

Viewpoint

Pediatric Gastrointestinal Foreign Body Ingestions: A Current Perspective on High-Risk Objects

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Abstract

Foreign body ingestion (FBI) is a common pediatric emergency, particularly among children aged 3–6 years and those with developmental delays. While most ingestions are benign, certain high-risk objects, including button batteries, rare earth magnets, water beads, and sharp objects, require prompt identification and intervention to prevent significant morbidity and mortality. This narrative review synthesizes current epidemiology, injury mechanisms, diagnostic strategies, and evolving management guidelines for these high-risk ingestions, emphasizing the importance of timely intervention, standardized protocols, and ongoing advocacy for product safety and public education.

Keywords: pediatric foreign body ingestion; button battery; rare earth magnets; water bead ingestion; sharp object ingestion

1. Introduction

Foreign body ingestion (FBI) represents a pediatric emergency, primarily attributable to developmental behaviors such as oral exploration. It most commonly occurs in children aged 3–6 years, as well as in children with developmental delays and, less frequently, psychiatric illness [1,2]. It is distinct from foreign body aspiration, which, while also an emergency, occurs less frequently. Coins remain the most commonly ingested objects [2]. However, certain particularly high-risk items, such as button batteries (BBs), rare earth magnets (REMs), water beads (WBs), and sharp objects (SOs), necessitate prompt localization and intervention to mitigate significant morbidity and mortality.

The esophagus is a frequent site for impaction of ingested foreign bodies, accounting for 29–68% of emergency department (ED) presentations [3,4]. As illustrated in Figure 1, the esophagus has three anatomical narrowing points prone to impaction: the thoracic inlet at the cricopharyngeal muscle, the mid-esophagus at the aortic crossover, and the distal esophagus at the lower esophageal sphincter [5]. While most small objects pass beyond the stomach without incident, management controversies persist, particularly for high-risk items in the stomach and small bowel. Notably, FBIs are often asymptomatic; thus, high-risk object ingestion warrants diagnostic imaging regardless of symptomatology [2,6,7]. Similarly, symptoms may be nonspecific, requiring a high index of suspicion for FBI even in the absence of witnessed ingestion. This narrative review synthesizes recent reports in

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the epidemiology, injury mechanisms, diagnostic strategies, and evolving management guidelines for pediatric ingestions of BBs, REMs, WBs, and sharp objects.

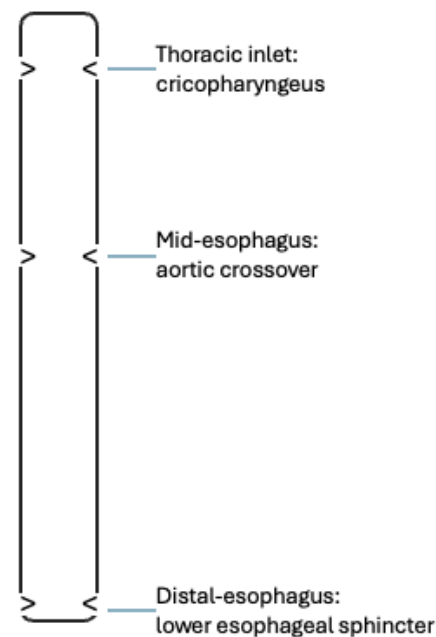


Figure 1. Anatomical narrowing points of the esophagus are prone to foreign body impaction.

2. Button Batteries

Button batteries (BBs) are ubiquitous in household items such as remote controls, watches, kitchen appliances, and toys. BBs are flat, disc-shaped cells with distinct positive and negative poles; larger diameters (>20 mm) are particularly concerning due to higher voltage. Their small size, high energy potential, and widespread presence render them a significant public health hazard, with ingestion rates increasing by 66.7% from 1999 to 2019 [8]. Additionally, US surveillance data revealed a more than twofold increase in ED visits for battery-related injuries between 1990 and 2009, equating to approximately one pediatric battery-related ED visit every 1.25 h in the following decade [9].

