

# Module 2: Tobacco or Health

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## Tobacco Addiction

### Introduction

Select the play button to hear Dr. Luz Myriam Reynales Shigematsu, Head of the Department of Tobacco Research at the National Institute of Public Health Mexico (INSP), introduce the Tobacco Addiction Lecture.

Why do people keep using tobacco products even when they are harmful? And what exactly is addiction and what makes it so difficult for people to overcome smoking addiction? And what are the effects of smoking on the brain? What is needed for people to be able to quit smoking?

As you go through the exercises in this section, you will learn what addiction is and develop a better understanding of the process. You will learn how tobacco affects the brain and the body, and what happens to the body when someone stops smoking. Finally, you will learn about tobacco withdrawal and about treatment to help people stop using tobacco products.

### Learning Objectives

- Define terms related to addiction and dependence.
- Describe how addiction and tobacco affect the body.
- Describe the process of tobacco withdrawal and addiction.

### Addiction Terminology

To discuss tobacco addiction, you need a good understanding of some important terms. These include addiction, dependence, withdrawal, and tolerance.

**Addition:** Addiction is a long-term problem caused by the ways that someone's brain responds to rewards and the memory of experiences. This causes them to try to obtain a reward—such as nicotine—even though their actions cause them harm.

**Dependence:** Dependence on a substance means that someone cannot stop using that substance even though they may want to and the substance is harming them. If someone finds that they cannot stop using a substance that is harming them, and that they have symptoms when they try to stop, then they have become dependent.

**Withdrawal:** Withdrawal describes what happens when someone does not use a substance that they are dependent on. It can involve physical and psychological symptoms, such as cravings and irritability.

**Tolerance:** Tolerance means the way that someone adjusts to a substance, meaning that they need higher doses to get the same effect that they used to get from a smaller dose.

### **Addictiveness of Tobacco**

The tobacco industry has increased the addictiveness of tobacco products to encourage their use.

The design and contents of tobacco products make them more attractive and addictive than ever before. Cigarettes today deliver nicotine more quickly from the lungs to the heart and brain. While nicotine is the key chemical compound that causes and sustains the powerful addicting effects of cigarettes, other ingredients and design features make them even more attractive and more addictive.”

US Surgeon General’s Report 2010

### **Nicotine**

Dr. Reynales Shigematsu discusses the modifications of nicotine delivery.

As we have seen in Module 1, manufacturers have marketed cigarettes as having reduced inhaled chemicals after making modifications like adding ventilation to cigarette filters. However, people may compensate by changing the way that they smoke and some think that this design is defective and misleading. Cigarettes marketed as low tar and light cigarettes seem safer to consumers, even though they still pose serious health risks.

In addition to ventilation, there are other ways that manufacturers have changed cigarettes. Menthol has been marketed as being less irritating and safer, even though there is no evidence that it reduces risk. Flavorings are also added and their risks are not well understood. Ammonia was added to allow nicotine to reach the central nervous system faster.

Instead of being safer, cigarettes are still risky and many new modifications, such as flavorings, have unknown health effects. Changes in tobacco blends have increased their risk of causing cancer and people have responded to changes like ventilation by changing their smoking patterns to compensate.

The Surgeon General's 2010 report noted, "The evidence is that changing cigarette designs over the last five decades, including filtered, low tar, and "light" variations have NOT reduced overall disease risk among smokers and may have hindered prevention and cessation efforts. The overall health of the public could be harmed if the introduction of novel tobacco products encourages tobacco use among people who would otherwise be unlikely to use a tobacco product or delays cessation among persons who would otherwise quit using tobacco altogether."



### Blood Nicotine Concentration

Dr. Reynales Shigematsu discusses blood nicotine concentration.

Nicotine in the blood causes physiological effects, although it can be difficult to study the complex interactions of the chemicals involved. Addictiveness can be increased by changing smoking patterns (for example, by making smokers inhale more deeply and often) and by expanding the respiratory passages to increase airflow. One hypothesis suggests that the relatively large amount of nicotine

absorbed as one dose, a bolus, leads to a rapid increase in nicotine in the brain that increases the ability of nicotine to cause dependence.

One way that manufacturers have increased the addictiveness of tobacco products is by using ingredients that allow nicotine to have a faster and greater effect.

Additives such as menthol eucalyptol and theobromine appear to increase uptake of nicotine by expanding respiratory passages. Menthol slows down metabolism of nicotine, as do lactones and some flavorings (e.g., benzaldehyde). This can increase the effect of nicotine on the user. The speed at which a drug gets to the brain affects its addictiveness: smoking a chemical or drug is more addictive than other methods of using drugs, such as chewing gum and transdermal patches.

### **Nicotine Addiction: Factors**

Nicotine addiction is caused by many factors. Learn about some factors that lead to this addiction.

- People associate positive experiences with nicotine use, which encourages them to keep using; these positive experiences may include increased attention, reduced anxiety, and improved mood.
- People experience withdrawal symptoms when they try to stop using, causing them to give up and continue to use.
- People learn the behaviors of nicotine use and make those behaviors part of their lifestyle.
- People need more and more nicotine to get the same response (tolerance).

### **Nicotine Addiction: Tolerance**

Dr. Reynales Shigematsu discusses tolerance.

