E-cigarettes: only a few serious poisoning cases but vigilance still needed

Since the early 2000s, several studies by poison control centres have focused on electronic cigarettes and their e-liquid refills, describing the circumstances and severity of exposure. In order to continue this work, a prospective study was carried out between 1 July 2019 and 31 December 2020, funded as part of ANSES's mission on tobacco and related products. The majority of cases concerned accidental exposure of children. However, these were not very serious and had a favourable outcome. Some were due to mistaking a bottle of e-liquid for a medicine, or handling e-liquid components while following do-it-yourself recipes. Despite the introduction of regulations governing these products, vigilance is still needed to ensure that they are safe for use by vapers and those around them.

The diversification of e-cigarette devices and their growing popularity since the early 2000s have been accompanied by an increase in cases of accidental exposure, whether through ingestion of e-liquid, eye or skin splashes, or inhalation. While these cases primarily concern adult users of these devices, exposure among children has also been observed.

Poisoning cases monitored by poison control centres for several years

The poison control centres (PCCs) in France published an initial report in 2011 on exposure cases reported from January 1999 to December 2010, then a second report for the period from January 2013 to 2014 [1]. A number of accidental exposure circumstances were described, the most frequent of which were ingestion by children causing digestive problems, splashes of e-liquid when the e-cigarette was being filled by the vape, causing eye irritation, and ocular administration of e-liquid that had been mistaken for eye drops. E-cigarettes were also responsible for respiratory symptoms such as coughing, especially in new vapers. Although overall they were of low severity, most of the cases in these two studies involved children, which prompted the vigilance to be extended and the exposure circumstances and products involved to be further documented.

In addition, when European Directive 2014/40/EU on tobacco products was transposed into French law, the Ministry of Health tasked ANSES with receiving and analysing notifications from manufacturers and importers of vaping products containing nicotine and intended for the French market. Indeed, prior to any marketing in a Member State of the European Union, manufacturers must provide information on their products and, in particular, on the composition of e-liquids containing nicotine [2].

As part of a research and development financial agreement established on ANSES's initiative, the Toulouse PCC coordinated a prospective study to identify cases reported to the eight French poison control centres between 1 July 2019 and 31 December 2020. For each case, as well as the data usually provided by the PCC in the medical file, more detailed information was collected on the exposure circumstances and the products, while ANSES helped with the composition data provided by manufacturers and importers.

Cases of exposure regularly reported but not serious

Over the 18 months of the study, 919 cases were recorded by the PCCs, an average of 51 per month, whether symptomatic or not. There were no peaks during this period, not even during the successive lockdowns and curfews in 2020 due to the COVID-19 pandemic (see Figure 1).

In the majority of cases (71%), calls to the PCCs came directly from the exposed individuals or their close relatives. The remaining calls were from healthcare professionals. In 91% of cases, exposure occurred in the home of the exposed individual.

Exposure victims ranged in age from one month to 89 years, but the majority were very young: half of the cases involved children under 4 years of age, 3% involved children aged 5 to 12 years, and 6% were aged 12 to 18 years. Thus, 60% of those exposed were minors (see Figure 2).

The sex ratio of 1.2 showed a slight male predominance.

The most common routes of exposure were oral (74%) and ocular (17%).

Of the 919 cases, almost 50% were asymptomatic. This proportion was 70% for children under 5 years of age, and 55% for those aged 5 to 12 years. From the age of 12 onwards, symptomatic patients were in the majority: over 70%, and up to 100% of cases among people aged 65 and over (see Figure 3).

Of the 464 symptomatic cases, 94% were of low severity, with digestive symptoms (nausea, vomiting, abdominal pain), ocular symptoms in the event of contact with the eye (pain, conjunctivitis) or headaches.

The cases of moderate severity (5%, or 24 cases) involved young adults who accidentally ingested e-liquid or were poisoned while vaping during normal use. In addition to the symptoms already mentioned, four patients reported persistent vomiting, and there was one case of bradycardia, one case of tachycardia, one case of convulsions, one case of hallucinations and one case of hematemesis (vomiting blood).

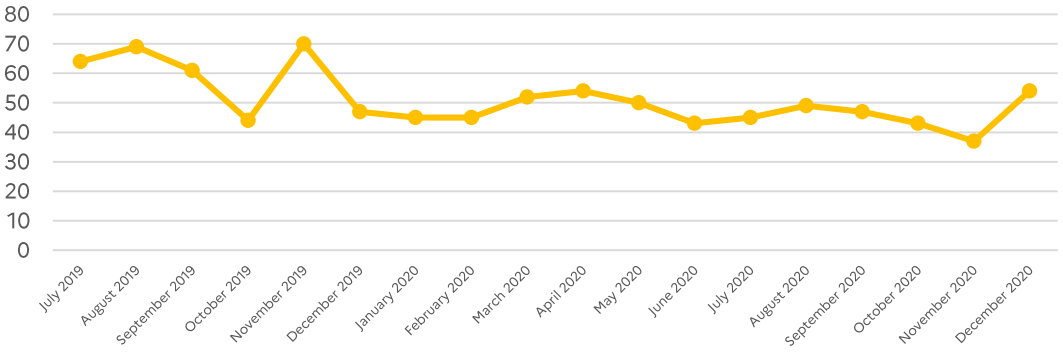

Figure 1: Monthly change in the number of cases of exposure to vaping products reported to poison control centres (N=919). Source: SICAP (July 2019 - December 2020).

