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Smoking cessation and electronic cigarettes

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ABSTRACT

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Smoking is considered as one of the major preventable causes of death all over the world. Smoking has deleterious effects on almost every organ of the body. The serious risks associated with smoking diminish rapidly after quitting and life-long abstinence is known to reduce the risk of lung cancer, heart disease, stroke, chronic lung disease etc. A lot of emphasis has been laid on the beneficial effects of smoking cessation. Nicotine Replacement Therapy has been shown to reduce the incidence of smoking in the general population. ENDS, commonly referred to as electronic-cigarettes (e-Cigarette), are battery-operated cigarettes, better known as Electronic Nicotine Delivery Systems (ENDS) which resemble a cigarette, designed for the purpose of nicotine delivery. There is a liquid in these devices which comprises of nicotine, propylene glycol, glycerine, water and flavoring agents. With the use of this device, nicotine is delivered without any combustion being involved and thus the harmful effects of smoke are minimized. E-cigarettes do not produce the harmful chemicals which are emitted by conventional cigarettes. They do not emit carbon monoxide which is otherwise a key component of conventional cigarette smoke. At present data are limited, but still it is clear that e-cigarette emissions are not harmless as was initially claimed. These devices are a source of indoor air pollution. Use of e-cigarettes in clean air environments may result in pollution and may harm even the non-smokers.

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INTRODUCTION

Smoking is considered as one of the major preventable causes of death all over the world. It is estimated that around 5 million people in the world die of active smoking and more than 600000 nonsmokers die as a result of exposure to passive smoke annually. Smoking significantly increases the chances of a respiratory disease and over half of the respiratory disease related deaths are due to smoking (Ward, 2014). The serious risks attributed to smoking diminish rapidly after quitting and life-long abstinence is known to reduce the risk of lung cancer, heart disease, stroke, chronic obstructive pulmonary disease etc.

Smoking has deleterious effects on almost every organ of the body (Jha, 2009). In the eyes, it causes macular degeneration; in the integumentary system, it causes hair

loss, ageing, wrinkles and wound infections; in Central Nervous System, it increases the risk of ischemic Cerebrovascular accidents; in the mouth and pharynx, it causes cancer and gum disease; in the lungs it causes lung cancer, chronic obstructive pulmonary disease (emphysema and chronic bronchitis), pneumonia and asthma. In the cardiovascular system, smoking increases the risk of ischemic heart disease and hypertension (Wells, 1994). It increases the risk of stomach cancer and peptic ulcers; in the pancreas, it increases the risk of cancer and alters the regulation of blood glucose; it also increases the risk of bladder and cervical cancer. Smoking is also known to cause peripheral arterial disease, osteoporosis and erectile dysfunction (Tostes et al., 2008).

HEALTH BENEFITS OF SMOKING CESSATION

A lot of emphasis has been laid on the beneficial effects of smoking cessation. Few researchers have quantified this information in terms of benefits gained in relation to the duration of smoking cessation (Taylor et al., 2002). It has been postulated that within twelve hours of smoking cessation, blood levels of carbon monoxide reduce significantly; in five days there is improvement in the sense of taste and smell, which are otherwise altered in most smokers. Within six weeks of smoking cessation, the risk of wound infection is also markedly reduced. After three months of smoking cessation, it has been reported that the lung functions significantly improve. After fifteen years of smoking cessation, all cause mortality is reduced to the same levels as for those who have never smoked (Taylor et al., 2002).

The level of dependence on smoking can be judged, based on Fagerstrom Nicotine Dependence Questionnaire (Fagerstrom et al., 1989). It involves the following questions:

1. How soon after you wake up do you smoke your first cigarette? (Score 0-3)
2. Do you find it difficult to refrain from smoking in public? (Score 0-1)
3. Which cigarette would you hate to give up most? (Score 0-1)
4. How many cigarettes a day do you smoke? (Score 0-3)
5. Do you smoke more frequently during the first hours after waking than during the rest of the day? (Score 0-1)

A total score of 8-10 suggests high dependence; 5-7 suggests moderate dependence and 1-4 suggests low dependence.

Methods to cope with craving for smoking

There are certain steps which should be taken in order to abstain from smoking. These steps would be helpful only if there is a strong will to quit smoking.

1. Delay: Action on the urge to smoke should be delayed. After 5 minutes, the urge to smoke weakens and the intention to quit comes back
2. Deep breathe: Person should take a long slow breath in and slowly release it out. This should be repeated three times.
3. Drink water: Person should drink water slowly holding it in mouth a little longer to savour the taste
4. Do something else: Person should try to do something else to take his mind off smoking. Exercise is a good alternative or listening to music is another.

NICOTINE REPLACEMENT THERAPY (NRT)

NRT has been shown to reduce the incidence of smoking in the general population. The aim of NRT is to replace nicotine which is the main reason for craving of cigarettes and other harmful components of tobacco smoke are minimised. NRT also reduces withdrawal symptoms and sometimes may have to be prescribed to alleviate severe withdrawal symptoms.