Tolerance, meaning that someone adjusts to a chemical, develops with chronic use but it isn't clear whether the development of tolerance makes someone more strongly dependent on nicotine.

When people first start smoking, it's often aversive in certain ways. They may not

even like it. As they continue to smoke and become more tolerant, there are fewer obvious negative effects (like coughing). It is possible that tolerance is most important during this time, as it gets easier for people to smoke more.

### **Nicotine Addiction: Withdrawal**

Dr. Reynales Shigematsu discusses withdrawal.

Withdrawal is all of the symptoms and emotions that someone experiences when they don't get the substance to which they are addicted.

So what happens when a smoker doesn't get a cigarette? When someone cannot smoke, they begin to feel distress within hours. They may feel psychological effects such as stress and worry. They may have behavioral changes as they try to work out how to cope. They may have medical symptoms from the physical effects of not getting nicotine.

These include cognitive effects, weight gain, coughing, nausea, sweating, sore throat, and headaches. They may become irritable, angry, anxious, or depressed as they go longer without nicotine. The more dependent someone is on nicotine, the worse these effects are.

### **Nicotine Withdrawal and Cessation**

Dr. Reynales Shigematsu discusses nicotine withdrawal and cessation.

When someone stops using nicotine, the effects of withdrawal begin within hours and usually are their worst within a week. This is a difficult time, so people have the highest risk of relapse as they try to get through it.

Other factors, such as other medical conditions, can make the process even more difficult. For example, someone with depression may feel hopeless and discouraged. This may make it easier for them to give up on stopping nicotine use. People differ in a variety of ways beyond medical conditions and some people simply find it more difficult than others. Additionally, women find it more difficult to stop at some times of the menstrual cycle, such as the luteal phase after ovulation, than at others (like at the follicular phase before ovulation).

Although the severity of withdrawal is similar in women and men, women have more difficulty stopping completely. We also know that the severity of symptoms is worse in people who previously smoked the most frequently. Other factors, especially those that affect how reinforcing smoking is, may affect the severity of withdrawal symptoms in different people. For example, smoking is more reinforcing in those who are not obese and in those with a history of alcohol dependence. Non-nicotine factors such as associations with certain situations, like driving, also play a role.

Although the risk of relapse is greatest soon after stopping, there is still a risk of relapse even after withdrawal is complete. This is especially true during the first year after stopping.

### Quiz

Which of these terms is NOT a factor of nicotine addiction?

- tolerance
- clairvoyance
- withdrawal
- learned behaviors

### Answer

#### Factors That May Be Helpful in Treating Withdrawal

Dr. Reynales Shigematsu discusses some factors that might be helpful in treating withdrawal.

There are a variety of medical approaches that can make withdrawal easier for some people, including nicotine replacement therapy and medications such as bupropion. Psychotherapy and other motivational techniques can be very helpful. People can understand more about what triggers them to smoke and how to avoid these triggers. There are many resources available to help people quit. You will learn more about cessation efforts in Module 5.

## Summary

Dr. Reynales Shigematsu summarizes the Tobacco Addiction Lecture.

Tobacco use has effects on physiology and psychology that affects addiction, tolerance, dependence, and withdrawal. These consequences result in serious health effects from tobacco products.

## How Tobacco Affects Health

### Introduction

Dr. Elif Dagli, Pediatric Pulmonologist, Lecturer at Marmara University, Acibadem University, East Mediterranean University, and Chair of the Health Institute Association (Istanbul, Turkey), introduces the How Tobacco Affects Health Lecture.

Many of the chemicals in tobacco products and the smoke they create can cause cancer. Many of these chemicals also cause heart disease, lung disease, and other health problems.

In this section, you will learn about some of these chemicals and how they affect health.

### Learning Objectives

- identify the components of tobacco smoke.
- Describe the health effects of tobacco use.

### What Chemicals Are Found in Tobacco and in Tobacco Smoke?

A cigarette is bent in almost a circle. A skull and crossbones sits in the middle of the bent cigarette. Names of chemicals are arrayed around the outside of the cigarette. The user can select each chemical name to learn more about what's found in tobacco and in tobacco smoke.

The chemicals include:

- Nicotine: Can be highly addictive depending on how it is absorbed into the body. Nicotine can be toxic/deadly in high concentrations.
- Ammonia: A poisonous gas; it is also used in household cleaners.
- Arsenic: A toxic chemical; it is also found in pesticides.
- Benzene: Causes cancer; it can be found in gasoline.
- Benzo(a)pyrene: Causes cancer; it is found in coal tar and automobile exhaust.
- Cadmium: A toxic metal; it is used to make batteries.
- Carbon monoxide: A colorless, odorless and tasteless poisonous gas; it is also found in automobile exhaust smoke.
- Ethylene oxide: A toxic chemical; it is also found in antifreeze.
- Formaldehyde: Causes cancer; it is used to embalm bodies.
- Hydrogen cyanide: A poisonous gas; it can be found in chemical weapons.
- Lead: A toxic metal; it was once found in paint and gasoline.
- Radioactive elements: Cause cancer and are toxic; examples include polonium 210 and uranium.
- Vinyl chloride: A toxic chemical; also used to make plastics.

### Health Effects and Your Body

Dr. Dagli discusses secondhand smoke.