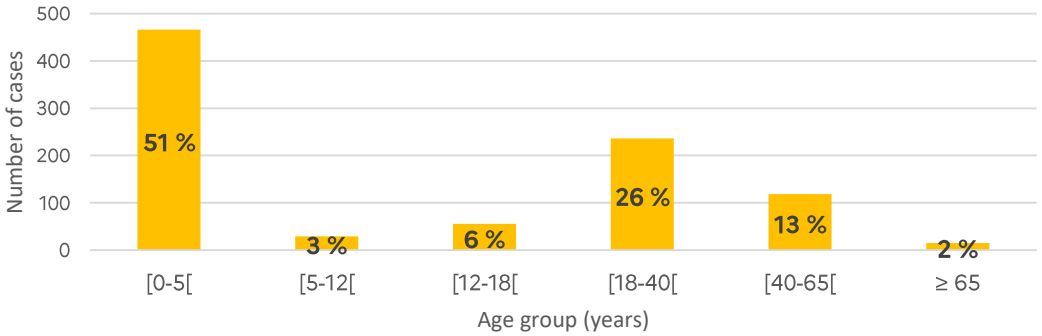

Figure 2: Number and percentage of cases of exposure to vaping products reported to poison control centres, by age group (N=919). Source: SICAP (July 2019 - December 2020).

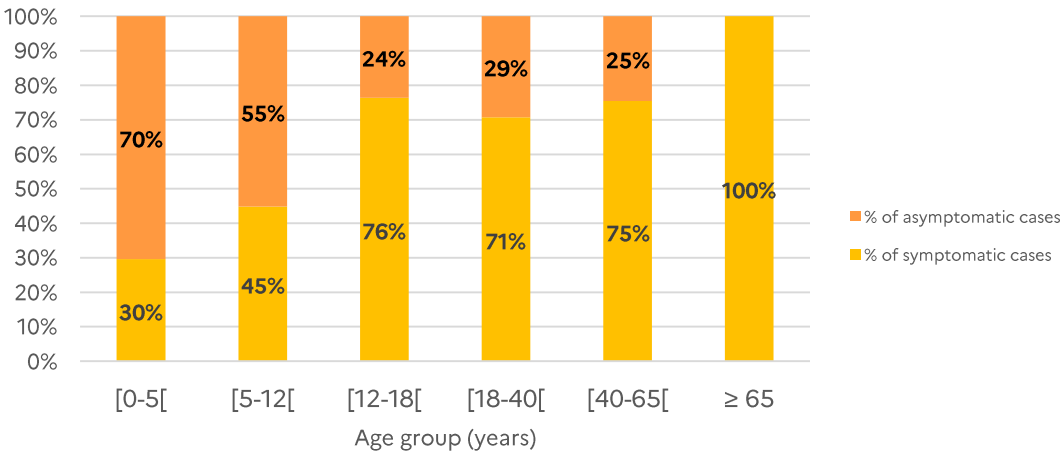

Figure 3: Percentage of symptomatic and asymptomatic cases by age group (N=919). Source: SICAP (July 2019 - December 2020).

Three cases were very serious, including a two-year-old child who swallowed a small amount of e-liquid after unscrewing the tank of an e-cigarette. The child experienced a tachycardia of 220 beats/min shortly afterwards, and was admitted to the hospital emergency department. They were discharged a few hours later, as the tachycardia had spontaneously resolved. The other two high severity cases were in adults:

- a man who ingested 10 ml of e-liquid containing 6 mg/ml of nicotine with the intention of committing suicide, and who suffered two generalised convulsive seizures and cardiovascular shock[1] in the hours following ingestion. He was admitted to hospital for one day, then his condition improved;

- a woman who had been vaping for nine months as part of an effort to give up smoking was hospitalised for 12 days with pneumothorax (collapsed lung). However, the lung specialist did not establish a definite link with the vaping.

When known, the outcome of the symptomatic cases was always favourable (91% of cases).

Circumstances specific to children

Among under-fives (n=469), the exposure cases were accidental in origin and mainly concerned ingestion of e-liquid (95%), due to the exploratory behaviour of this age group. The e-liquid bottles had either been opened by the children themselves, left open by others or were damaged. The other exposure circumstances were e-liquid splashes in the eyes or on the skin or, more rarely, inhalation after mimicking vaping while handling an e-cigarette.

