Journal of Pediatric Gastroenterology and Nutrition, Publish Ahead of Print
DOI : 10.1097/MPG.0000000000002955

Magnet Ingestions in Children Presenting to Emergency Departments in the United States 2009-2019: A Problem in Flux

Patrick T. Reeves MD[1,2], Bryan Rudolph, MD, MPH[3], Cade M. Nylund MD[1,2]

[1]Department of Pediatrics, Walter Reed National Military Medical Center, Bethesda, MD

[2]Department of Pediatrics, Uniformed Services University of the Health Sciences, Bethesda, MD

[3]Department of Pediatrics, The Children's Hospital at Montefiore, Bronx, NY

Address Correspondence to:

Patrick Reeves
8901 Rockville Pike, Bethesda, MD, 20814
Fax (301) 319-2420
Office (301) 295-4959
patrick.t.reeves.mil@mail.mil

Short title: Pediatric Magnet Ingestions after 2016

Funding Source:
There was no funding support beyond the salary disclaimers, as above, for the completion of this project.

Conflicts of Interest:
Salary support was provided for Drs. Reeves and Nylund by the United States Department of Defense. The authors have no financial relationships relevant to this article to disclose.

Disclaimer:

This work was prepared as part of the official duties of Drs. Reeves and Nylund who are employed by the United States Army and Air Force. The views expressed in this article are those of the authors and do not reflect the official policy or position of the United States Army, Air Force, Department of Defense, or the United States Government. Title 17 U.S.C. 105 provides that ''Copyright protection under this title is not available for any work of the United States Government.'' Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person's official duties.

Salary support was provided for Drs. Reeves and Nylund by the United States Department of Defense. The authors report no conflicts of interest.

Contributors' Statement Page:

Patrick Reeves (patrick.t.reeves.mil@mail.mil) conceptualized the study, interpreted the data analysis, drafted the manuscript, and approved the final manuscript.

Bryan Rudolph (brudolph@montefiore.org) contributed to study design, developed the data analysis plan, interpreted the data, and revised the manuscript.

Cade Nylund (cade.nylund@usuhs.edu) contributed to study design, performed the statistical analysis, interpreted the data, revised the manuscript, and served as subject matter expert and project manager.

All authors approved the final version of the manuscript.

Abstract:

Background:

Small rare-earth magnet (SREM) ingestions are a dangerous, potentially fatal health hazard in children. The U.S. Consumer Safety Commission removed these products from the market in 2012 until a federal court decision vacated this action in 2016. This study aims to investigate whether the reintroduction of SREMs is associated with an increase in the national frequency of magnet ingestions in children.

Methods:

Data from the National Electronic Injury Surveillance System (NEISS) were used to evaluate suspected magnet ingestion (SMI) trends within patients (0-17 years) from 2009-2019. SMI cases were stratified (total, small/round, and multiple magnet ingestions) and trend analyses were performed for two periods: 2013-2016 (off-market) and 2017-2019 (on-market). National SMI estimates calculated using the NEISS-supplied weights and variance variables.

Results:

An estimated 23,756 children (59% males, 42% < 5 years old) presented with a SMI from 2009-2019 with an average annual case increase of 6.1% (P=0.01) There was a significant increase in both small/round SMI encounters and multiple magnet ingestion encounters from 2009-2019 (P<0.001 and P<0.01, respectively). From 2017-2019, there was a greater proportion of small/round type SMIs to total SMIs estimated n=541 (CI, 261-822) and a greater proportion of multiple magnet ingestions to total SMIs estimated n=797 (CI, 442-1,152) (both, P<0.01). After 2017, there was a 5-fold increase in the escalation of care for multiple magnet ingestions (estimated n=1,094; CI 505-1,686).

Conclusions:

The significant increase in magnet ingestions by children from 2017-2019 indicates that regulatory actions are urgently needed to protect children and reverse these trends.