In Module 1, you learned about secondhand smoke. The chemicals released by burning tobacco affect smokers and everyone around them. Non-smokers are exposed to the same toxic chemicals as the smoker and face many of the same risks to their health. There is no safe level of secondhand smoke.

Opening windows or using air filters does not decrease the risk of secondhand smoke. One hundred percent smoke-free areas are the best way to prevent exposing others to these toxins. Children and the elderly are especially vulnerable to secondhand smoke.

## Health Effects

Dr. Dagli describes how tobacco affects health.

Over 7 million people worldwide die each year due to smoking. Smoking harms almost every organ of the body. Tobacco use is recognized as the one risk factor common to four main groups of noncommunicable diseases: cancers, cardiovascular disease, chronic lung disease, and diabetes.

The image of a body is shown in outline. A header reads: Tobacco use\* causes cancer throughout the body. Twelve parts of the human body are called out with the cancerous effects of tobacco use on those body parts listed.

- Mouth and throat: oral cavity and pharynx
- Voice box: larynx
- Acute myeloid leukemia
- Kidney and renal pelvis
- Uterine cervix
- Urinary bladder
- Esophagus
- Lungs, bronchus and trachea
- Liver
- Stomach
- Pancreas
- Colon and rectum

\*Tobacco use includes smoked (cigarettes and cigars) and smokeless (snuff and chewing tobacco) tobacco products that, to date, have been shown to cause cancer.

#VitalSigns

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[www.cdc.gov/vitalsigns/cancerandtobacco](http://www.cdc.gov/vitalsigns/cancerandtobacco)

Department of Health and Human Services USA

## Smoking and Noncommunicable Diseases (NCDs)

Dr. Dagi discusses smoking and noncommunicable diseases (NCDs).

Noncommunicable diseases (NCDs) account for 70% of all deaths worldwide. These are diseases that are not spread from one person to another, and include cardiovascular disease, cancer, chronic lung diseases, and diabetes.

Smoking increases a person's risk for all four of these diseases. Globally, more than 25% of adults are smokers; and many more are affected by secondhand smoke.

### Health Effects: Cancer

Dr. Dagi discusses smoking and cancer.

Lung cancer was first linked to smoking in the 1950s. Over 85% of lung cancer cases are due to smoking. But, smoking also increases the risk of many additional cancers including liver, colon, esophageal, throat, stomach, pancreatic, bladder, kidney, and cervical cancer. The three most common cancers caused by smoking in women are lung, colorectal, and pancreas. The three most common cancers caused by smoking in men are lung, colorectal, and bladder. The US CDC estimates that 30% of all cancer deaths are caused by smoking in the United States.

Cigarettes, cigars, tobacco pipes, and hookahs using tobacco all contain the same cancer-causing ingredients. Smokeless tobacco contains about the same amount of nicotine and many of the cancer causing chemicals. Smokeless tobacco causes cancers of the mouth, tongue, cheek, and gum.

### Health Effects: Lungs

Dr. Dagi discusses the effects of smoking on the lungs.

Inhaling smoke damages cells in your airways and lungs and increases the risk of lung cancer as well as the risk of lung infections and lung diseases. This includes exposure to secondhand smoke. Smokers are 38 times more likely to develop chronic obstructive pulmonary disease (COPD) than nonsmokers. COPD includes

emphysema and chronic bronchitis. The damaged tissues in lungs with COPD are not able to absorb enough oxygen for the body's needs.

Early COPD symptoms include coughing and shortness of breath. Later COPD symptoms include trouble breathing, a fast heartbeat, asthma, and mental decline.

### **Health Effects: Heart, Blood Vessels, and the Brain**

Dr. Dagli discusses the effects of smoking on the heart, blood vessels, and the brain.

Smoking causes one-third of all the deaths from diseases that affect the heart and blood vessels, also known as cardiovascular diseases (CVD). Smoking damages blood vessels and causes the buildup of plaque that blocks the flow of blood. The narrowing of blood vessels increases blood pressure.

Smoking causes the heart to beat faster, which also increases blood pressure. If a blood clot affects blood flow to the heart, it can lead to a heart attack.

Smoking also has health effects for the brain. If a blood clot affects blood flow to the brain, it can lead to stroke. This causes brain damage and may lead to death.

Smokers are four times more likely to have a stroke compared to nonsmokers.

### **Health Effects: Other Conditions**

Dr. Dagli discusses the effects of smoking on other conditions.

Smoking affects many other body systems, including the reproductive system. Smoking is linked to reduced fertility in both men and women. Smoking can also lead to complications during pregnancy including ectopic pregnancies, low birth weight, premature birth, and birth defects. Babies born to women who smoke are more likely to have lung and brain damage, cleft lips, and SIDS (sudden infant death syndrome).

Buerger's disease is a disease that is found almost entirely in smokers. This disease causes blood clots to form that can lead to death and decay of body tissues. This results in painful sores on the hands and feet. In some cases, the damaged tissue must be amputated. Smoking also increases eye diseases.

Learn more about smoking-related eye disease.

- Age-related macular degeneration: damaged tissue in the eye makes it more difficult to read and see fine detail
- Glaucoma: degeneration of the nerve in your eye
- Cataract: clouding of the eye lens
- Atherosclerotic peripheral vascular disease (PVD): the buildup of plaque that affects other organs (such as kidneys or the stomach) or the arms and legs; loss of oxygen in any of these areas has serious consequences

### Oral Health and Smoking

Dr. Dagli discusses oral health and smoking.

