

CASE REPORT

Beliefs and reality of e-cigarette smoking

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SUMMARY

In this global health case study, we describe a case of nicotine addiction due to chronic use of electronic cigarettes (e-cigarette) and discuss the beliefs on safety and awareness of their side effects. Many people believe that smoking an e-cigarette (vaping) does not have any side effects, especially among teenagers and young adults. Teenagers using an e-cigarette at a young age are twice as likely to try cigarettes later in their life because of nicotine dependency or other social factors. More recent studies have shown long-term systemic side effects of vaping regardless of traditional cigarette smoking history. This report was done for further assessing their risk and to clear out misconceptions of this large-scale condition.

CASE PRESENTATION

A 25-year-old male patient presented to the emergency room with diaphoresis, restlessness, tachycardia, chills, nausea and a temperature of 38.3°C. He was in a normal state of health five days back. He had no significant past medical history and was moderately built, well nourished, conscious, alert, and oriented to time, place and person. He stated that he was not a smoker or an alcoholic and exercises regularly. Family history was unremarkable. He had trouble sleeping and an increased appetite for food since the past five days. He recently faced financial problems, which led him to a depressive state. He underwent drastic lifestyle changes and currently is homeless, residing in a shelter.

Further examination was not remarkable. All systems were normal. On admission, a psychiatrist was consulted to help the patient cope with depression. He stated not being suicidal but had the feeling of being low and having a loss of interest in everything. He had been feeling this way only after his financial problems began. He refused to take medications due to his assumption of them having many side effects. His fever decreased after being given acetaminophen, but he was still restless, diaphoretic, nauseated and was repeatedly craving to 'vape' for which he was severely distressed and aggressive. When asked about vaping, which refers to the use of an electronic cigarette (e-cigarette), he was found to be a chronic user of vape for the past 10 years. He never smoked a traditional cigarette and only used e-cigarettes. On further cross-questioning, he admitted to smoking e-cigarettes throughout the day during his free time while driving, between meals and even during breaks at work. After losing his job, due to his financial state, there was an abrupt stop in his smoking habits as he

did not have enough money to purchase e-cigarette refills.

The patient's brother was contacted to bring the liquid refills to check the nicotine content. On reading the contents of the 30 mL refill bottle, nicotine content was found to be 24 mg/mL of which he used one-third of a bottle/day which is 8 mL of liquid. His nicotine consumption per day would be about 192 mg/day not taking into account the large amount lost in the vaporisation process.

Thereby, due to the high amount of nicotine consumed and the abrupt stoppage of intake, he was diagnosed to have nicotine withdrawal. When asked why he did not state using e-cigarettes in his smoking history, he said he never considered it as smoking but only as vaping. Given his depression and his nicotine dependence, he was started on bupropion which would treat both of his major symptoms.

GLOBAL HEALTH PROBLEM LIST

- ▶ The exponential increase in the use of e-cigarettes since its introduction to the public in 2004.
- ▶ E-cigarettes are advertised as being safe but a high level of nicotine is inhaled by the users.
- ▶ Nicotine in the e-cigarettes does cause withdrawal symptoms.
- ▶ The youth in various parts of the world are falling prey to the trend of vaping.

GLOBAL HEALTH PROBLEM ANALYSIS

The use of e-cigarettes has exponentially risen since its introduction to the public in 2004, often credited to Hon Lik, a Chinese pharmacist, and the popularisation of the word 'vaping' on social media sites has made it a new trend in today's culture. They have become widely available, with a variety of flavours and nicotine levels and at a cheaper price than the traditional cigarettes. Traditionally, e-cigarettes were marketed as smoking cessation aids as they were considered non-hazardous, safe and without the effects of second-hand smoking.

