-dependent smoker requires about 20 mg of nicotine a day from about 20 cigarettes;” when someone smokes light cigarettes, then tend to smoke more to compensate for lack of nicotine (Ferrence et al, 2000). For every 8 to 9 mg nicotine cigarette, only 1mg can be absorbed by the body; 20 cigarettes each provide 20 1-mg doses. The rate of absorption is where the term “pack a day” derives.

Nicotine as a Gateway Drug

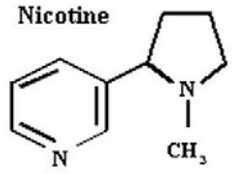

Figure 3: The Nicotine Molecule

Kandel and Kandel (2014) suggests that a developmental sequence for drug use begins when an individual uses a legal drug and evolves to using illegal drugs. Pertaining to nicotine, “the use of tobacco or alcohol precedes the use of marijuana, which in turn precedes the use of cocaine and other illicit drugs” (Kandel and Kandel,

2014). In 2012, the majority of young adults age 18-34 using cocaine had first started using tobacco. In a study using mice subjects, Kandel and Kandel (2014) discovered that the effects of cocaine were greater when preceded with nicotine. Mice given nicotine for seven days, followed by four days of combined nicotine and cocaine use, were 98% more active than control mice which were given only water and then cocaine. The reverse, seven days of cocaine followed by a combination of the substances, did not yield the same results. The experiment group also displayed a higher preference (78%) for the chamber the mice were held in than the control, associating the nicotine water with the chamber. Priming the mice with nicotine resulted in higher reward properties of cocaine.

Kandel and Kandel (2014) also observed cocaine and nicotine use in a human population. In a group of students age 15.7 to 34.2 years, 75.2% of the cocaine users regularly smoked the month they began using cocaine. Those that started smoking after using cocaine had a much lower dependence.

The Threat of E-Cigarettes

The majority of youth in 8^{th}, 10^{th}, and 12^{th} graders in 2015 reported they used e-cigarettes to "see what they were like" and "because they tasted good" (University of Michigan, 2015), highlighting the tobacco industry's marketing practices of dangerous products. E-cigarettes, instead of acting as a new method to quit smoking, are used instead as a new means of using recreational substances (Brian, 2014), including nicotine.

Vaping: inhaling and exhaling the vapor produced by an electronic cigarette or battery powered device to delivery nicotine or marijuana

Lane County 11th grade tobacco use increased from 17.2% in 2013 to 29.3% in 2015, mostly due to *vaping*; 8th graders saw a growth from 11% to 17% (Oregon Healthy Teens Survey, 2015). Because of the common perception that e-cigarettes and vaporizers are significantly less harmful than cigarettes, they have started to replace traditional cigarette use in youth and young adults. In 2009 the "Food and Drug Administration (FDA) prohibited the addition of flavors (except menthol) to cigarettes, which likely helped reduce youth cigarette use" (University of Michigan, 2015); flavor additions were not regulated in cigarillos and other tobacco products. E-cigarettes, however, were introduced in 2007, and are produced with a variety of appealing flavors. Since, vape bars and shops where vaping is allowed indoors have made an appearance. There are fourteen vape shops and four online retailers in Lane County, not including other retailers that sell e-cigs and vape products.

There is limited research on the impact of e-cigarettes and vaporizers. According to DrugAbuse.gov, the worst health outcomes due to smoking are associated with the tar and added chemicals inhaled from cigarettes, which are not components of e-cigarettes. The head rush and pleasure, and addictive nature, is due to the nicotine. Because of the non-combustible nature of vaporizers, there is discussion around the impact of secondhand smoke. The substance that is exhaled from e-cigarettes is neither smoke nor vapor, but an aerosol, which are ultrafine particles suspended in gas. People who do not smoke

While there may be lack of smoke and combustible chemicals, vapes and electronic devices still use nicotine, a highly addictive substance. Exposure and inhalation of nicotine "may prime the brain to become addicted to other substances"