Smoking has many negative effects on oral health. Some of the more noticeable are persistent bad breath and discolored teeth. But smoking has many more serious effects such as oral cancer, mouth sores, and gum (periodontal) disease. Gum disease is an infection of the gums that can cause your gums to pull away from your teeth and can weaken the bones in the jaw. This can lead to shifting teeth and tooth loss.

### Quiz

Which of the following has NOT made cigarettes more harmful now than 50 years ago?

- changes in tobacco blends
- use of ventilation
- use of ammonia
- average time to smoke a cigarette

### Answer

Average time to smoke a cigarette: Changes in tobacco blends have increased their risk of causing cancer and people have responded to ventilation by changing the way they smoke to compensate. In addition to ventilation, there are other ways that

manufacturers have changed cigarettes: ammonia was added to allow nicotine to reach the central nervous system faster.

### About the Dangers of Tobacco Smoke

The words tobacco smoke sit in the center of an infographic. A ring divided into colored sections encircles these words. A cigarette encircles this ring. Various dangers branch off of the colored sections. Some dangers branch off of other dangers. The following list of dangers will be grouped in the way they are grouped on the infographic.

- Radioactive elements: the image of a diagram of an atom is shown. The term radioactive diseases branches off the atom. An icon of a person with various radioactive ailments is shown.
- The carcinogenic resins: the image of a caution emblem and of tar spilling from a container is shown. The term damage dental enamel branches off the tar. The image of damaged teeth is shown. The term inflammation of the mucous membranes of the mouth branches off the tar. The image of a mouth is shown.
- Carbon monoxide: the image of a gas mask is shown. The term respiratory failure branches off the gas mask. The image of damaged lungs is shown. The term illness of heart branches off the gas mask. The image of a damaged heart is shown.
- Nicotine: the image of a droplet of nicotine is shown. The term lung cancer, problems with blood vessels branches off the nicotine droplet. The image of the human circulatory system is shown as well as an image of lungs. The term gastric damage and intestine branches off the nicotine droplet. The image of a stomach and intestine is shown. The term illness of heart also branches off the nicotine droplet.
- Styrene: the image of a laboratory beaker with liquid in it is shown. The term deterioration of the sensitivity bodies of touch branches off the beaker. The image of a hand with damaged fingertips is shown. The term impaired

hearing branches off the beaker. The image of an ear with confused punctuation, or sound, is shown. The term vision impairment branches off the beaker. The image of an eye is shown.

- Arsenic: the image of a skull and crossbones is shown. The term poisoning of the whole organism branches off the skull and crossbones. An icon of a person is filled with poisoned liquid.
- Hydrocyanic acid: the image of a molecule with HCN (hydrocyanic acid's formula) is shown. The term poisoning of the whole organism also branches off the HCN molecule.
- Nervous and cardiac problems: the image of a hazardous materials icon is shown. The term heart disease and blood branches off the hazardous materials icon. The image of a damaged heart and of a drop of blood are shown. The term nervously mental illness branches off the hazardous materials icon. The image of a person's nervous system and of a brain are shown.

## Summary

Dr. Dagli summarizes the How Tobacco Affects Health Lecture.

Tobacco use causes many diseases including cancer, lung disease, heart disease, and other diseases, and affects most organs of the body. Avoiding tobacco use can reduce the likelihood of developing certain diseases and conditions. One of the most effective ways to prevent smoking is through policy interventions, which we will explore in greater detail in Module 5.

# Environmental Impact of Tobacco Products

## Introduction

Dr. Donald Makoka, Research Fellow at the Center for Agricultural Research and Development at the Lilongwe University of Agriculture and Natural Resources (LUANAR) in Malawi, introduces the Environmental Impact of Tobacco Use Lecture.

Tobacco products have health effects on individuals who use them, but they have other effects as well. How do you think they affect the people who cultivate tobacco plants? What effects does this have on the environment?

In this module, we will focus on tobacco cultivation and tobacco product manufacturing, and their impact on health and the environment.

## Learning Objectives

- Describe the effects of tobacco plant cultivation on the environment.
- Explain how farmers who grow tobacco are affected by their work.
- Explain the effects of tobacco product manufacturing on the environment.

## Tobacco Cultivation: Products

Dr. Makoka discusses the cultivation of tobacco products.

The cultivation of tobacco products causes a variety of problems. It uses water and land that could otherwise be used for other purposes. When land is cleared for tobacco planting, trees must be cut down (causing deforestation). Deforestation also occurs because trees are needed to provide the wood products needed to cure tobacco leaves.

There is evidence of biodiversity loss (meaning loss of species diversity) from tobacco-related habitat damage in Bangladesh, Argentina, Brazil, Thailand, Honduras, and other countries. The contracting of tobacco cultivation to workers in the Pacific Islands is worsening the effects there in recent years as well.

During the production process, sediments can get into water supplies and harm water quality. Also, the loss of topsoil can result in desertification. Even when the topsoil remains, nutrients can be leached out of the ground, making it less fertile.

### Cultivation and Chemicals

Dr. Makoka discusses the cultivation and chemicals associated with tobacco.

Tobacco plant cultivation involves the use of relatively large amounts of chemicals. Many crops are rotated, but tobacco plants usually are not, contributing to disease and pests. The increased risk of plant loss means that chemicals such as pesticides, fungicides, herbicides, and growth regulators are used in relatively large quantities.