1. Nicotine transdermal patch

It is an initial choice of most of the physicians because it is quite simple to use.

It can be combined with many other forms of NRT and provides a round the clock action (Tang et al., 1994).

Table 1. Initial recommended dosage of Transdermal Patch.

| Patient group | Initial dose | Duration |
|---|------------------------------------|------------------|
| >10 cigarettes/day or weight >45 kg | 21 mg/24 hour patch or mg/16 hours | At least 8 weeks |
| <10 cigarettes/day or weight <45 kg or cardiovascular disease | 14 mg/24 hour patch or mg/16 hours | At least 8 weeks |

Most common side effects of nicotine transdermal patch are skin irritation and sleep disturbance.

2. Inhaler

Nicotine inhalers are useful for patients who miss the classical 'hand to mouth' action of smoking and the main problem in these patients is the habit of the so-called 'hand to mouth' action (Sumner et al., 2003) The initial recommended dosage for inhaler is 6-12 cartridges/day for 12 weeks followed by 3-6/day for 2 weeks and 1-3/day for 2 weeks. The most common adverse effect of nicotine inhaler is throat irritation.

3. Gum

Nicotine gums are useful for those who cannot tolerate patches or who require combination therapy. It is a very simple method for reducing the craving for smoking (Pack et al., 2008)

Table 2. Initial recommended dosage.

| | | |
|---------------------------------------|------|---|
| Patients who smoke <20 cigarettes/day | 2 mg | One gum per hour. Should be tapered over 3 months |
| Patients who smoke >20 cigarettes/day | 4 mg | One gum per hour. Should be tapered over 3 months |

Adverse effects of nicotine gums include gastrointestinal disturbances, dyspepsia, nausea and hiccups. Sometimes headaches may occur if the gum is chewed too quickly. Jaw pain and dental problems have also been reported.

4. Lozenge

These are useful for patients who cannot use patches, need combination therapy or do not wish to use nicotine gum for dental or other reasons.

Table 3. Initial recommended dosage.

| | | |
|--|--------------|---|
| Patients who smoke their first cigarette >30 minutes after waking | 2 mg lozenge | One lozenge can be used every 1-2 hours to a maximum of 15 20 or 4mg lozenges/day |
| Patients who smoke their first cigarette within 30 minutes of waking | 4 mg lozenge | One lozenge can be used every 1-2 hours to a maximum of 15 20 or 4mg lozenges/day |

Most common adverse effects are gastric upset and throat irritation.

5. Microtabs

Microtabs, also known as sublingual tablets are useful for patients who cannot use nicotine transdermal patches or those who need combination therapy. Microtabs may be particularly useful for feeding mothers.

Table 4. Initial recommended dosage.

| | | |
|--|--------------------|--|
| Patients who smoke first cigarette >30 minutes after waking | 1 x 2 mg microtab | 1-2 microtabs can be used every 1-2 hours to a maximum of 40 microtabs/day |
| Patients who smoke first cigarette within 30 minutes of waking | 2 x 2 mg microtabs | 1-2 microtabs can be used every 1-2 hours to a maximum of 40 microtabs/day |

Most common side effects are mouth and throat irritation, gastrointestinal upset and sometimes cough.

NICOTINE REPLACEMENT THERAPY: CAUTIONS AND CONTRAINDICATIONS:

NRT is Contraindicated in:

- Nonsmokers;
- Those with sensitivity to nicotine;
- Children aged less than 12 years

It should be used with caution or under medical supervision in:

- Dependent smokers with recent myocardial infarction,
- Reported severe cardiac arrhythmias or
- Patients with recent cerebrovascular accident

NRT should be used with care only when benefits outweigh risks in :

- Patients who weigh <45 kg;
- Patients with recent or planned angioplasty, bypass grafting or stenting;
- Patients with unstable angina;
- Pregnant or lactating women

BUPROPION

It is a Non-nicotine oral therapy which works through an unknown mechanism of action and significantly reduces the dependence on smoking. It helps to reduce withdrawal symptoms as well (Wilkes, 2008). The recommended dose is 150 mg once per day for 3 days and may be increased up to 150 mg twice per day with an 8 hour interval between the doses. Main adverse effects are insomnia, headache, dry mouth, nausea, dizziness and anxiety. Sometimes serious adverse events may occur which include seizures.

ELECTRONIC NICOTINE DELIVERY SYSTEMS (ENDS)

ENDS, commonly referred to as electronic-cigarettes (e-Cigarette), are battery-operated electronic nicotine delivery systems (ENDS) which resemble a cigarette, designed for the purpose of nicotine delivery. However the advantage is that no combustion is necessary for their

operation. This device was invented by a Chinese pharmacist, Hon Lik, in 2003. Electronic cigarettes (ECs) have been introduced to the market in recent years to act as an alternative to conventional smoking with an intention to lower the risks associated with conventional smoke (Etter et al., 2011).