(Drugabuse.gov). E-cigarettes also face discrepancies with labeling and ingredients. The FDA found nicotine in e-cigarettes specifically labeled nicotine-free, as well as varying ranges of nicotine in products that were supposed to contain the same amount (Journal National Cancer Institute). E-cigarettes are not only misleading in their labeling, but they could also cause an individual to smoke more nicotine than intended, thus increasing their threshold for nicotine need and influencing potential health outcomes and associated costs. Overcompensating is a concern for ENDS (electronic nicotine delivery system) users, as labeling is misleading; switching from one liquid solution to another could actually increase nicotine dependence because of false labeling. There are no federal quality standards to ensure accuracy of ENDS solution constituents as advertised or labeled. Other issues include:

Refillable cartridges allow user to smoke marijuana

Other toxic chemicals found in e-liquid: aldehydes (known respiratory irritant), tobacco-specific nitrosamines, metals, tobacco alkaloids, and polycyclic aromatic hydrocarbons

Substantial discrepancies between content and label

Standard cigarette ranges from 8-9mg of nicotine (absorbed nicotine is 1mg); e-cigarettes can range from 0-36mg, 4 times the standard nicotine content of cigarettes

These products should also fall under new policy for raising the minimum legal sale age as they contain nicotine, which is the addictive substance. The tobacco industry has had a considerable influence on the dosing and composition of nicotine products (Henningfield, 2008, p 458). Because nicotine is the addictive chemical in tobacco products, creating and sustaining a dependence in its users is vital to maintaining the

smoking population. However, because “nicotine is too irritating- other substances are required for sensoric reasons” (Henningfield, 2008, p 462). Flavorants, now most commonly found in e-cigarettes and vaporizers, mask the irritating effect of nicotine and mediate the consumption of the user. Reduced irritation may encourage increased nicotine use, especially in youth. The flavorings, however, are also appealing to young children. Nicotine liquid is extremely poisonous, and as little as 1 teaspoon of nicotine liquid spilled on the skin is enough to kill an adult (Christy Inskip, personal communication, 2016) (Bassett, Osterhoudt, & Brabazon, 2014) (The Editorial Board, 2015). There has been one case of an individual attempting suicide via injection of nicotine liquid (The Editorial Board, 2015). Propylene Glycol is a synthetic liquid used in nicotine liquids, and while it has been cleared safe for consumption, there is no safe measure for when it is heated, turned into an aerosol, and inhaled. It is also an irritant on the skin.

DrugAbuse.gov (2015) also suggests that “students who have used e-cigarettes by the time they start 9th grade are more likely than others to start smoking traditional cigarettes and other smokable tobacco products within the next year.” Some people may use e-cigarettes as a cessation method, e-cigarette use can make quitting harder and may lead to dual use.

Misuse and Unsafe E-cigarette Devices

One of the biggest concerns of the rising popularity of vaporizers is the potential to use them to vape retail marijuana. Because vaporized marijuana does not emit a distinct smell, and e-cigarettes do not smell like combustible tobacco, it can be impossible to tell if an individual using a vaporizer is vaping marijuana or nicotine. This

is of particular concern because the MLSA for retail marijuana in Oregon is 21, and tobacco is 18.

The very device of which to vape nicotine liquid has shown to be dangerous. On February 3, 2016 in Missoula, Montana, an e-cigarette exploded, causing the teen using it to lose a number of teeth. According to CNN Wires (2016), the Federal Emergency Management Agency reports that 80% of explosions occur while the device is charging, and 12% occur while either in storage or in use. The damage in this specific case resulted in not only tooth loss, but also a loss of a chunk of jawbone. E-cigarette explosions have also been the cause of a broken neck and coma (Alfred Ng, 2015), as well as facial fractures and burns to the face, inside of the mouth, hands, and legs while the device was in a pocket (CBS News, 2016). The US Fire Administration suggests the flaw is due to faulty batteries (Alfred Ng, 2016).

Another possible issue with the device itself is the heated nicotine liquid in the metal chamber. Heating of the device could release chemicals in the metal chamber that, by themselves or mixed with nicotine liquid, could produce an adverse impact on the user. This could produce a cytotoxic impact on human embryonic stem cells. The possibility of such occurrences has not been studied. There are currently no e-cigarettes that are approved by the FDA and cannot be recommended for cessation use.

