Vaping, E-cigarettes and Alternative Smoking Devices...
How do we advise our Clients??

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Course Objectives
This course will:
• Define vaping, e-cigarettes and water pipes
• Discuss the history of these products, components, usage trends and demographics
• Explore current available evidence on the safety of e-cigarettes & their products
• Investigate the potential health effects of e-cigarettes
• Identify the effects of vaping on the oral tissues
• Discuss the available evidence for smoking cessation effectiveness of e-cigarettes
• Discuss government regulation of e-cigarettes and vaping from both a Health Canada Perspective and a Provincial perspective
• Discuss the role of the dental hygienist in both education and health promotion regarding e-cigarettes and vaping

Definitions

VAPING: Inhaling vapour that is produced by an e-cigarette macmillandictionary.com

E-CIGARETTES: Electronic cigarette, a.k.a. e-cigarette, e-cig, electronic vaping device, personal vaporizer, or electronic nicotine delivery system (ENDS). Delivers pure nicotine and releases water vapour that vanishes in seconds. (Have been on the market for 12 years)
• Puffing activates the battery-operated heating element in the atomizer and the liquid
• The liquid consists of various combinations of: propylene glycol, glycerin, nicotine, tobacco extracts, flavorants and/or adulterants which vaporize to an aerosol or vapour.
• The new generation of EC’s seem to be very efficient nicotine delivery systems
• Almost ALL regular EC users use EC’s with Nicotine (Elter & Bullen, et al.)

WATER PIPES (Hooka’s): flavoured tobacco or cannabis whose vapour or smoke is passed through a water basin before inhalation. (en.wikipedia.org)
• During a typical one-hour hookah session, a user expels into the air 2-10 times the amount of cancer-causing chemicals and other harmful chemicals compared to a cigarette smoker.
• Early origins in the 1500’s!! Unlike the e-cigarette!
In the Arab world and the Middle East, water pipes are regularly smoked as part of their culture. There are numerous local names for water pipes in the Middle East and other countries in Europe and South Asia/India such as argila, galyan, nargile, etc.

Social smoking is done with a single or double hose hooka and sometimes even triple and quadruple hose hookas are used at parties.

Introduction

E-cigarettes were first invented by a Chinese Pharmacist, Hon Lik in 2003.

In the beginning, EC’s were primarily produced by small manufacturer’s in China and sold on the Internet.

In the last few years, major tobacco companies such as:

- Lorillard, (N.C., USA)
- British Tobacco Company
- Altria
- RJ Reynolds Tobacco Company
- Imperial Tobacco

Have launched their own brands and are buying up existing ones

Marketing and sales have exploded & EC shops & lounges pop-up everywhere

For the first time in more than 40 years, tobacco companies are back on TV with cigarette adds (CNN Money, 2014)

Industrial Economists project EC’s will surpass conventional cigarette sales in about 3 decades and the global EC market is expected to hit $10 billion by 2017 (Lopex, 2013; Stocks, 2013)

As of 2014, there were 466 brands of e-cigarettes with Global sales of around $7 billion.

This epidemic spread raises great concern in some health and public health professionals yet great enthusiasm in others! WHY????

E-cigarettes are currently perceived to be less harmful than smoking BUT, they are not without risk!

Some health professionals believe that e-cigarettes will play a role in Harm Reduction as an alternative to conventional cigarettes.

Tobacco is the deadliest product on the market & is estimated to cause 1 billion deaths in the 21st century (Eriksen et al., 2012)
Usage Trends & Demographics

- Although e-liquids come in both nicotine containing and non-nicotine forms, the majority of regular e-cigarette users are using the nicotine-containing liquids.
- Usage is widespread globally with kiosks and shops throughout the world
- Use amongst both grade school and high school kids is becoming very prevalent
- CDC reports that e-cigarette use among middle & high school students tripled between 2013 & 2014 from 4.5% to 13.4%
- A study by the Canadian Cancer Society in Quebec in 2012-2013 found:
  - 1/3rd of secondary school students reported use of e-cigs
  - Among Grade 11 students, 41% had tried e-cigs!
  - 9% of 6th graders had tried e-cigs!!!!

