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Original Contributions

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PEDIATRIC EXPOSURES TO ELECTRONIC CIGARETTES REPORTED TO TEXAS POISON CENTERS

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☐ **Abstract—Background: Electronic cigarette use is increasing. There are concerns that pediatric exposures to these products may result in serious adverse affects. Objectives: This study describes pediatric exposures to electronic cigarettes. Methods: Cases were electronic cigarette exposures among patients age 5 years or less reported to Texas poison centers during January 2010–June 2014. The distribution by selected variables was determined. Results: Of 203 exposures, two cases were reported in 2010, five in 2011, 20 in 2012, 70 in 2013, and 106 in January–June 2014. Fifty-one percent of the patients were male; 32% of the patients were aged 1 year, and 42% were 2 years of age. Ninety-six percent of the exposures occurred at the patient's own residence. The exposure routes were ingestion (93%), dermal (11%), ocular (3%), and inhalation (2%). Fifty-eight percent of the patients were managed on site. Of the patients seen at a health care facility, 69% were treated or evaluated and released. Eleven percent of the exposures were serious. The most commonly reported clinical effects were vomiting (24%), drowsiness/lethargy (2%), and cough/choke (2%). The most frequent treatments were dilution/irrigation/wash (65%) and food/snack (16%). Conclusions: Electronic cigarette exposures involving young children reported to poison centers are increasing. Such exposures are likely to involve patients ages 2–3 years, occur at the child's own residence, and occur by ingestion. Further study is needed to determine which subgroups are at risk for serious outcomes and warrant evaluation at a health care facility.** © **2015 Elsevier Inc.**

☐ **Keywords—electronic cigarette; nicotine; poison center**

INTRODUCTION

Electronic cigarettes (also known as e-cigarettes) are battery-powered devices that heat a liquid solution of nicotine, flavorings (e.g., fruit, mint, chocolate), and other chemicals (e.g., propylene glycol, glycerol). The users then inhale the vapors that result (1–4). Electronic cigarettes first became easily available in the United States in 2006. They are advertised in TV commercials (2).

It has been suggested that electronic cigarettes are more cost-effective and socially acceptable than regular cigarettes. They also might be used in locations where smoking is restricted. In addition, electronic cigarettes have been marketed as aids to quit smoking (5). Although electronic cigarettes seem to have fewer toxins when compared to traditional cigarettes, little is known about the impact of electronic cigarettes on public health.

Electronic cigarette use is increasing in the United States. The HealthStyles survey, a national survey that collects health-related information from individuals ages 18 years and older in the United States, reported that awareness of electronic cigarettes increased from around 40% in 2010 to 58% in 2011. Ever use of electronic cigarettes by all respondents increased from

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2–3% to 6%, and by current smokers increased from 10% to 21% (5). According to the National Youth Tobacco Survey, a school-based questionnaire given to middle school and high school students during 2011–2012, ever use of electronic cigarettes increased from 1.4% to 2.7% among middle school students and from 4.7% to 10.0% among high school students (3). Moreover, electronic cigarette exposures reported to poison centers in the United States and Europe have increased annually since they appeared on the market (1,6–11).

Nicotine is readily absorbed through the lungs, skin, mucous membranes, and gastrointestinal tract. It binds to nicotinic cholinergic receptors, initially resulting in sympathetic nervous stimulation and, at higher doses, parasympathetic nervous stimulation. Adverse clinical effects most often found with electronic cigarette exposures reported to poison centers include vomiting, nausea, ocular irritation, dizziness, tachycardia, agitation, headache, red eye, abdominal pain, oral irritation, chest pain, coughing, flushing, palpitations, and confusion (1,6–13).

Electronic cigarette exposures are of particular concern for young children. The flavoring in electronic cigarettes may make them attractive to children (12). One study in France estimated that, based on a toxic dose in children of 1.4 mg/kg, a child would need to ingest as little as 0.4 electronic cigarette refill cartridges (containing 34 mg of nicotine) or <1 mL of liquid from a refill cartridge (concentration 16 mg/mL) (13). Moreover, the formulations of the products vary widely, with declared nicotine concentrations ranging from 18 mg/mL or less to 100 mg/mL (14). Thus, the amount of an electronic nicotine product that is potentially toxic to a child may be difficult to determine. Many states do not have restrictions on sales of electronic cigarettes to minors (1,3). Also, they are available over the Internet.

There is limited information in the literature on potentially adverse exposures to electronic cigarettes involving young children. The United States Food and Drug Administration Center for Tobacco Products maintains a database of voluntarily reported adverse events involving electronic cigarettes. During August 2008–September 2013, three cases involving patients age 5 years or less were reported. One infant choked to death on a cartridge, an 8-month-old suffered a spasm or dystonic reaction after secondhand exposure, and a 3-year-old suffered burns after an exploding electronic cigarette started a fire (15). In a published case report, a 10-month-old developed vomiting, tachycardia, and ataxia after ingestion of a "small" amount of electronic cigarette liquid (16).

Of total exposures reported to poison centers in the United States and Europe, the proportion that involved patients age 5 years or less ranged from 15% to 51% (1,6–11). However, most of these investigations contained little detailed information on exposures just among these young children. One study did provide a separate analysis for patients aged 19 years or less, of which 85% were 5 years old or younger (10). However, this study examined only several variables among this age group.

The intent of this investigation was to describe the pattern of potentially adverse electronic cigarette exposures involving young children reported to a large poison center system.

MATERIALS AND METHODS

The data source for this retrospective study was the Texas Poison Center Network (TPCN), a system of six poison centers that together service the entire state, which has a population aged 5 years or less of over 2.3 million. All of the poison centers in the TPCN use a common electronic database to collect information on all exposures in a consistent manner. The data variables and allowable codes in this database were standardized by the American Association of Poison Control Centers (17).

Cases were all electronic cigarette exposures reported to the TPCN during January 2010–June 2014 where the patient age was reported to be age 5 years or less. No exposures to electronic cigarettes among this age group were reported to the TPCN prior to 2010. Exposures not followed to a final medical outcome were included in the investigation because they accounted for almost one-third of all of the cases. Moreover, the prior study that provided information on patients aged 19 years and less likewise included all medical outcomes (10). The distribution of cases was determined for selected patient demographics, circumstances of the exposure, patient management, and outcome. Dose was not examined because it was unknown in 40% of cases and listed as a taste/lick/drop, sip, or mouthful in an additional 42% of the cases. Moreover, even if the amount were identified, dose would be difficult to calculate because different brands of the electronic cigarette containers vary in volume and nicotine concentration. Furthermore, the actual concentration may differ from the declared concentration (14).

The medical outcome or severity of an exposure is assigned by the poison center staff and is based on the observed or anticipated adverse clinical effects. Medical outcome is classified according to the following criteria: no effect (no symptoms due to exposure), minor effect (some minimally troublesome symptoms), moderate effect (more pronounced, prolonged symptoms), major effect (symptoms that are life-threatening or cause significant disability or disfigurement), and death. Not all exposures are followed to a final medical outcome