ENDS are battery operated devices that vaporise a liquid. The liquid in these devices contains nicotine, propylene glycol, glycerine, water and flavoring agents. With the use of this device, nicotine is delivered without any combustion being involved and thus the harmful effects of smoke are minimized. Most of the ENDS are shaped to look like the conventional cigarettes (Fig 1), however some of them have also been given the form of everyday items such as pens, USB devices etc.

The Current Status of ENDS

The use of ENDS is increasing all over the world. It is estimated that in 2014 there were 466 brands (Regan et al., 2013) and sales of e-cigarettes are forecasted to increase by a factor of 17 by 2030. However there still are concerns about their safety and efficacy. It has been shown that individual puff of e-cigarette contains about 0 to 35 µg nicotine per puff (Goniewicz, 2013). A puff of the e-cigarette with the highest nicotine content contained 20% of the nicotine contained in a puff of a conventional cigarette. The levels of other toxicants in e-cigarette were 1 to 2 times lower than in conventional cigarette smoke but they were higher than those found in nicotine inhaler (Goniewicz et al., 2014).

However the overall rate of smoking actually increased with the advent of electronic cigarettes. The prevalence of smoking doubled in UK and USA from 2008 to 2012. Dual Smoking increased by 61% among middle school students in US.

Cytotoxicity with e-smoking

Bahl *et al* screened 41 e-cigarette refill fluids from 4 companies and found that 3 cell types are most susceptible to e-cigarette: human pulmonary fibroblasts, human embryonic stem cells, and mouse neural stem cells (Bahl et al., 2012) Cytotoxicity varied among products from highly toxic to low or no cytotoxicity. They were more cytotoxic to stem cells. Farsalino *et al* studied the effects of cytotoxicity of electronic cigarettes on cultured rat cardiac myoblasts. This cytotoxicity was attributed to the concentration of flavoring agents used in the electronic cigarettes. These findings suggest that the stem cells are more sensitive than the differentiated adult pulmonary fibroblast cells and therefore adult lungs may probably not be the most sensitive tissues to assess the effects of exposure to aerosol generated by e-cigarettes. Also, these findings have further raised concerns that pregnant women who use e-cigarettes or are exposed to e-cigarette aerosol may be essentially vulnerable to the harmful effects.

Passive exposure and ambient air pollution

E-cigarettes do not produce the harmful chemicals which are emitted by conventional cigarettes. They do not produce carbon monoxide which is otherwise a key

component of conventional cigarette smoke. The size of particulate matter emitted by e-cigarettes is similar to those of conventional cigarettes, and most of the particles are in the ultrafine range (modes, $\approx 100\text{-}200\text{ nm}$) (Zhang et al., 2013). The Particle number in the environment, which was recorded to be $400 / \text{cm}^3$ was shown to increase to $49000 - 88000 / \text{cm}^3$ after 2 hours of exposure to ENDS in one study (Schober et al., 2013).

Effects on Health

Recent studies have found that e-cigarettes deliver much lower levels of plasma nicotine than conventional cigarettes (Vansickel et al., 2013). Further studies have shown that regardless of nicotine delivery, e-cigarettes can also relieve some of the withdrawal symptoms (Bullen et al., 2010). However, exposure to propylene glycol from e-cigarette can cause irritation of the eye and respiratory tract, and prolonged use may also adversely affect the central nervous system. Electronic cigarettes also increase the dynamic airway resistance and it was seen that WBC levels increased after smoking an electronic cigarette. These devices have also been shown to be carcinogenic.

Effects on Cessation of Conventional Cigarettes

E-cigarettes were initially promoted as means of smoking cessation and most individuals who use e-cigarettes believe that these devices will help them quit conventional cigarettes which are more harmful (Etter, et al., 2011). In fact, Adkison *et al* studied the smoking habits of current and former smokers in the *International Tobacco Control study in the United States*, and found a statistically significant reduction in number of conventional cigarettes smoked per day, following use of electronic cigarettes (Adkison et al., 2013). However four clinical trials further examined the efficacy of e-cigarettes as tools for smoking cessation and when analysed together, these studies suggest that e-cigarettes are not associated with successful quitting in general population-based samples of smokers.

CONCLUSION

At present data are limited, but still it is clear that e-cigarette emissions are not harmless as was initially claimed. These devices are a source of indoor air pollution. Introduction of e-cigarettes into clean air environments may result in pollution and may harm even the non-smokers. Still long term studies are required to ascertain the exact policy recommendations for ENDS. As of now, it can be said that the use of e-cigarettes should be discouraged similar to traditional cigarettes. The health related claims for e-cigarette products which were in market until now should be prohibited until approved by further research.

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