When a BB lodges in the esophagus, contact between the poles completes an electrical circuit, generating hydroxide radicals at the negative pole and causing rapid alkaline liquefactive necrosis. Mucosal erosion can begin within two hours, progressing to battery adherence, esophageal perforation, tracheoesophageal fistula, or vascular-enteric fistula. BB ingestion is thus the most dangerous form of FBI, with fatalities reported from massive hemorrhage due to aorto-esophageal fistulas [10]. Esophageal impaction requires emergent endoscopic removal, ideally within two hours of presentation. Initial symptoms may be absent or include drooling, dysphagia, or vomiting. Hematemesis, when present, may signal more severe injury and/or erosion into vascular structures. Unexplained symptoms in young or non-verbal children, even without a known history of ingestion, should prompt imaging, especially if hematemesis is present [11]. Although this review focuses on ingested BB, lodgment in other moist anatomical sites like the nasal cavity, external auditory canal, or vagina also constitutes a medical emergency and requires prompt removal.

Biplanar chest and abdominal radiographs, including anterior–posterior and lateral views, are essential for localization and to distinguish BBs from coins. BBs and coins may appear similar on AP views; careful assessment for the “halo,” “double ring,” or “flying saucer” signs, and the lateral “step off” sign, aids identification. Case reports have described adjustment of radiographic windowing or exposure parameters to enhance visualization of metallic detail, occasionally allowing recognition of features consistent with coins. This

may be considered an adjunctive technique when distinguishing BBs from coins [12,13]. If esophageal impaction is suspected, oral honey or sucralfate is recommended while awaiting definitive removal [14,15]. This is based on limited evidence, but there is minimal-to-no likelihood of harm. These weak acids coat the BB, limiting electrolysis and neutralizing hydroxide ions [16]. Honey, at a dose of 10 mL every 10 min for up to six doses, may be administered pre-hospital by caregivers for children ≥ 12 months old if ingestion occurred within the preceding 12 h. In the ED, honey or sucralfate at the same dose may be used while awaiting endoscopy in the same population. Honey is contraindicated in children under 12 months due to botulism risk.

Emergency department management of suspected or confirmed BB ingestions should prioritize rapid diagnosis and transfer to the endoscopy suite. Due to the rapid onset and progression of tissue damage from the battery's negative pole, even short delays may worsen prognosis. In one quality improvement study, implementation of a specific multidisciplinary team and protocol for patients presenting with BB ingestion reduced transfer time by 4.2 h and improved multiple other metrics, including direct referrals to otolaryngology and mitigation measures such as honey or sucralfate pre-procedure and acetic acid lavage post-removal [15]. This single-center study, while encouraging, was not adequately powered to detect differences in morbidity and mortality.

If radiographs confirm BB passage beyond the esophagus and the child is asymptomatic, management is not as straightforward. Symptomatic patients require endoscopic or surgical removal. Guidelines differ regarding asymptomatic gastric BBs. The primary concern is not gastric injury, but rather the risk of esophageal injury from transient impaction during its path through the gastrointestinal tract. The North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) recommends diagnostic endoscopy within 24–48 h for children under 5 years with BBs > 20 mm, primarily to assess for esophageal injury [17]. For older children or BBs < 20 mm, outpatient follow-up with radiographs is advised within 48 h for larger BBs and 10–14 days for smaller ones. Endoscopic removal is indicated if the BB remains in the stomach at follow-up. However, updated guidelines are not currently available, and a retrospective study reported a gastric mucosal injury prevalence of 21% among patients with gastric BBs who underwent endoscopic removal [1]. The Button Battery Taskforce recommends outpatient radiographs at 4 days for higher risk cases or 10–14 days for lower risk cases, with endoscopic removal if the BB persists [18]. The European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) tailors recommendations to the time since ingestion: for diagnoses within 12 h, follow-up radiographs at 7–14 days; for diagnoses after 12 h, evaluation for esophageal and vascular injury with endoscopy and CT angiography is advised [14].

Advocacy and policy initiatives have targeted manufacturers, policymakers, and public awareness. The U.S. Consumer Products Safety Commission (CPSC) now requires child-resistant battery compartments in products intended for children under three years [19]. In 2022, Reese's Law mandated child-resistant packaging and compartments [20]. Manufacturers have responded by implementing design-based safety measures with improved packaging and, in some cases, bitter coatings to deter ingestion. More recently, a manufacturer has introduced a food-safe dye incorporated into button batteries that is released upon contact with saliva, providing a safety cue to caregivers to seek immediate medical attention following a suspected ingestion [21]. Advocacy groups have called for safer batteries, better public awareness, and increased regulation [22].