Keywords:
advocacy, foreign bodies, ingestion, magnets

Table of Contents:
This study provides national estimates of magnet ingestion in U.S. children between 2009-2019 and the first such estimate since high-powered magnets re-entered the market.

What's Known on This Subject:

- The U.S. Consumer Product Safety Commission effectively banned the sale of high-powered magnet sets in 2012.
- Magnet ingestions decreased 28% until a federal court decision allowed high-powered magnets to re-enter the U.S. market in 2016.
- Multiple public policy decisions are pending additional ingestion data, including proposed federal legislation.

What This Study Adds:

- Total magnet ingestions, likely high-powered magnet ingestions, and multiple magnet ingestions all substantially increased after 2016.
- Escalation of care, defined as hospital admission or transfer, also increased after 2016.

Abbreviations: emergency department (ED); United States (US), Center for Disease Control (CDC), Consumer Product Safety Commission (CPSC), Small rare-earth magnets (SREMs), American Society for Testing and Materials now ASTM International (ASTM), North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN), American Academy of Pediatrics (AAP), magnet rule set (MRS), National Electronic Injury Surveillance System (NEISS), confidence intervals (CI), suspected magnet ingestion (SMI), small or round (small/round), 2013-2016 (off-market), 2017-2019 (on-market)

Introduction

Small rare-earth magnet sets (SREMs) are a novelty item comprised of extremely powerful, small, easily manipulated neodymium magnets. Sold in sets of up to 1,000, they were first introduced in 2009 and marketed as stress-relieving desk toys, currently intended for consumers over the age of 14.[1] Despite the use of warning labels and multiple public education campaigns, however, the sale of SREMs has coincided with a significant uptrend of magnet ingestions in children of all ages.[2,3]

When more than one is ingested, high-powered magnets frequently attach across bowel loops and cut off the vascular supply, leading to tissue perforation, fistulae, sepsis, or death.[4-9] Given this unique health hazard and increased injury frequency, in 2012 the North American Society for Pediatric Gastroenterology Hepatology and Nutrition (NASPGHAN), the American Academy of Pediatrics (AAP), and numerous consumer groups lobbied the U.S. Consumer Product Safety Commission (CPSC) to take action. Within a matter of months the CPSC did so, issuing a recall order and notice of proposed rulemaking to effectively ban high-powered magnet sets.[10] These actions are credited for the decrease in pediatric magnet ingestions that followed.[11]

One company, however, contested these actions and sued the CPSC in federal court.[12] On November 22, 2016, the 10th Circuit Court sided with that company, Zen Magnets, and vacated the magnet rule set (MRS), once again allowing SREMs to be sold within the United States.[13] The number of magnet ingestions in children is believed to have increased substantially since then, though national estimates are lacking. [14]

In the interim, Zen Magnets has pushed for a new rule set that relies on warning labels and packaging requirements alone – steps that are ineffective in preventing injuries.[2,3] A magnet rule set is nevertheless close to passage within ASTM International (ASTM)- formerly the American Society for Testing and Material- an organization responsible for developing product safety standards often adopted by the CPSC, over the objections of NAPGHAN, the AAP, consumer groups, and even CPSC staff from the Office of Hazard Identification and Reduction.[15] The objections are that warning labels, as the CPSC has acknowledged, do not work. Therefore, NASPGHAN, the AAP and others believe there should be a "performance standard" (i.e. making magnets too large to swallow or too weak to cause harm) instead. Meanwhile, Congress is now considering legislation that would essentially ban high-powered magnet sets.[16,17]

Additional data are urgently needed to inform these pending public policy decisions. We therefore utilized the National Electronic Injury Surveillance System (NEISS), a database of consumer product injuries that provides a stratified national probability sample, to investigate whether magnet ingestions have increased since high-powered magnets re-entered the U.S. market.