Farmers in low- and middle-income countries use toxic pesticides banned in high-income countries often without appropriate safety measures. These chemicals find their way into water—sometimes including water used for drinking.

In countries where tobacco production does follow plant rotation, such as Malawi and other parts of southern Africa, instances of disease and pests are mitigated, but it does not decrease the use of fungicides, herbicides, and growth regulators.

Learn more about each pesticide and its chemical use.

- Adicarb: an extremely toxic pesticide that is harmful to many species
- Chlorpyrifos: an insecticide that is harmful to the nervous system and found over long geographic distances around the area where it is used
- 1,3-D (1,3-dichloropropene): a soil fumigant that can cause respiratory and other problems and that contaminates water
- DDT: an insecticide and one, among other, pollutants banned in the United States that remain in the environment long after tobacco cultivation

### Farmers' Health

Dr. Makoka discusses farmers' health.

Farmers who work with tobacco face exposure to toxic chemicals and often lack information about how to protect themselves from harm. Mixing and spraying toxic

chemicals often results in exposure through breathing and skin absorption even if they do not directly handle the chemicals themselves. Evidence indicates this exposure may cause both neurological and psychiatric harm. One study found symptoms of pesticide poisoning in 26% of tobacco workers in Kenya.

### **Farmers' Health: Green Tobacco Sickness (GTS)**

Dr. Makoka discusses farmers' health and green tobacco sickness (GTS).

Farmers who work with tobacco plants are at risk for Green Tobacco Sickness or GTS, symptoms that are caused by exposure to nicotine directly through the skin. Even when protective equipment is available, it may not be used sufficiently due to heat and other factors. For example, impermeable gloves can interfere with work and are hot.

Learn more about how to work safely with tobacco plants.

For example, farmers who are working with wet plants or consuming alcohol are at increased risk of having extended exposure to nicotine on their skin. Alcohol is thought to increase blood flow near the skin, allowing nicotine access to the bloodstream. Handwashing can be helpful.

The CDC recommends the careful use of protective equipment such as gloves, water-resistant clothing, and long-sleeved clothing. Workers should also be aware of symptoms and of the risk of heat illness, which increases with GTS.

### **Case Study: The Philippines**

#### **The situation**

Because of considerable concern about the global health burden of cigarette smoking, the World Health Organization Framework Convention on Tobacco Control (WHO FCTC) entered into force in 2005. Within this framework, Article 17 addressed the need to help tobacco farmers with “economically viable alternative activities.” Article 18 addressed the need to address human health risks associated with tobacco farming.

In the Philippines, which ratified the WHO FCTC, tobacco farming has been an important way of life for many people. To fulfill the obligations of Article 17 of the WHO FCTC, the Philippines must help these tobacco farmers find other ways to support themselves.

### **The response**

The Philippines has made several changes to try to address concerns related to tobacco. A law passed in 2012 designated that some of the revenues from tobacco excise taxes should be used for projects that can help farmers move away from tobacco farming.

An important first step in designing ways to address a public health issue was to fully understand the current situation. A 2016 report by the American Cancer Society and Action for Economic Reforms presented the results from a detailed survey of farmers in the Philippines to help in the development of new approaches for economically viable alternative activities.

Based on the planting season from 2013–2014, the survey found that tobacco farmers had generally been farming tobacco continuously for about 18 years, and farmed with the participation of multiple family members. Although farmers often had some additional income from other crops, 85% of households reported that tobacco farming provided most of their income. Some worked independently and some worked through contracts with tobacco companies.

Farmers appeared to be willing to consider farming different crops, such as corn, legumes, and various other vegetables, but obstacles were in their way. One important finding of the report was that access to credit was important in determining what opportunities farmers could access. Farmers may also be more willing to switch if there are improved markets for other crops. Farmers reported that they farmed tobacco after inheriting the farm from their parents, because they felt they could not grow other crops on their land, because of the market for tobacco, and because of influence by tobacco producers. Knowing these realities can help in finding ways to help farmers change.

## **The result**

The survey found that several factors were relevant to farmers' willingness to switch to other crops. For example, farmers in different regions may be more or less likely to switch than those in other regions. For example, there are differences in type of tobacco grown in lowland versus upland regions and the upland farmers may be less likely to switch due to being able to charge more for their product. Farmers with more experience appear to be more willing to consider switching, as were those with additional technical education who may perhaps have additional employment opportunities. However, farmers who thought they were doing relatively well and those cultivating larger amounts of tobacco were less willing to switch. Additionally, many people have been farming tobacco for a long time, and tradition can make it harder for them to switch.

By understanding the incentives and constraints encountered by farmers, it will be possible to help them find alternate, healthier ways of making a living.

## **Tobacco Product Manufacturing**

Data on how manufacturing tobacco products impacts the environment are limited, with much of this information coming from tobacco companies themselves with no independent verification.

Tobacco product manufacturing produces toxic emissions such as carbon dioxide, which is linked to climate change. The process also produces pollution from the transport of materials and from wastes that are produced both during production and from consumer use of tobacco products. In particular, the manufacture of the paper parts of tobacco products and the packaging in which they are sold produce wastes. The transport of tobacco products also requires energy.