3. Rare Earth Magnets

Rare earth magnets (REMs), first developed in the 1980s, became increasingly accessible over time as early foundational patents expired in the 2000s and global manufacturing

capacity expanded [23–25]. Ingestion of a single magnet typically poses minimal risk; however, multiple REMs or a single REM in combination with other metallic objects present a significant hazard due to the strong magnetic attraction, which can compress bowel loops and result in ischemia, necrosis, perforation, or fistula formation. Tissue injury may occur within eight hours of ingestion. Multiple magnet ingestion is common, attributable to their small size, vibrant appearance, and packaging in large quantities.

After REMs entered the consumer market, reports of magnet ingestions to the National Electronic Injury Surveillance System (NEISS) increased 8.5-fold from 2002 to 2011 [26]. The CPSC responded by restricting sales and recalling high-powered magnet sets in 2012, followed by mandated reductions in magnetic strength in 2014 [27,28]. However, the reversal of these regulations in 2016 led to a marked increase in multiple magnet ingestions [29,30]. This trend extended beyond the United States, with Canada also reporting a rise in cases [31]. In 2022, the CPSC reinstated a ban on high-powered magnets for non-industrial use, yet REM ingestions continue to occur [32].

Diagnosis is challenging, as clinical presentation is often non-specific or asymptomatic [33–35]. When present, abdominal pain and vomiting are the most common symptoms [33,35,36]. Biplanar radiographs are essential to determine both the number and location of magnets, as anteroposterior views alone may underestimate quantity. Given reports of magnet impaction in the hypopharynx concurrent with abdominal magnet presence, comprehensive imaging from nose to pelvis should be considered [37,38]. A 2025 UK national study found that over half of magnet ingestions involved multiple magnets, while a US single-center study reported a mean ingestion of 6.4 magnets (range 2–68) [34,35].

Management centers on urgent endoscopic removal of multiple magnets located in the esophagus or stomach. For asymptomatic patients with multiple magnets beyond the stomach, conservative inpatient observation with serial radiographs every 4–6 or 8–12 h and administration of laxatives such as PEG 3350 is recommended [36]. Failure of progression or development of symptoms necessitates surgical consultation. Notably, midline crossing of REMs on serial imaging is associated with a decreased need for surgical intervention; this may be considered as potential evidence of progression [34]. Invasive procedures are required in most cases, with surgery required in 10–43% [33–35,39].

Advocacy efforts emphasize the importance of warning labels and the restriction of hazardous content on social media, particularly material that promotes risky behaviors such as using REMs to mimic tongue piercings.

4. Water Beads

Water beads (WB) are superabsorbent polymers that expand dramatically when hydrated, reaching up to 56 mm in diameter within the gastrointestinal tract [40]. Sold in packages containing thousands, and until recently marketed as sensory toys, gel projectiles, decorations, and horticultural products, WBs pose an emerging threat to children due to their small initial size, bright colors, and attractive packaging.

NEISS data show no WB cases before 2007, but ED visits have increased markedly since 2013, with rates increasing by more than 100% annually in both 2021 and 2022 [41]. The CPSC estimates 6300 cases of water bead ingestion in the 5-year period from 2017 to 2022 [42]. Expansion within the gastrointestinal tract can cause obstruction and, less commonly, perforation, particularly when multiple water beads coalesce to create a gelatinous bezoar that is too wide to pass through the narrower sections. Acrylamide content raises concerns about neurotoxicity, and some WB products have also been found to contain the harmful substance bisphenol A [41,43–45]. The CPSC has periodically recalled WB products resembling candy since 2013, and in 2025, approved a new federal safety standard aimed at reducing the risk of injury and death from ingestion of water beads in children [42].