The Menthol Effect

Menthol is a spearmint-type flavor added to tobacco products to lessen the irritating effect of smoking. The majority (98%) of tobacco retailers in Lane County sell menthol cigarettes (Lane County Retail Assessment, 2014). Because of its soothing effect and ability to hide the harsh taste of tobacco, menthol makes cigarettes more

appealing to youth; smokers of younger age groups are more likely to smoke menthol cigarettes (Nonnemaker et al, 2013). Adolescents that smoke menthol cigarettes are more likely to progress to established smoking and more likely to exhibit nicotine dependence (Nonnemaker, 2013). One factor contributing to higher dependence is that users may smoke more because it is not as harsh. Menthol cigarettes contain higher concentrations of carbon monoxide, which is associated with higher nicotine absorption; they also "may increase the risk of both lung and bronchial cancer by promoting lung permeability and diffusability of smoke particles" (Campaign for Tobacco Free Kids, 2015). Individuals who smoke menthol cigarettes are also less likely to successfully quit.

Menthol cigarettes are mostly targeted at black communities. An R.J. Reynolds Tobacco Company executive commented "we don't smoke that s**t. We just sell it. We reserve the right to smoke for the young, the poor, the black and stupid." Black communities have a higher density of tobacco retailers with a greater emphasis on menthol cigarettes. Menthol brands, such as Kool, target young black adolescents using magazine advertisements, event sponsorships, and African American Organizations. (Campaign for Tobacco Free Kids, 2015). The combined efforts of the tobacco industry's marketing practices in black neighborhoods and menthol's associated dangers put black youth at a particularly high risk of tobacco experimentation and addiction.

Cessation Barriers

Nicotine develops the dependence primarily, and cessation from it can cause withdrawal, leading users to experience uncomfortable symptoms that may result in relapse. The brain has to adjust to the absence of nicotine, and symptoms to readjustment can last between a couple days to a couple months (smokefree.gov). Such symptoms can include feeling sad, having trouble sleeping, irritability, trouble concentrating, restlessness, slower heart rate, and weight gain or loss (smokefree.gov). The first week is the most vulnerable for people trying to quit and is when most people relapse. Withdrawal is uncomfortable, but not dangerous. Because of the intense changes to acetylcholine receptors and their role in development, it is especially difficult for young people or those who started smoking as an adolescent to quit. Schwartz-Bloom and Gross de Núñez, (1974) explain that the "caudate nucleus, an area of the brain that controls voluntary movement, illustrates [adaption to nicotine]. Without the nicotine, neurons cannot maintain impulses at the levels they had previously. As a result, some smokers experience hand tremors between cigarettes." Menthol cigarettes also decrease success in cessation (Campaign for Tobacco Free Kids, 2015).

Economy

Raising the MLSA of nicotine products may potentially keep money in the local economy. The tobacco industry suggests tobacco creates jobs, however the economic impact of using tobacco is greater (WHO, 2008). The policy would make it easier for retailers who also sell alcohol to have a standard age check and avoid costly fines or having their license to sell tobacco suspended for accidentally furnishing tobacco to a

minor, which results in lost revenue due to not being able to sell tobacco. As the onset of smoking is delayed, less money goes to tobacco and tobacco healthcare costs, which results in more available money to use in the local economy.

The 2014 Lane County Tobacco Retail Assessment found that three out of five tobacco retailers in Lane County offer a price discount on at least one tobacco product, and nine out of ten sold small affordable cigarillos, which can be as cheap as $.59. The lowest recorded price for a pack of cigarettes in Lane County is $4.85 (Lane County Retail Assessment, 2014).