## **Tobacco Chemicals and Water Supply**

A farm with fields of tobacco plants is shown sitting beneath a mountain. Tributaries from the fields lead to a river. The river leads to a lake with groundwater shown in a

cutout. There are four labels a user can select to learn more about tobacco's impact on a water supply.

**Clouds and Rain:** As rain and frequent watering of the tobacco plants occurs, pesticides drain off the plants in runoff water. It is estimated that tobacco requires an average of 1 inch per week of water for good growth.

**Tobacco Crops:** Large and frequent applications of pesticides are required to protect tobacco plants from insects and disease. Among the pesticides that are commonly used on tobacco are the highly toxic aldicarb and chlorpyrifos. Methyl bromide, an ozone-depleting chemical slated for worldwide elimination, is often used to fumigate the soil prior to planting tobacco seedlings.

**Lakes and Tributaries:** The contaminated runoff from the tobacco plants not only pollutes the farm soil, it enters waterway tributaries.

**Groundwater:** As the contaminated water moves from tributaries to rivers and lakes, not only are animals in the environment affected, the toxins seep into the groundwater that supports food crops and drinking water.

## Butt Disposal

Dr. Makoka discusses cigarette butt disposal.

The number of cigarette butts generated each year around the world is in the trillions. The butts have been designated as toxic waste. This means that the large number of butts left for disposal pose a threat to a healthy environment. Some states have begun to push for special disposal laws, but it seems like a daunting task when many butts are simply dropped to the ground, thrown in the trash, or dumped in landfills where they act as pollution.

Cigarette butts normally consist of a portion of unsmoked tobacco, a filter, and the filter wrapper. The toxic substances that remain in the tobacco and filter can make their way to water sources, either through landfill ground contamination, or drain systems in cities that pick up the discarded butts on the streets. This pollution can impact aquatic life and animals that might ingest the butts.

## Tobacco and the Environment

A woman stands facing the screen. An image of a forest is behind her.

Woman: We all know the tobacco industry causes harm to people's health, but most people don't know the harm the tobacco industry has on our planet.

Image behind the woman changes to show dozens of cigarette butts.

Woman: The first thing you might think about is butt litter. Every year 4.5 trillion cigarette butts are littered worldwide.

Text on screen reads: 4.5 trillion

Woman: Cigarette butts are made of plastic and never completely decompose.

Text on screen reads: Plastic doesn't decompose.

Woman: These cigarette butts litter our sidewalks, parks, and beaches. They can make their way into our waterways, which can leech harmful chemicals and can poison animals, birds, fish, and even children.

The image behind the woman shows cigarette butts on sidewalks; then cigarette butts are shown flowing into a drainage grate. Then an image of a dog, a bird, fish, and children are shown.

Woman: Tobacco growing causes deforestation, especially in developing countries.

Image behind the woman shows a forest with many cut down trees.

Woman: Each year 494,00 acres of forest are destroyed around the world just to make cigarettes.

Text on screen reads: 494,000 acres destroyed

Woman: That's four times the city of Toronto.

An image of four Toronto skylines appears behind the woman.

Woman: Forests are being cut down to make room for more tobacco fields and to fuel the fires that dry the tobacco.

An image of a tobacco field appears behind the woman; then the image of dried tobacco leaves appears.

Woman: This doesn't even include all the paper that's being used on cigarettes and the packaging. Each year six trillion cigarettes are made. Now that's a lot of paper.

Text on screen reads: six trillion cigarettes

An image of a huge stack of paper appears behind the woman.

Woman: Cigarette production also contributes to climate change; the cigarette smoke itself contains greenhouse-effect causing gases.

An image of the globe appears with squiggly heat lines radiating off the surface. Then icons of dozens of men and women appear on screen. Gradually the icons of men and women fade.

Woman: The tobacco industry is making a product that kills half of its long-term users and harms the environment—this doesn't seem right.

The forest image appears again behind her.

Woman: Do you want to know why I'm tobacco free? Because I care about the environment.

Text on screen reads: I'm tobacco-free because I care about the environment.

Created by Concerned Youth from Public Health Units across Southwestern Ontario.

## Summary

Dr. Makoka summarizes the Environmental Impact of Tobacco Use Lecture.

In addition to these known issues related to tobacco farming and tobacco product manufacture, new problems related to tobacco production are being identified. We will discuss some of these emerging issues in the next lecture.

## Emerging Issues

### Introduction

Dr. Suchitra Krishnan-Sarin, Professor of Psychiatry, Division of Substance Abuse, Yale Tobacco Center for Regulatory Science, introduces the Emerging Issues Lecture.

Think about the different health effects that are caused by tobacco. Think about what the chemicals in tobacco might do to prenatal development. What about development during adolescence? How does tobacco impact different age groups? Are different types of tobacco products really different? Do some have less of an impact on health?

In this section, you will learn about tobacco products' impact on human development in different sub-populations, and differences in the nicotine delivery by product type.

### Learning Objectives

- Describe how nicotine affects prenatal, infant, and adolescent brain development.
- Understand the difference between combustible and non-combustible tobacco products.
- Discuss flavor capsules and trends in cigar popularity.

### Nicotine and Brain Development: Prenatal Development

Dr. Krishnan-Sarin discusses prenatal nicotine and brain development.