Reported cases typically involve young children, with ages ranging from 7 to 26 months, ingesting multiple beads [46,47]. A retrospective review of water bead ingestions between 2013 and 2023 found that while most cases occurred in children aged 0–5 years, 14% involved children aged 6–18 years, some of whom had developmental delays [48]. Diagnosis is often delayed for two primary reasons: first, water beads expand gradually as they transit through the digestive tract and absorb fluid, leading to delayed symptoms onset; and second, affected children often present with non-specific symptoms such as decreased oral intake and vomiting that mimic other common diagnoses. Small bowel obstruction requiring laparotomy, sometimes repeated for missed beads, has been described [47]. Diagnosis is challenging as WBs are radiolucent and plain radiographs are unreliable. Point-of-care ultrasound (POCUS), CT, and specific MRI sequences are recommended for detection and management [40]. Gastrografin contrast studies may aid both diagnosis and therapy, as both in vitro and ex vivo pig studies demonstrate that it can shrink WBs, but evidence in humans is limited [49,50]. Osmotic laxatives should be avoided as they may cause expansion of water beads [49].

Despite a dramatic rise in WB-related emergency visits since 2021, pediatric gastroenterology societies have yet to publish specific management guidelines [41]. Expectant management is typically pursued in older and/or asymptomatic children, with approximately 90% able to be discharged from the ED, even in the setting of multiple bead ingestion [48]. Younger children and those with symptoms are more likely to require admission with medical and/or surgical intervention, which ranges from pro-motility medications and close observation to laparotomy.

Prevention of WB ingestion has been challenging. Advocacy has focused on restricting access and mandating compositional changes. In December 2025, the CPSC limited the maximum expanded diameter of WBs marketed as toys to 5 mm, restricted acrylamide content, and began requiring clearer, more detailed, and more prominent warning labels for water beads marketed as toys to children under 14 years [42]. However, these rules do not apply to WBs marketed for decoration or horticulture, limiting but not eliminating pediatric exposure.

5. Sharp Objects

Sharp objects (SO) that pose a risk of GI tract perforation are varied and may include pins, needles, glass shards, wood splinters, toys, fish and chicken bones, razor blades, jewelry, heated tobacco sticks containing micro-blades, and other types of blades [51]. One study of 580 pediatric patients who presented with SO ingestion found that nearly half (46.55%) presented with metal object ingestions, while 31% presented with glass shard ingestion and 11% with fishbone ingestion [52]. Epidemiology of ingested SOs varies considerably by geographic location and environment, with one Israeli study showing 13% of sharp object ingestions consisting of hijab pins and a study from India showing 11% of all ingestions to be nails or screws [6,53].

It is essential to establish the location and type of object ingested promptly. Many sharp ingested FBs, even those that are radio-opaque, may be small and narrow, such as pins and needles, making diagnosis more difficult. Radiolucent objects such as wood splinters are not easily visualized on a plain X-ray. They may still show findings consistent with FB, including free air, air trapping, or tracheal compression or deviation, but a negative X-ray should not be interpreted as the absence of a foreign body, especially if there are symptoms and/or a convincing history [5]. Multiple other modalities of imaging have been successfully used, although MRI use should be avoided until the absence of metal is confirmed. POCUS has shown promise in identifying radiolucent FBI in small case series, but large studies are lacking at this time, and, depending on location, views may be obscured by bowel gas [54,55].

SOs, like other high-risk objects, may become impacted in the esophagus and cause tissue damage or perforation. Thus, esophageal sharp foreign bodies should be removed as soon as possible, with caution to avoid further injury during the removal procedure. The consensus is that most SOs should be removed if they are accessible by endoscopy to avoid the risk of perforation further down in the GI tract [17,56]. Certain sharp objects have traditionally been thought to be higher risk than others, with narrow and sharply pointed objects more likely to cause perforation, while foreign bodies with sharp edges rather than sharp points, such as razor blades, as well as objects with one sharp point but a blunt base, such as nails and screws, may be lower risk. Adult studies show that thin and pointed objects, such as sewing needles and toothpicks, as well as fish and chicken bones, are relatively high-risk for complications, including bowel perforation and mortality [57]. Most published pediatric studies are small and do not differentiate between types of sharp objects, although toothpicks, needles, and fish and chicken bones are commonly identified as high risk [2]. Quitadamo et al. conducted the largest study to date of the management and outcomes of pediatric SO ingestions [52]. In their retrospective review of 580 pediatric patients presenting with accidental SO ingestion, the vast majority (96.2%) of patients were asymptomatic. Nearly half (46.55%) had ingested various metal objects, including earrings, pins, needles, hairpins, screws, and other objects. 31% had ingested glass shards, while the remaining ingestions included plastic objects, fish and chicken bones, and assorted other sharp objects. 104 (17.9%) of 580 patients met criteria for endoscopic removal, but only 78 (13.4%) of the patients underwent endoscopy. The remainder were managed expectantly due to clinician preference, anesthetic contraindications, or rapid distal passage. Although the authors do not specify which objects were more prevalent in the patients who were managed expectantly, none of the expectantly managed patients experienced perforation or required surgical management of their ingested SO. This suggests that additional studies are needed to clarify which sharp objects are the highest risk in pediatric patients, as it appears to be quite different from adults.