There are 59,200 people in Lane County who regularly smoke (Oregon Health Authority, 2014), which is defined by the CDC (2015) as "an adult who has smoked at least 100 cigarettes in his or her lifetime, and who now smokes every day or some days;" a typical smoker requires about 20mg a day (Ferrence, et al., 2000). Considering the rate of absorption of about 1 mg per cigarette, a typical smoker may smoke up to 20 cigarettes a day, which is a standard pack size in the U.S. Below is the conservative estimated cost of purchasing tobacco in Lane County in one year assuming every person smokes a pack a day:

59,200 (regular smokers) x ($)6.28 (average price of pack of non-menthol cigarettes) x 365 (days a year)

= $104,798,800 (spent on cigarettes a year in Lane County)

The estimated total spent on cigarettes does not include e-cigarettes and other products. Lane County spends $143.5 million on tobacco-related healthcare each year. This does not include the $115 million in productivity losses due to premature tobacco-

related deaths in Lane County (Oregon Health Authority, 2014), not counting productivity losses to tobacco-related illnesses that do not result in death.

($) 115,000,000 (productivity losses) + ($) 143,500,000 (healthcare costs)

= $258,500,000

This equates to approximately $1,775 per household (Census, 2010-2014) in Lane County. This is money that could potentially be used instead to fund education, provide employment, and in other ways to better the community. Over the next four years, the county will have spent over $1 billion dollars compensating for the adverse effects of tobacco and nicotine use. However, because smoking rates among 11th graders and the adolescent population has nearly doubled since 2013, the estimated cost will likely be considerably greater. These estimates are on the conservative end, and do not account for e-cigarettes or non-combustible tobacco products.

Counter-Argument

The primary counter-argument to more restrictive nicotine policy revolves around personal freedom. The argument of age to partake in certain activities or substances is one of entitlement, not of health or safety. Even with accurate health warnings, a legal adult should not be restricted from what they purchase (except in the case of alcohol and most currently, marijuana).

There are many age restrictions that are not parallel with legal adulthood in the U.S. The legal age to drive a car is 16, but restrictions around who can ride in the care still apply. Sixteen is also the legal age for marriage, with parental consent, and 18

without. At age 18 an individual is required to register for the selective service, is able to vote, view pornographic imagery, purchase lottery tickets, and smoke. Older age restrictions apply to alcohol and serving alcohol, and marijuana.

There is and always has been inconsistency with what adulthood in the U.S. entitles to an individual. This reasoning, however, is not a reliable argument against policy given the research. There is a difference between what "America will let citizens do on its behalf and what they can do in their own time;" the Department of Defense spends more than $1.6 billion a year on tobacco related healthcare, highlighting the harmful impact of tobacco on American troops (Higginbotham & Philofsky, 2015).

Another counterargument is that a Tobacco21 policy would hurt businesses. However, only about 2% of tobacco revenue is attributed to 18-20 year olds, so businesses would see a miniscule difference in overall revenue. Additionally, tobacco has a 50% mortality rate, and if customers pass away from a tobacco-related disease, they will no longer be able to purchase anything at any business (Higginbotham & Philofsky, 2015).

The Bigger Picture

While policy to raise nicotine product MLSA is primarily for Lane County, combined with other county's Tobacco21 policies it may push the State of Oregon to pass statewide legislation. While Oregon does have an Indoor Clean Air Act, which prohibits smoking in the workplace, within 10 feet of all entrances, exits, accessibility ramps, windows, and air-intake vents, this law does not apply to Oregon casinos, 25% of hotel rooms, and certified smoke shops (Oregon Health Authority).

Oregon has eight tribal casinos, and secondhand smoke is an occupational hazard for many casino workers. Even with ventilation and non-smoking areas, the very nature of smoke causes harm not just to casino workers, but to other players at the casino who do not smoke. Raising MLSA of nicotine products would likely protect casino workers and non-smoking casino visitors by reducing overall rates of adult smoking in the long-term.

Partners of pregnant women who smoke also contribute to maternal and child health outcomes (Public Health Implications). A partner who smokes is exposing the mother to secondhand smoke and outcomes associated with it, and thus could impact the health of the baby. Lane County has a higher rate of teen pregnancy than Oregon overall, and the highest rate of pregnant women who smoke. By preventing teens access to nicotine products through age restriction, those children born to teen mothers will have fewer negative health outcomes as nicotine use declines.

