The Journal of Emergency Medicine, Vol. ■, No. ■, pp. 1–12, 2018

0736-4679/$ - see front matter

https://doi.org/10.1016/j.jemermed.2018.05.016

Selected Topics: Toxicology

SINGLE-USE LAUNDRY DETERGENT PACK EXPOSURES IN CHILDREN UNDER 6 YEARS: A PROSPECTIVE STUDY AT U.S. POISON CONTROL CENTERS

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☐ **Abstract—Background: After the widespread introduction of single-use liquid laundry detergent packs (LLDPs), a prospective observational study was initiated among 12 U.S. poison control centers (PCCs), serving 25% of the population. Objectives: To evaluate qualitative and quantitative data, including demographics, route of exposure, clinical effects, medical outcome, management site, level of care, and circumstantial variables surrounding the LLDP exposure. Methods: Analysis of LLDP exposures involving children (age < 6 years) reported to PCCs participating in the prospective study (March 2012–February 2016). PCCs captured a detailed exposure history and followed each patient to symptom resolution. Each case narrative was reviewed to isolate key patient, product, and situational variables and to verify accuracy of coded data. Trend and comparative analyses were performed on absolute case counts, relative proportions, and reporting rates normalized using Nielsen consumption data. Separately, the impact of exposure reduction interventions introduced by a single manufacturer were assessed by comparing reporting rate during pre-/postintervention periods. Results: There were 11,175 childhood exposures reported, with 90.3% involving children aged ≤ 3 years. Ingestion (82.6%) and ocular (14.2%) were the major routes of exposure. The size of the market for LLDPs more than doubled from ~2.0 to ~4.6 million LLDPs purchased. Total exposure reports increased from Year 1 (n = 2297) to Year 4 (n = 3206), however, normalized reporting rates dropped by 37% (4.4 to 2.8 exp/million LLDPs purchased). Significant declines ($p < 0.0001$) were also observed for ingestions and ocular exposures with major/moderate outcome. Conclusions: There was a significant reduction in exposures that resulted in major/moderate outcomes, and the majority of patients did not require intervention in an emergency department setting.**

☐ **Keywords—laundry pods; toxicology; pediatrics**

INTRODUCTION

Household cleaning products, including those used to clean laundry, are ubiquitous in U.S. households and remain the second leading source of exposures reported to poison control centers (PCCs) involving young children (American Association of Poison Control Centers annual reports, 1999–2015) (1). Single-use liquid laundry detergent packs (LLDPs) were widely introduced into the U.S. market in early 2012. Numerous published reports have described LLDP exposures in the United States, but until now they have involved case series, abstracts, cases managed by a single PCC or pediatric institution, or retrospective analyses of annual data available from the American Association of Poison Control Centers National Poison Data System or the National Electronic Injury Surveillance System database (2–21). Few of these studies have evaluated trends over time for demographic or clinical parameters collected by PCCs beyond the first 2 years of market introduction (2012–2013) (5,8,9). None of the studies provided data on the circumstances resulting in exposure to the LLDP.

Received: 29 November 2017; Final submission received: 10 April 2018;
Accepted: 30 May 2018

After market entry, a prospective observational study was initiated among regional PCCs in the United States and Canada to evaluate the in-market exposure experience for LLDPs with a focus on unintentional exposures in young children. The objectives of the study were to gather detailed qualitative and quantitative data, including demographics, route of exposure, clinical effects, medical outcome, management site, level of care, and circumstantial variables surrounding the LLDP exposure.

METHODS

Study Design and Data Sources

This is an analysis of exposure data reported to 12 U.S. PCCs participating in the ongoing prospective study, representing 18 geographically diverse states and a 2012 U.S. Census estimated population of ~74 million (all ages) that includes ~4.8 million children (age < 5 years) (22). This estimate represents 23.7% of the total U.S. population (all ages) and 23.8% of the total number of U.S. children age < 5 years, and is representative of the total U.S. population in terms of gender and age distribution. The protocol was reviewed by an institutional review board associated with each of the participating PCCs.

LLDP exposure cases identified using American Association of Poison Control Centers (AAPCC) generic codes for single-use laundry detergent products were downloaded from the National Poison Data System (NPDS). NPDS is a centralized surveillance database maintained by the AAPCC and used by all U.S.-based PCCs, including the 12 PCCs that participated in this study. The exposure narrative, containing a detailed written description of each PCC encounter, was obtained from the participating PCC study site and merged with the NPDS case record using a study database maintained by the coordinating center.

All exposures were managed and documented in accordance with the contributing PCC's standard operating procedures. Based on the route of exposure, follow-up calls were conducted at specified intervals after the initial PCC encounter (12–24 h for ingestions, 30 min to 3 h for ocular exposures, and 48–72 h for dermal exposures) and continued at regular intervals (e.g., every 1–2 days) until symptoms were resolved or anticipated to be permanent. Additionally, caregivers were asked a series of questions related to the circumstances of exposure, that is, those describing product, environmental, and situational variables. Responses were captured in the exposure narrative as free text and transcribed to coded fields within the study database.

The amount of product that consumers purchased in the United States was obtained from The Nielsen Company, LLC (New York, NY). These data were expressed in terms of millions of LLDPs purchased and used to normalize LLDP product exposures during the time period covered by this analysis.

Case Selection Criteria

Case eligibility was limited to human LLDP exposures involving a child (age < 6 years) reported by a participating PCC study site from March 1, 2012 through February 29, 2016. All LLDP products marketed during the study period were included in the dataset. The exposure narrative was reviewed to identify the specific LLDP product involved (brand, version, and manufacturer). Cases that involved a suspect LLDP product were included in the initial dataset even if additional products or substances were reported as suspected concomitant exposures. Excluded from analysis were exposures involving a single-use granular or solid detergent form, fabric care products that do not contain detergent (e.g., fabric booster), and products that were incorrectly coded as an LLDP (e.g., automatic dish detergents, multi-use formulations).

Variables

NPDS variables include patient demographics (age, gender, weight), exposure route(s), exposure reason, caller site, exposure site, substance, clinical effects, therapies, management site, level of health care received (if applicable), and medical outcome (Table 1) (1). If more than one route of exposure was reported, a primary route was assigned based on the most clinically significant symptoms identified. If there were no symptoms present, the primary route was assigned based on the focus of concern emphasized within the exposure narrative.

Additional variables, not otherwise available within NPDS, were coded within the study database based on a review of the exposure narrative. These variables include specific LLDP product attributes (brand, version, manufacturer, color, packaging), diagnostic procedures (e.g., laboratory values, endoscopy findings), PCC recommendations (health care referrals, monitoring instructions, compliance with recommendations, timing of triage decisions), and situational variables obtained from the caregiver interview. Endoscopic findings were reviewed by a physician (SY) who assigned a severity score (0: normal findings; 1: mild erythema or mild edema, or both; 2: superficial burns or moderate edema, or both; 3: deep burns or severe edema, or both). If an actual endoscopic grade was reported (1, 2, or 3), then the corresponding severity was assigned.

Situational variables coded in response to the caregiver interview included a description of how the product was