Research indicates that tobacco has an effect on brain development during different periods in life. Pregnant women who smoke affect their baby's prenatal development.

Learn more about what tobacco use can do to brain development.

- **Decrease the total number of cells in the brain** - the chemicals in tobacco can impact the plasticity of infant brain cells, reducing their development and network expansion.

- **Reduce or delay the onset of puberty in males** - nicotine can impact the endocrine system, potentially inhibiting testosterone production during adolescence.
- **Be a factor in attention-deficit/hyperactivity disorder (ADHD) and other cognitive issues** - smoking during pregnancy has been implicated in neurobehavioral deficits induced by nicotine.

### Nicotine and Brain Development: Infancy Development

Dr. Krishnan-Sarin discusses nicotine and brain development during infancy.

During infancy, there is brain growth and brain plasticity, which is responsible for increasing the number of signals the brain gets from the rest of the body. Exposure to nicotine in tobacco products in infancy can change the brain's neural networks and diminish the brain's plasticity. This may cause problems later for a child's capacity to process information.

### Nicotine and Brain Development: Adolescent Development

Dr. Krishnan-Sarin discusses nicotine and brain development during adolescence.

During adolescence, the part of the brain that is responsible for decision-making is still developing. Research indicates that the developing brain of a teenager is affected by smoking, especially the areas related to their decision-making processes and decisions about smoking.

Nicotine is highly addictive and can quickly impact the "reward" center of the brain, motivating the adolescent to continue smoking and use of other nicotine-containing products. Research indicates that the earlier an adolescent begins smoking, the harder it is to quit.

### E-cigarettes

Dr. Krishnan-Sarin discusses e-cigarettes.

E-cigarettes are known by many different names, including vape pens, e-hookahs, mods, electronic nicotine delivery system (ENDS), etc. They are battery-powered

devices that can deliver aerosol containing nicotine and other chemicals. The use of e-cigarettes is often called "vaping." More recently, there has been tremendous market growth in more discrete, pod-like devices. An example of this is the JUUL device, which has led to frequent use of the term "JUULing" to refer to these behaviors.

Essentially, e-cigarettes are comprised of a heating element, a battery, and e-liquid (which contains flavoring agent(s), a solvent, and often nicotine).

Although e-cigarettes produce fewer toxic chemicals than smoke from regular cigarettes, we know very little about their safety. E-cigarette aerosol can contain harmful and potentially harmful substances such as nicotine, heavy metals, volatile organic compounds, and cancer-causing agents. Bystanders can inhale this aerosol when e-cigarette users exhale. Because e-cigarettes are constantly evolving, we have limited current understanding of what levels of these substances are released from each of the different types of e-cigarettes.

Learn more about the different characteristics of e-cigarettes.

- Cigalikes: Cigalikes/disposable e-cigarettes/single use e-cigarettes look like traditional cigarettes.
- Mid-size e-cigarettes: Mid-size e-cigarettes offer longer battery life, larger e-liquid capacity, stronger vapor production, as well as increased user control.
- Mods: Mods, or tank systems, offer greater user control (for example, of the level of voltage and resistance), greater vapor production, extended battery life, and full customization.
- E-cigarettes with digital displays: E-cigarettes with digital displays may contain information on/or record parameters such as battery life, pattern/frequency of use, and safety warnings.
- Pod devices: Pod devices accept pods—small refillable e-liquid containers—that are made especially for the device; most pods come pre-filled with a flavor; pod devices are often smaller in size than other types of e-cigarettes and easier to conceal; pod devices include the JUUL device.





## Quiz

The use of e-cigarettes is often called what?

- mellowing
- lunging
- breading
- vaping

## Answer

Vaping: E-cigarettes are known by many different names, including vape pens, e-hookahs, mods, electronic nicotine delivery system (ENDS), etc. They are battery-

powered devices that can deliver aerosol containing nicotine and other chemicals. The use of e-cigarettes is often called "vaping." However, the aerosol produced by e-cigarette use is not water vapor, and thus some public health professionals prefer not to use this term when referring to their use.

### E-cigarette Flavors

Dr. Krishnan-Sarin discusses e-cigarette flavors.

Flavored tobacco products are particularly attractive to consumers. Many e-liquids come in flavors that are attractive to youth, including cotton candy, fruit, peanut butter cup, cookies n' cream, pop rocks, and gummy bear flavors, to name a few. There are over 15,500 unique e-cigarette flavors available online. Moreover, the mod and tank systems give consumers the ability to mix and customize flavors. Data show that flavors may play a role in initiation and uptake of e-cigarettes.

It is also important to note that e-cigarette aerosol is not harmless water vapor, as is often claimed by the industry marketing. It contains chemicals and toxins such as formaldehyde, acrolein, volatile organic compounds (e.g., toluene), tobacco-specific nitrosamines, and metals (e.g., like nickel and lead). However, the levels of these chemicals in e-cigarette aerosol are far lower than those in cigarette smoke.

The risk of inhaling many e-cigarette flavorings is unknown. Even though flavors are labeled "safe" for ingestion, their safety has not been assessed for inhalation. In fact, the 2016 US Surgeon General report states that some of the flavorings in e-cigarettes have been shown to cause serious lung disease when inhaled. For example, diacetyl, a chemical found in e-cigarette aerosol, is known to cause "popcorn lung"—a condition that involves thickening and narrowing of the airways, resulting in coughing, wheezing, and shortness of breath.