Methods

We identified magnet ingestions from 2009-2019 utilizing the National Electronic Injury Surveillance System (NEISS) database, with a particular focus on two time periods: 2013-2016 (off-market), when the MRS was in place and SREMs within the U.S. were effectively banned, and 2017-2019 (on-market), when sale of SREMs resumed following the Tenth Circuit Court decision. Methods outlined in the proceeding paragraphs are similar to those previously published by members of this research group. [18]

Data Source and Study Population

The NEISS database catalogues ED visits for injuries related to consumer products over a nation-wide census. Specifically, the system functions as a stratified national probability sample of hospitals that have at least six beds and an emergency department. All institutions included in the database provide 24-hour services through their respective ED and all possess the basic capabilities to treat children. NEISS thereby serves as a public health tool by pairing injury data with national census statistics, allowing for correlative conclusions on product risks.

Inclusion Criteria and Variable Classification

NEISS was queried to capture suspected magnet ingestion (SMI) cases in subjects 0-17 years of age using "ingested object" as the primary diagnostic search term. "Total" magnet ingestion cases were identified if the word magnet appeared anywhere in the case narrative section. These include any magnet ingestion, regardless of type or source. "Small/round" magnet ingestion cases, which are likely SREM-related, were identified by narrative words such as "small," "tiny," "1 cm or less (specified)," "toy," "battery-like," "marble," "bead," "BB," "ball," "sphere," "round," or "circular." Suspected multiple magnet ingestions were identified by narrative words such as "multiple," "number specified greater than 1," or the plural word, "magnets." Clinical and demographic data were captured, as were any recorded outcome data (e.g., hospitalization or discharge). Cases were designated as "escalation of care" if the disposition code for the encounter included "treated and transferred," "treated and admitted/hospitalized," or "held for observation."

Statistical Analysis

NEISS supplied weights and variance variables used in all analyses. Taylor series linearization was used to generate national estimates with 95% confidence intervals (CI). This procedure takes a component of interest (the actual number of suspected magnet ingestions in a single year) and uses a linear estimator (national census data) to approximate population-wide values. Of note, national estimates were not reported if fewer than 30 cases were identified, as low case numbers tend to produce uninterpretable estimates with high coefficients of variation and wide confidence intervals. Population aggregate incidence rates were calculated using United States Census Bureau age-specific population estimates by year.[19]

Regression analyses were modeled to determine if there were significant differences in age for total, small/round, or multiple magnet ingestions across both the time period of interest and since 2009. Rao-Scott Chi-square was used for all categorical comparisons. Because the off- and on-market groups cover a different number of years (off-market included 4 years and the on-market period included 3 years), we divided the sample weights in each period by the number of years before calculating annualized estimates and corresponding confidence intervals.

Multiple trend analyses were then performed using the design-corrected logistic regression method to examine trends in magnet ingestion rates over time (2009-2019) and the time period of interest (2013-2016 compared to 2017-2019).[20] In this evaluation, yearly census population data were used to evaluate changes in magnet ingestion rates over time. Next, we evaluated changes in the proportions of small/round ingestions to total magnet ingestions or multiple magnet ingestions to total magnet ingestions. These analyses were performed using NEISS national estimate data as the numerator and the national age-specific population per year (supplied by the United States Census Bureau) as the denominator.

A P-value <0.05 was considered statistically significant. SAS 9.4 (SAS Institute, Cary, NC) was used for all analyses [21]. This study was reviewed and deemed exempt by the Uniformed Services University of the Health Sciences Institutional Review Board.

Results

There were an estimated 23,756 (CI, 15,878-30,635) total SMI cases between 2009-2019 (Figure 1). Of those, an estimated 3,709 (CI, 2,342-5,076) cases involved small/round magnets and 6,100 (CI, 3,889-8,311) involved multiple magnets (Table 1). The average annual increase in total cases was 6.1% over this time period (*P*=0.01). There was also a statistically significant increase in small/round magnet ingestions (*P*<0.001) and multiple ingestions (*P*=0.02) between 2009-2019.