Safety Literature

- Current Literature is sparse and hypothetical with conflicting results
- Most literature is in the form of lab or animal studies
- A large number of studies have been conducted by tobacco/e-cigarette companies (thus may be biased)
- Major areas of concern:
  - Potential Risk of Carcinogens in E-cigarettes
  - Potential Cancer Risk
  - Concern for both users and effect of second-hand vapour for non-users
- Recent Public Health England update on E-cigarettes found e-cigarettes contain carcinogens in lower concentrations than conventional cigarettes such as formaldehyde & acetaldehyde
- However, when high voltage devices are used, concentrations become much larger! (Kosmider et al.; 2014)
- Risk of oral and lung cancer from inhalation of these compounds in preclinical experimental studies have shown e-cig vapours associated with:
  - increased inflammation, oxidative stress and disruption of endothelial barrier function (Schweitzer et al. 2015)
- Findings also show that these vapours may promote allergen induced airway hyper-reactivity (Lim et al; 2014)
• These vapours may also predispose people to respiratory virus and bacterial infection by impairing immune function and enhancing the virulence of pathogens such as methicillin-resistant Staph Aureus (MRSA) (Wu et al.; 2014)
• Exposure to e-cigs impairs pulmonary anti-bacterial & anti-viral defenses in a mouse model (Sussan et al., 2015; Crotty et al.; 2014)
• This Public Health England update concluded with:
  • Further basic science & epidemiological research is needed to increase our evidence base on the benefits and harms of e-cigarette vapour.
  • Until then, patients should not be misled into thinking that the likelihood of future harm is negligible when there is insufficient evidence to support this claim.

Think about how long it took for conventional cigarettes to be shown to produce harm!!

A Systematic Review of the Health Effects of Electronic Cigarettes
Pisinger C. and Dossing M. (Preventive Medicine; 2014;69:248-260)

Objective: to provide a systematic review of the existing literature on health consequences of vaping e-cigs.
• Identified 1101 studies!!! 271 were relevant after screening and 94 were eligible

Results:
• Once inclusion and exclusion criteria were applied, 76 studies were included in this investigation of adverse events studies in both human and animal experiments
• Serious methodological problems were found
• In 34% of the articles, the authors had a conflict of Interest (ie. worked for or paid by a tobacco company)

Study Findings:
• Fine /ultrafine particles; harmful metals; carcinogenic tobacco-specific nitrosamines; volatile organic compounds; carcinogenic carbonyls (some in high but most in low/trace concentrations)
• Cytotoxicity & changed gene expression
• Of Special Concern: Compounds NOT found in Conventional Cigarettes: eg. Propylene Glycol
• Experimental studies found increased airway resistance after short-term exposure
• Reports on short-term adverse events were often flawed by selection bias
• Human bronchial cells exposed to high nicotine vapour show a similar pattern of gene expression to those exposed to tobacco smoke! (Park et al; 2014)
• Vapour induced the release of cytokines & pro-inflammatory mediators (Cervellati et al.; 2014)
• Half of the liquids analysed contained up to 5 times the maximum amount of impurities specified in the “European Pharmacopoeia”! Some of these harmful products include:
  • Highly toxic diethylene glycol
  • Coumarin
  • Amino-tadalafil
  • Rimonabant (+ an antioxidative impurity of rimonabant)
• Silicate beads
(Etter et al.; 2013)

Adverse Events Reported *(in the systematic review)*

**Pulmonary System**
- Same particle dose received as with smoking and vaping along with increased airway resistance *(Marini et al.; 2014)*
- Concomitant decrease in specific airway conductance *(Palamidas et al. 2014)*
- An increase in overall peripheral airway resistance *(Vardavas et al.; 2012)*
- 2 studies found immediate reductions in exhaled nitric acid similar to smoking *(Marini, 2014; Vardavas, 2012)*

**THESE FINDINGS ARE ALL REMINISCENT OF THOSE SEEN IN TOBACCO SMOKING!!**

**Cardiovascular System**
- Several studies of EC users found that short-term vaping resulted in:
  - Elevation in Diastolic Blood Pressure *(Battista, et al; 2013; Czogala et al.; 2012)*
  - Decrease in $O_2$ saturation *(Vakali, et al.; 2014)*
- Three other studies found no increase in heart rate or BP but an increase in $O_2$ saturation

**Study Conclusions:**
- Many methodological problems
- Severe conflicts of interest
- Relatively few and often small experimental studies
- Inconsistencies and contradictions
- Lack of long-term follow-up