Although more evidence is needed to guide management, it is reasonable to recommend urgent endoscopic removal of gastric and proximal duodenal SOs at the discretion of the treating clinician, with expectant management in some cases, depending on size, location, and type of object. SOs located in the intestine beyond the proximal duodenum should be managed with serial radiographs if radio-opaque and/or inspection of stools until the object is passed, which can often be performed as an outpatient.

Prevention of SO ingestion is less amenable to regulation than prevention of BBs, REMs, and WBs, but should include public education campaigns about keeping sharp objects out of reach of young children, not putting sharp objects like pins in the mouth while sewing, and seeking care promptly if a sharp object is accidentally ingested.

6. Multiple Ingestions

Multiple ingestions are much less common in pediatric patients than in adults. When they do occur, it is typically in adolescents who ingest multiple objects (e.g., wood, tools, cutlery, pens) to self-harm [57]. There is limited literature on the evaluation and management of these ingestions in pediatric patients. However, treating clinicians should obtain a detailed history, including collateral information from family members regarding what objects may have been available to the patient, especially if they are unwilling or unable to provide a detailed history themselves. Plain radiographs can be used to evaluate for radio-opaque high-risk foreign bodies such as BBs, coins, and large or sharp metal objects, although clinicians must keep in mind that many foreign bodies, including sharp objects such as toothpicks or glass shards, are not easily visible on X-ray. CT or ultrasound may be considered, but sensitivity for the detection of toothpicks, glass shards, and sewing needles

remains low, regardless of the imaging modality [57]. Many of these patients require case-specific management based on symptomatology and length and type of foreign body; however, early involvement of a multidisciplinary team and prompt endoscopy in the absence of absolute contraindications is advisable.

Guidance from NASPGHAN and ESPGHAN on management of BB, REM, WB, and SO is summarized in Table 1.

Table 1. Comparison of NASPGHAN and ESPGHAN guidelines on the management of selected high-risk foreign body ingestions.

Foreign Body	NASPGHAN (Key Guidance)	ESPGHAN (Key Guidance)	Notes/Key Distinctions
Button batteries (BB)	Esophageal BB require emergent removal. Gastric BB management is risk stratified guided by age, battery size, location, and time since ingestion.	Esophageal BB require emergent removal. Gastric BB management is risk stratified guided by age, battery size, location, and time since ingestion.	Guidance is concordant between societies for esophageal BB. Minor differences exist in age and size thresholds for select gastric cases. ESPGHAN mentions honey/sucralfate as an early consideration.
Rare earth magnets (REM)	Ingestion of multiple REM requires urgent endoscopic removal. Asymptomatic single REM ingestion may be managed expectantly with close clinical and radiographic observation.	Ingestion of multiple REM requires urgent endoscopic removal. Asymptomatic single REM ingestion may be managed expectantly with close clinical and radiographic observation.	NASPGHAN explicitly describes magnet ingestion scenarios (multiple REM or REM with metallic object), while ESPGHAN addresses magnets within broader high-risk foreign body frameworks.
Water beads (WB)	No formal guidelines	No formal guidelines	Management is extrapolated from general foreign-body ingestion principles and case-based evidence.
Sharp objects (SO)	Esophageal SO require urgent endoscopic removal. SO in the stomach and beyond may be managed expectantly with close clinical and radiographic observation.	Esophageal SO require urgent endoscopic removal. SO in the stomach and beyond may be managed expectantly with close clinical and radiographic observation.	Guidance is concordant between societies. Management decisions beyond the esophagus are individualized based on symptoms, object characteristics, and progression through the GI tract.