### JUUL

Dr. Krishnan-Sarin discusses JUUL e-cigarettes.

JUUL e-cigarettes became very popular among adolescents in the US in 2016. By April 2018 JUUL had nearly half of the US e-cigarette market share, and exceeded

the top market share (46.2%) of Philip Morris USA's Marlboro brand for traditional cigarettes. JUUL e-cigarettes are flat and rectangular, and look like USB drives. They use changeable cartridges filled with nicotine liquid.

JUUL comes in flavors such as mint, mango, and crème brûlée—which are proven to appeal to young people and encourage initiation of use. In addition, JUUL uses a technology (combining nicotine salts and benzoic acids) that allows higher concentrations of nicotine to be inhaled at lower temperatures, thus increasing the addictive potential of these e-cigarettes.

Moreover, numerous online retailers and resellers who do not have age-verification systems market JUUL. These developments are particularly worrisome as the popularity of JUUL and similar pod-like e-cigarettes among adolescents in the U.S. continues to soar.



### Heated Tobacco Products (HTP)

Dr. Krishnan-Sarin discuss heated tobacco products (HTPs).

Heated tobacco products (HTPs) are battery-powered electronic devices that claim to heat leaf tobacco, instead of burning tobacco like traditional cigarettes.

Manufacturers of these products claim that they deliver an inhalable aerosol that contains high concentrations of nicotine like regular cigarettes—and that because

they are not combusted at higher temperatures, they may contain lower levels of toxic compounds.

However, it is important to note that many of the cancer-causing and toxic compounds in cigarette smoke are found in HTP aerosol, albeit in lower concentrations. Further, incomplete combustion (pyrolysis) may be taking place, given the emission of substances like acetaldehyde, an irritant carcinogenic volatile organic compound, benzo[a]pyrene, a cancer-causing polycyclic aromatic hydrocarbon, and carbon monoxide. Currently, these heated tobacco products are only available in some markets.

Some examples of HTPs in the global market include Ploom TECH (Japan Tobacco International), Glo (British American Tobacco), PAX (PAX Labs), and IQOS (Philip Morris International). In 2019, IQOS entered the U.S. market.

## **IQOS**

Dr. Krishnan-Sarin discusses IQOS.

IQOS is a Philip Morris International product that began to be introduced into some markets in 2014. This product heats tobacco with battery-powered electricity. It consists of the IQOS holder, a charger, and the tobacco sticks (which are also called HeatSticks or HEETS).

## **Flavored Capsules**

Dr. Krishnan-Sarin discusses flavor capsules.

The ability to embed small, liquid-filled flavor capsules in the filter of cigarettes increases the appeal to younger audiences, in addition to older smokers. Tobacco industry documents suggest that youth are the industry's target for flavor capsule cigarettes.

Flavor capsules are crushable beads that give bursts of flavors when squeezed. They provide the smoker with the opportunity to switch flavors, such as menthol, fruit-

flavored, or clove-flavored. Some products are designed with two capsules, providing multiple flavors in one cigarette.

Market interest has been strong. North America and Europe have the greatest revenue share of the global flavor capsule market; however, it is rapidly increasing in developing countries in the Asia Pacific region where tobacco control regulations are weak. Also, flavor capsule cigarettes have a relatively high market share in developing countries in Latin America.



### Quiz

True or False? There can be no more than one flavor capsule per cigarettes?

### Answer

False: One or more flavor capsules can be added in the filter section of a cigarette.

### Changing Trends: Cigars

Dr. Krishnan-Sarin discusses the changing trends with cigars.

As cigarette use has declined over the years, cigars have remained popular, especially in emerging countries such as in Asia and South America. Cigars are made by rolling tobacco in leaf tobacco or in a substance that contains tobacco.

Cigars, especially large ones, contain more nicotine, tar, and carbon monoxide when burned than regular cigarettes. While premium cigars account for a small percentage of cigar sales, they remain the highest in value based on the higher selling price. For mass consumption, little cigars and cigarillos are seeing a rise in consumption and are responsible for the highest number of cigar sales.

### **Cigarillos or “Little Cigars”**

Dr. Krishnan-Sarin discusses cigarillos or “little cigars.”

Little cigars often contain fruit and other flavors that appeal to youth. More than two in three US middle and high school students who used tobacco products in the past 30 days in 2014, smoked flavored little cigars.

A significant percentage of youth use cigarillos for blunt creation. Many cigarillos come with dotted lines where they can be cut open and the tobacco can be replaced with marijuana. There are also behaviors like “spliffing” where tobacco and marijuana are mixed.

### **Summary**

Dr. Krishnan-Sarin summarizes the Emerging Issues Lecture.

Emerging issues in tobacco use include tobacco industry strategies to sustain nicotine addiction through the introduction of new products and technologies that target and appeal to youth. Nicotine harms the brain at different stages in life; therefore, every effort must be made to combat tactics to promote tobacco use, especially in youth and pregnant women.

Although the industry argues its newer reduced-risk products are safer, evidence shows that a number of the harmful chemicals found in traditional cigarette smoke are also found in the aerosol of these products. Moreover, these products contain high levels of nicotine that initiate and sustain addiction. The use of flavors to attract youth and promote initiation of tobacco use remains a major cause for concern.

**Module Complete.**