No Firm Conclusions could be Drawn on the Safety of EC’s

However...**THEY CAN HARDLY BE CONSIDERED HARMLESS!!**

**Special Concerns:** Compounds not found in CC’s such as:

- Glycols
- Propylene glycol
- Glycerin
- Volunteers exposed to *propylene glycol* mist for 1 minute developed slight airway obstruction and increased self-rated severity of dyspnea *(Wieslander et al.; 2001)*
- Long-term exposure to *Propylene Glycol* has been found to exacerbate and/or induce multiple allergic symptoms in children *(Choi et al.; 2010)*
• Experimental studies show moderate cytotoxic effects on skin fibroblasts (Ponec et al.; 1990); irritation to the upper respiratory tract and squamous metaplasia of the epiglottis following exposure at concentrations present in EC’s (Renne et al.; 1992)
• **Ethylene Glycol** has been associated with pronounced toxicological risks (Hess et al.; 2004) and has been found to replace glycerol/propylene glycol in several brands! (Hutzler et al.; 2014)

**Other Concerns**
*Flavours, Metals, Rubber, Silicone & Ceramics*
• Significant amounts of metals (probably from solder joints, wires etc.) & silicate beads (probably from the fiberglass wick) have been found in EC’s (Williams et al.; 2013)
• Occupational exposure to silicate dusts can cause extensive pulmonary damage (Elmore, 2003)
• Lead & chromium concentrations (Same as CC’s) BUT the range of NICKEL was 100 X Higher than in CC’s!!!!!
• E-fluid was also found to contain TIN and to be cytotoxic! (Williams, 2013)

**THESE METALS APPEAR ON THE US FOOD & DRUG ADMINISTRATION’S “HARMFUL AND POTENTIALLY HARMFUL CHEMICALS” LIST (FDA, 2014)**
Effects of Vaping on Oral Tissues

- It is well-known that nicotine plays a significant role in the pathogenesis of cigarette smoking associated diseases, such as Periodontitis (Considered one of the true risk factors for periodontitis)
- However, very few studies are available investigating the effects of e-cigarettes on the periodontium
- After an extensive search of the literature, only 2 in-vitro studies could be found on this topic! Both studies looked at the effects of vaping on oral fibroblasts providing some degree of evidence that there may be an effect on oral tissues...however still speculation at this point!


**Study Purpose:** to investigate the effects of e-cigarette fluids on human primary cells in the oral cavity (ie. gingival fibroblasts)

**Methods:**
- Human Fibroblast Samples were obtained from the retromolar pads of patients having third molar extractions
- Various e-cigarette Fluid ingredients were tested on these samples in the lab:
  - Propylene glycol
  - Glycerine
  - Various flavouring substances
  - Nicotine (at various concentrations)

**Results:**
- Suggest an extreme toxicity for concentrations higher than 1mg/ml just after 24 hours
- The vaping seemed to increase the reduction of cell metabolic activity
- Authors speculate that this raise could be due to the presence of particles & various kinds of chemicals in the aerosol generated from the atomizer
- Increase in Reactive O$_2$ Species (ROS) production after 24 hrs in both nicotine-vaped and not vaped samples
- Also, the nicotine-free fluids induced an increase in ROS after 24 hrs.

**Conclusions:**
- Cigarette fluids induce an oxidative stress leading to the occurrence of early and late **apoptosis** (cell death) to a **major extent** in nicotine-treated samples, but **also present** in samples treated with nicotine-free fluids
- Based on these results, more studies are **mandatory**, as this study indicates similar responses of oral tissue fibroblasts to those of conventional cigarettes!

**Reports from Poison Control Centres**
- The Centres for Disease Control & Prevention in Atlanta (CDC) report that annual e-cigarette calls to Poison-control Centres in the US have increased from 238 in 2011 to 3,692 in 2014. (An increase > 1400%!!!!)
• More than ½ (58%) of the calls to poison control centres concerning e-cigarettes involved young children under the age of 5!
• Their analysis showed that e-cigarette calls were more likely than conventional cigarette calls to include a report of an adverse health-effect
• Most common effects: vomiting, nausea, eye irritation (ingestion, inhalation or absorption through eyes or skin of e-juice)
• In Canada, similar anecdotal reports from the Can Assoc. of Poison Control Centres