Abbreviations: NASPGHAN, North American Society for Pediatric Gastroenterology, Hepatology and Nutrition; ESPGHAN, European Society for Paediatric Gastroenterology, Hepatology and Nutrition; BB, button batteries; REM, rare earth magnet; WB, water beads; SO, sharp objects. Sources: NASPGHAN Endoscopy Committee clinical report on management of ingested foreign bodies in children [17]; ESPGHAN position paper on button battery ingestion [14], ESPGHAN position paper on magnet ingestion [36]; ESPGHAN pediatric endoscopy guidelines [58].

7. Discussion

This narrative review describes current evaluation and management of high-risk pediatric FBIs, which remains complex and is summarized in Table 2. Debates continue, and more high-quality studies are needed to guide clinicians on optimal imaging protocols, timing of intervention, best practices for implementation of care bundles and multi-disciplinary teams, and the necessity of universal endoscopic intervention for objects in the stomach or proximal duodenum. The clinical mantra “time is tissue” is especially applicable for

esophageal BB, which can cause liquefactive necrosis within just 2 h of contact. Additionally, urgent REM removal is indicated when multiple magnets or a combination of magnets and metallic objects are within endoscopic reach, as the force they exert toward one another can cause pressure necrosis, bowel perforation, and fistula formation. Delays in care remain prevalent, especially in rural areas without access to pediatric endoscopy capabilities, and mitigation techniques are not universally implemented. Implementation of diagnosis-specific bundles reduces time to intervention for high-risk ingestions and may improve outcomes; this should be further explored and standardized.

Table 2. Summary table on high-risk foreign body ingestions.

Foreign Body Type	Specific Injury/Danger	Diagnostic Approach	Management Approach	Special Notes
Button Batteries (BBs)	Rapid alkaline liquefaction necrosis, esophageal perforation, tracheoesophageal or vascular fistula, fatal hemorrhage	Biplanar X-rays; look for “halo,” “double ring,” “step off” signs	Emergent endoscopic removal if esophageal; honey/sucralfate pre-endoscopy (if <12 h, age ≥12 months); outpatient follow-up for gastric BBs per guidelines	Risk of esophageal injury persists for delayed presentation, even with distal location of BB
Rare Earth Magnets (REMs)	Bowel wall compression, ischemia, necrosis, perforation, fistula formation	Biplanar X-rays to assess number/location	Urgent endoscopic removal if accessible; inpatient observation with serial X-rays and laxatives for distal magnets; surgery if no progression or symptoms develop	Regulatory bans exist but exposures continue; social media may promote risky behaviors
Water Beads (WBs)	GI obstruction, perforation, possible neurotoxicity (acrylamide)	Ultrasound, CT, MRI; plain X-rays may be unreliable (radiolucent); consider gastrografin contrast studies	Supportive care; surgical intervention for obstruction; imaging to locate beads; gastrografin may shrink beads	Diagnosis often delayed; new regulations limit toy bead size/content; non-toy beads remain a hazard

The lack of specific guidelines for WB and SO ingestion, as well as the limited literature on multiple ingestions in the pediatric population, underscores the need for further high-quality research and consensus. Recent retrospective studies suggest that expectant management may be appropriate in selected cases where FB are in the stomach or duodenum at initial presentation, with larger numbers of WBs or larger SOs and smaller patient size corresponding to increased risk of complications. Future efforts should focus on refining risk stratification tools, standardizing imaging protocols, and implementing diagnosis-specific bundles and multi-disciplinary teams that improve the timeliness of interventions.

8. Conclusions

Effective management of high-risk pediatric foreign body ingestions requires a high index of suspicion, including in asymptomatic patients with a known or suspected ingestion history and in symptomatic patients without a known history of FBI. Accurate diagnostics and timely intervention are essential in preventing morbidity and mortality. Nevertheless, persistent uncertainties in optimal management persist. The development of evidence-based guidelines for WB and SO ingestion is a priority, as is updating BB and REM ingestion guidelines to reflect the most recent evidence. These guidelines should address the best evidence regarding imaging, endoscopic intervention, and effective ways, including implementation of bundles or protocols, to reduce delays in care.

Finally, continued advocacy for product safety and public education is essential to reduce the morbidity and mortality associated with these preventable injuries. Regulation and legislation to prevent high-risk ingestions should be evidence-based, while education

of parents and families about the dangers of high-risk household objects should be ongoing at both the individual health provider and public health levels.

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