For adolescents (n=55), although the sale of e-liquids is legally prohibited for them as it is for tobacco, 27% of the exposure cases in this age group resulted from "normal" use of e-cigarettes, 11% were due to e-liquid leaking into the mouth while vaping, and 11% were the result of e-liquid splashes when filling the e-cigarette tanks. The other circumstances, when known, were accidental in 36% of cases (confusion of an e-liquid refill with another product, accidental ingestion, exposure after unsuitable decanting of a vaping product), and intentional (suicide attempts) in 11%.

Between the ages of 18 and 40 years, the majority of exposure cases when using e-cigarettes were accidental, due to splashes when filling (33%) or leaks of e-liquid while vaping (19%). This trend was also found in the 40-65 age group. In people over 65 years of age, most exposure cases involved accidental ocular administration of e-liquid, due to confusion with eye drops (87% of cases).

Do It-Yourself[2] recipes and product confusion constitute significant sources of exposure

Despite the difficulty in collecting information that would enable the e-cigarettes or e-liquids involved to be characterised with certainty, in most cases the product could be precisely identified. The e-liquids responsible for exposure were ready-to-use products in 79% of cases and mostly contained nicotine, with levels ranging from 0.1 to 20 mg/ml. Eleven patients reported that their e-liquid contained cannabidiol (CBD).

In more than 20% of all cases in this study, the person had been exposed to an e-liquid from a DIY recipe, or to one or more of its components. The proportion of children under 12 years of age exposed to a DIY product (either already prepared or to one of its components) was 25%, compared with 15% of those over 12 years of age.

In 8% of all cases, the individual had used the e-liquid bottle instead of a medical product. In more than 75% of these cases, the individuals concerned had administered the e-liquid into their eyes instead of their eye drops. In the other cases, the bottle of e-liquid had been used instead of a bottle of vitamin D for children, or ear drops. The proportion of symptomatic patients in these circumstances was higher (81% versus 48% for other circumstances), mainly due to ocular damage from confusion with eye drops.

Results supported by the literature

These results are in line with those of the study by German poison control centres, which analysed the cases received between January 2015 and February 2019: they recorded about 20 cases per month, over half of which concerned minors; 50% of cases were asymptomatic and 83% involved accidental ingestion [3].

In the study by French poison control centres, half of the exposed individuals exhibited symptoms, in particular nausea and vomiting in the case of ingestion, the main route of exposure in the study. These symptoms are due to the nicotine present in more than 80% of the e-liquids involved in this study, and its pharmacological and irritant effects on the intestinal mucosa [4]. Children under five years of age were more often asymptomatic than adults, which is consistent with the small amounts of e-liquid ingested. Two studies by American and European poison control centres confirmed this by showing that a majority of cases in children under five years of age involved accidental exposure to e-liquids with low severity [5].

Monitoring to be continued to improve vaper safety

From a regulatory point of view, European Directive 2014/40/EU, which came into force in 2016, requires manufacturers to implement specific processes to avoid accidental exposure, such as child-resistant packaging that is impossible to open and nicotine concentrations below 20 mg/ml. The public authorities are well aware of the importance of introducing ways of regulating e-liquids to protect children and adolescents, by imposing restrictions on the sale and advertising of this type of product.

This study highlights the central role of the PCC network in monitoring these exposure cases. The large number of calls concerning children under five years of age most likely reflects the greater concern of parents, who are more likely to call a PCC for toxicology advice. However, although these young children had virtually no symptoms, it is important to reiterate that vaping products (e-cigarettes and e-liquids) should never be left unattended and within the reach of children. Refill cartridges should not be stored with medicines, to avoid confusion with eye drops or bottles of vitamins intended for children.

1.Cardiovascular shock is an excessive lowering of blood pressure leading to an inadequate supply of oxygen-rich blood to vital organs.
2.Vapers preparing their own e-liquids from ingredients purchased separately (dilution base, nicotine and concentrated flavours).

The growing trend for vapers to make their own e-liquids from DIY kits justifies the continuation of monitoring. Although the study found that most cases of exposure involved ready-to-use bottles, DIY kits warrant special attention because of the high concentration of ingredients used (flavourings and nicotine, which sometimes exceeds the maximum permitted level of 20 mg/ml) and because of the proportion of children under the age of 12 who were exposed to them. According to a survey conducted by BVA for ANSES in 2020, 33% of vapers use DIY liquids on a regular or exclusive basis. However, these products are not currently regulated.

ANSES therefore recommends that the European regulation, and particularly the associated reporting obligations, should be extended to all vaping products on the market, whether or not they contain nicotine, and whether they are sold ready to vape or made by the users themselves [6].

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