Currently, data from several countries reported a large prevalence of: 0.3% in Indonesia, 1.2% in Italy, 1.9% in Greece and 5.9% in Poland. In 2015, the value of global sales of e-cigarettes was estimated to be US\$3.5 billion. The largest three markets are USA, Germany and Russia which collectively represent 60% of global sales.¹ More people are under the belief that they have no adverse effects whatsoever.² This case brings into light that the level of nicotine inhaled by chronic users of e-cigarettes can be very high and nicotine's addictive properties



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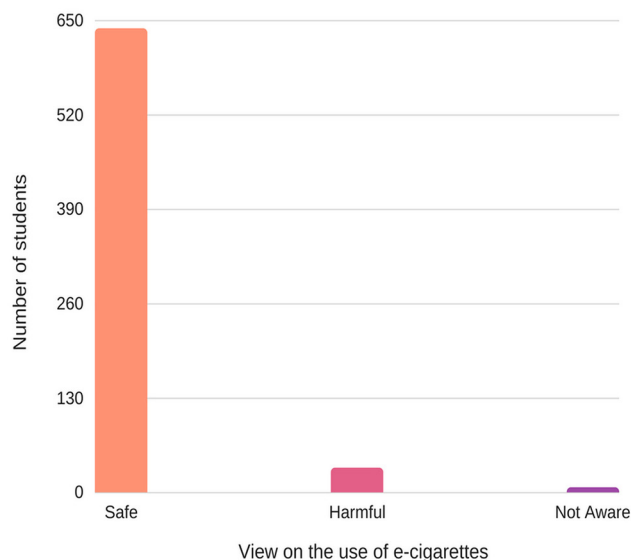


Figure 1 Study conducted at a New York School depicting the view on the safety of electronic cigarette (e-cigarette) use by students aged between 10 and 18 years.

are in full effect in them. The importance of educating patients and doctors about e- cigarettes and the need to ask about their use in history are necessary.

A study was conducted by the authors at a public school in New York City. A study sample of 680 students between the ages of 10 and 18 were handed a questionnaire, asking a simple question, 'Is vaping safe for the human body?'. The questionnaire was handed out to the students without any prior briefing of the topic in order to avoid any bias. The term vaping was defined, in case the students did not understand what it was. However, most of the students did understand, which is most likely due to the influence of vaping in pop culture. The results were tallied and an overwhelming 94% of students said e-cigarettes did not cause any harm to the body, and given the sample size of 680, the results were significant (figure 1). Therefore, it can be believed that a majority of the youth that use e-cigarettes consider it safe even though the long-term benefits are not yet transparent.

A JAMA report in 2016 showed that the use of e-cigarettes by students rose up to 16% in 2015, from 1.5% in 2011. This depicted a shocking 900% rise in the use of e-cigarettes in a short period.³ Teenager using an e-cigarette would be more likely to use a traditional cigarette or cigars, or chew tobacco and various other forms of tobacco later in life, which would have more adverse effects on their health, according to a study conducted by the Centre for Tobacco Control Research and Education.⁴

E-cigarettes aerosolize a liquid which contains nicotine and other flavoured ingredients by utilizing heat which then converts it to a vapour hence the term vaping. The major ingredients are propylene glycol, glycerine, nicotine and added flavourings.⁵ In the USA, the price of an e-cigarette ranges from US\$29.95 to US\$149.95, and the liquid refill cartridge costs between US\$9.95 and US\$19.95. The price of a cartridge depends on the quantity (3 mL–100 mL) and the amount of nicotine (0 mg/mL–36 mg/mL).⁶

According to a study done by Vansickel and Eissenberg which carried out measurement of nicotine concentration in the plasma of chronic e-cigarette users, it was found that after taking only 10 puffs using average-dose cartridges, peak nicotine concentrations increased, and after 1 hour of use, plasma levels measured

16.3 ng/mL suggesting that e-cigarettes can cause significant and sustained nicotine delivery.⁷ A study by Flouris *et al*, measured the serum cotinine which is the primary nicotine metabolite level, said that even after nicotine absorption level in e-cigarettes was lower than traditional cigarettes, serum cotinine was higher than the baseline.⁸ Early studies show that e-cigarettes did not increase nicotine levels and that has been the basis for people to believe they have no addictive or harmful effects. But the reality is that the devices have changed since then, progressing into their second generation.^{9–11} Recent studies have suggested that e-cigarette users achieve nicotine levels matching that of a traditional cigarette user.^{7,8,12} Urge to smoke and nicotine withdrawal symptoms were noticed in patients after 60 min in another study.¹³ Adolescents using e-cigarettes showed that nicotine dependence was apparent and that they were less likely to stop using e-cigarettes.¹⁴ Newer third-generation e-cigarettes deliver an equal amount of nicotine at the same duration of action as that of a traditional cigarette. A recent major national study on e-cigarettes revealed that vaping led more people to pick up a smoking habit due to the effects of nicotine rather than avoid or quit tobacco.¹⁵