The negative health outcomes of nicotine use also apply to animals. Particles from the smoke land on the fur on the animal, which is often times licked up and consumed (mostly by cats). These particles also land on carpet, furniture, and other

surfaces a pet may interact with. Pets can experience the same symptoms from secondhand and third-hand smoke as humans (American Veterinary Medical Association, 2015). Pets whose owners smoke are twice as likely to get cancer.

Conclusions and Implications

Research shows that smoking youth are more likely to smoke as adults. Policy increasing the sale age of nicotine products will decrease the rate of smoking in youth by reducing and delaying initiation, which will likely decrease the overall rate of adult smokers over time. Fewer people who smoke results in fewer negative health consequences (including secondhand smoke), fewer healthcare costs for smoking-related illnesses and fewer productivity losses, and more money that could potentially be funneled into the local economy.

Age restriction is necessary. Tobacco21 policy is most effective when part of a comprehensive tobacco prevention program (Tobacco 21, 2016). Three out of four, including seven out of ten people who use nicotine, in the U.S. support Tobacco21 policies (CDC, 2015); support in Lane County is expected to be similar. There is no safe manner in which to use nicotine products, yet they are still widely available and accessible to adolescents.

Tobacco and nicotine use result in exponential negative health outcomes at every stage in life. By raising the MLSA, the number of those who initiate engagement in nicotine products will effectively decrease and lower the frequency of all other nicotine and smoking related outcomes.

RAISING THE MINIMUM LEGAL SALE AGE OF NICOTINE PRODUCTS TO 21

Lane County, OR

TOBACCO PREVENTION

Why It Matters

Every child deserves to live in an environment protected from the pressures and health consequences of tobacco and nicotine addiction. Currently, more than 140 jurisdictions, including the State of Hawaii and State of California, have passed Tobacco21 policies. By raising the MLSA to 21, the pool of young adults of legal age to purchase tobacco products is pushed outside of the average high school social group; the Institute of Medicine estimates the immediate impact of a Tobacco21 policy is a reduction in youth tobacco initiation by 12% with a low financial impact.

LANE COUNTY STATISTICS

From 2013 to 2015, any tobacco use increased from 17% to 29% among 11th graders, and from 11% to 16% among 8th graders in Lane County. Specifically, use of non-cigarette tobacco products, like vape pens, increased drastically; the majority of adolescents used flavored products. By raising the minimum legal sale age (MLSA) of tobacco in Lane County, fewer youth will become addicted and suffer the negative health consequences of use. In addition, it will reduce the $143.5 million spent on tobacco-related healthcare and the $115 million in lost productivity due to early tobacco-related deaths each year in Lane County.

The marketing efforts of the tobacco industry directly target children, with about 66 % of tobacco retailers in Lane County displaying tobacco products or advertising in a manner that appeals to children (Lane County Retail Assessment, 2014). In Oregon, 70% of teens visit a convenience store at least once a week, and 73% of 8th graders and 85% of 11th graders reported seeing a tobacco advertisement on a storefront of in a store in Lane County. The more exposure a youth has to tobacco advertising, the more likely they are to experiment with tobacco (Smoke Free Oregon, 2016). These factors combined make teens especially vulnerable to tobacco initiation. Nicotine also triggers a process in the brain that raises the potential for addiction to other substances. Dependence occurs much faster in teens and young adults, and about 90% of adults who smoke first started using tobacco by age 18 (Center for Disease Control and Prevention, 2015).

WHAT WE CAN DO

Raising the minimum legal sale age of tobacco is part of an effective comprehensive approach to prevent and decrease use. A strong MLSA 21 ordinance would do the following:

Likely lower overall tobacco use rates by reducing and delaying the onset of tobacco use

Reduce youth access and usage in particular

Offer a complement to proven tobacco control measures

Simplify ID checks for retailers

A Tobacco21 policy will prohibit sale of all tobacco products, including inhalant delivery systems and paraphernalia, to minors.

There will be no additional impact on law enforcement. Regular random checks will continue under Oregon State Police and FDA.

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