Where’s the Evidence that E-cigarettes are a good smoking cessation tool??
• Some studies have shown that reduction & cessation rates have occurred with EC usage
• But ...a recent meta-analysis based on population studies, found EC users were significantly less-likely than non-users to quit smoking!! (Grana et al.;2014)
• Also, a longitudinal study in cancer patients showed that EC-users were twice as likely to be smoking at the time of follow-up as non-users. (Borderud et sl.; 2014)
• The Only existing Randomized Controlled smoking cessation Study (RCT) showed that EC’s were NOT significantly more effective than nicotine patch therapy (Bullen et al.; 2013)
• A survey sponsored by EC manufacturer’s found that only 1% of EC users achieved permanent abstinence by use of EC’s (Heavner et al.; 2010)
• One experimental study showed EC exposure may evoke smoking urges in young adult daily smokers (King et al.; 2014)
• EC use has spread to minors in the last few years (even children 12-14)
• Of major concern, young never-smokers are experimenting with EC’s

Thus....EC’s may be a “Gateway to Smoking”, however there are no studies to prove this!

Regulatory Standpoint
• Health Canada has NOT approved e-cigarettes with nicotine so these devices and liquids containing nicotine at the moment, cannot be sold in Canada
  
  HOWEVER
• Consumers seem to be obtaining e-cigarettes with nicotine despite the fact they are not yet approved!
• There are reports of numerous stores selling them as well as on-line sales

Nicotine Concentrations sold on CanadaVapes Website
Advertises Nicotine strengths available for their liquids!!!!
• 0 No Nicotine
• 3 mg/ml ULTRA LOW
• 6 mg/ml LOW
• 12 mg/ml MEDIUM
• 16 mg/ml MED-HIGH
• 24 mg/ml HIGH
Alberta Legislation

- Currently no *Provincial* Legislation
- AB Leaves the decision to municipalities
- Calgary City Council passed one of the most comprehensive e-cigarette bylaws in Canada on June 30, 2015, banning use of the devices everywhere traditional cigarettes are already prohibited.
- The bylaw has an exemption for e-cigarette retailers in enclosed locations that allows customers to test products in-store before buying. It goes farther than legislation already in place in Toronto, Ottawa and Edmonton, but is less strict than Vancouver and Red Deer.
- An *age restriction* on stores for e-cigarettes and e-liquids is *not in the bylaw*

“The Tobacco & Vapour Products Control Act” Province of British Columbia

- EC’s can only be sold to adults 19+
- Retail displays targeting youth are prohibited
- No advertising where youth can see it
- Indoor use ONLY in vaping stores to learn how to use the product
- Otherwise indoor use in Public places banned
- Cannot be sold in public buildings
- Use banned in public & private school grounds, indoor public spaces & workplaces
- Also banned on Health Authority properties

*BC has the lowers Smoking Rate in Canada (15.3%)!!*

The Role of the Dental Hygienist from both an Educational and Health Promotion Standpoint

*Dental Hygienists should inform their patients about the:*

- Number of conflicting studies that currently exist
- Mounting evidence that there may be some major adverse effects from vaping
- Lack of evidence that vaping is a good replacement for smoking and/or quitting
- Causes for concern
- Adverse effects of vaping
- Signs & symptoms of nicotine overdose
- Current regulation re: use of e-cigarettes with nicotine

Summary of Adverse Effects of Vaping

**Eyes**
- Irritation
- Blurry vision
- Wounds and burns in cases of e-cigarette explosion

**Mouth & Airway**
- Irritation
- Cough
- Increased airway resistance

**Heart & Circulation**
- Chest pain
- Increased blood pressure
Increased heart rate

**Stomach**

Vomiting

Nausea

Pain

**Signs and Symptoms of Nicotine Overdose**


**Rapid Onset**

- Burning sensation in mouth & throat
- Salivation & Nausea
- Abdominal pain, vomiting and diarrhea
- Agitation, headache
- Sweating, dizziness & confusion
- Hypertension, bradychardia
- Systemic reaction ranging from paroxysmal atrial fibrillation to cardiac arrest

*In cases of nicotine poisoning, death is usually rapid & can occur within minutes due to respiratory paralysis & depolarization blockade of the neuromuscular system*

**References**


José RJ. Potential risk of carcinogens in e-cigarette vapour. *BMJ* 2015;351:h5004


www.canadavapes.com