A report based on one industry by Public Health England (PHE) in 2015 is widely quoted around the world for saying vaping is '95% safer' and also for constantly urging manufacturers to submit the data needed to get a license. They are also trying to get help from the Medicines and Healthcare Products Regulatory Authority to do so. This report provided hyped virtual safety and attracted tremendous media interest worldwide. A BMJ report from the same year that brought out the problems with the PHE's claim, including this report, can make one question PHE's scientific credibility.¹⁶

According to a recent research published in the American Thoracic Society's American Journal of Respiratory and Critical Care Medicine which conducted a study on sputum samples collected from 15 e-cigarette users, 15 non-smokers and 14 present cigarette smokers. It was found that e-cigarette users had a unique and significant increase in neutrophils-derived proteins present in their airways. Neutrophils normally play a key role in immunity against pathogens, but their unchecked level can cause or exacerbate inflammatory lung conditions such as cystic fibrosis and chronic obstructive pulmonary disease. These proteins were also found in extrapulmonary tissue which indicated epithelial cell death. Some of the negative effects of e-cigarettes are the same as the consequences of smoking traditional cigarettes and showed an increase in oxidative stress biomarkers. Also, there was evidence of mucin 5AC overproduction which is known to be linked with lung pathologies like asthma, bronchiectasis and chronic bronchitis.¹⁷

Moreover, researchers from Johns Hopkins Bloomberg School of Public Health conducted a study, and discovered toxic levels of heavy metal in e-cigarette aerosols. They instructed the participants to bring their regular e-cigarette device and refilling dispenser. Analysis of these e-cigarette vaporisers borrowed from 56 participants showed that many were exposed to potential toxic levels of chromium, nickel and lead. High concentration of these heavy metals has been linked to cardiovascular disease, brain damage and cancers.¹⁸ The same group had conducted a study in 2017 and found elevated levels of chromium and nickel after analysis of urine and saliva samples of e-cigarette users.¹⁹

Therefore, e-cigarette use has increased exponentially in the recent years due to false advertising, development of a vast array of flavours, social media and the most important being social acceptance.^{20,21} With the high levels of nicotine available in liquid cartridges and the newer e-cigarette models which can

deliver the nicotine at more effective levels, there should be more research and regulation into the addictive effects of its use. E-cigarettes do present a safer alternative to tobacco cigarettes in terms of decreased lung cancer and second-hand smoking, but they do, nonetheless, have a harmful impact on public health globally. The amount of nicotine should be regulated or limited based on the addictive properties that are documented. Both the Food and Drug Administration (FDA) and European Commission have made strides to control the sale of e-cigarettes to minors but more awareness should be made to the public. Increased funding for research should be done to see the long-term safety effects of nicotine on e-cigarette users.

Patient's perspective

'I didn't know that a person could get addicted to vaping, I was so surprised when the doctors told me. Everyone was doing it and I just thought it was cool. People would tell me it's safe and just a fun thing to do. I will definitely stop vaping because I value my health and I understand now that putting any foreign substance in my body will have some adverse effects. I think younger people should know about the effects of vaping and how it could impact their lives'.

Learning points

- The addictive properties in electronic cigarettes (e-cigarettes) are due to nicotine and, if used long term, can lead to dependence as demonstrated in this case and other research articles.
- Use of e-cigarettes starts at a young age, thereby research to identify long-term effects of nicotine should be funded as they are not known.
- Most people smoke e-cigarettes under the false assumption of it having absolutely no side effects.
- Vaping is being considered as the next epidemic and it has been linked with severe side effects almost equalising those of traditional cigarettes.
- E-cigarette use raises many health concerns including increased nicotine dependence that may eventually cause a person to start or switch back to smoking a traditional cigarette.

Contributors Research, drafting and final versions were all done by the two authors. Work was shared equally. SM has written up the case report, parts of the analysis, research into the topics and did the research study at the local school in which he handed out opinion polls asking students if electronic cigarettes are safe or not. MIA has written up the summary, parts of the analysis, research into the topics and graphically represented the data collected by the study. Both of the authors have invested time and effort into the article.

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