The median (interquartile range) age of children suspected to have ingested any magnet, a small/round magnet, or multiple magnets was 4.9 (2.8-8.8), 5.4 (2.8-9.5), and 7.7 (3.3-11.2) years respectively. Cases since 2009 are reported by age in Supplemental 1,2 and 3 , http://links.lww.com/MPG/B983. Across all groups, the majority of SMI occurred in males and white children (56.9%), though a sizeable percentage did not have a reported race. Escalation of care was estimated to occur in 3,976 (CI, 2,226-5,726) total magnet ingestion cases, 561 (CI, 62-1,059) small/round magnet ingestion cases, and 2,240 (CI, 1,227-3,252) multiple magnet ingestion cases (Table 1).

When stratified by time period, there were 6,391 (CI, 4,181-8,601) estimated total magnet ingestion cases during the off-market period, or 1,598 (CI, 1,045-2,150) estimated cases per year (Table 2). Conversely, there were 8,478 (CI, 5,472-11,485) estimated total cases during the on-market period, or 2,826 (CI, 1,824-3,828) each year. This represents a 32% increase (P<0.001) in total magnet ingestions after 2016. There was also a statistically significant increase in the number of estimated small/round (P<0.01) and multiple (P<0.001) magnet ingestions across these two time periods, with 164 (CI, 66-263) small/round and 350 (CI, 200-500) multiple magnet ingestions during the off-market period compared to 541 (CI, 261-822) small/round and 797 (CI, 442-1,152) multiple magnet ingestion cases in the on-market period. The median age of children suspected of having an ingested any magnet(s) during off-market time period was 4.6 (2.6-8.5) years compared to 4.8 (3.0-9.2) years in the on-market period (P<0.001). There was no statistically significant age difference between children with small/round (P=0.71) or multiple (P=0.68) magnet ingestions when stratified by time periods.

Discussion

This study provides an update to the estimated national trends of suspected magnet ingestion by children and demonstrates, for the first time, a rapid increase in national magnet ingestions since the 10th Circuit Court decision in 2016. Ingestion frequency has increased each year, with an estimated 4,013 cases in 2019 alone. Importantly, this trend in total ingestions corresponds to an increase in the number of small/round ingestions, multiple magnet ingestions, and in the escalation of care, which strongly suggests that a large percentage of "total" magnet ingestion cases since 2017 are from SREMs. This is especially concerning given that previously published reports indicate that 32.5-75% of cases of multiple magnet ingestion result in perforation which could be extrapolated to suggest there were approximately 1983-4575 cases of perforation related to multiple SREM ingestions from 2009-2019.[16]

These data may be useful in enacting public policy measures within ASTM, the CPSC, and/or Congress, as myriad regulatory actions on high-powered magnet sets remain in flux. After the 10th Circuit Court decision, Zen petitioned the CPSC to adopt a new, mandatory rule set that would require warning labels and packaging requirements for SREMs but *not* the performance standards favored by NASPGHAN (i.e., making magnets either too large to swallow or too weak to cause harm). It also began working with industry partners to create a rule set within ASTM, the primary agency through which voluntary industry standards are created.

At the time of this article's submission, an ASTM ballot favored by industry is being circulated. This rule is similar to that called for by Zen Magnets in its petition to the CPSC and is expected to pass over the objections of NASGPHAN, the AAP, multiple consumer groups, and even CPSC staff. Although there is no indication companies will comply with the voluntary ASTM rule, passage will pressure the CPSC into issuing a new, *mandatory* rule set more favorable to industry.

Meanwhile, the CPSC is weighing action. On April 22, 2020, Zen Magnets unexpectedly withdrew its CPSC petition and, in response, the CPSC released its findings anyway. In a comprehensive rebuttal to Zen's petition, CPSC staff performed their own analysis of NEISS data and reach the same conclusion as our research group: high-powered magnet ingestions have increased since re-entering the market in late 2016. Of note, the CPSC analysis utilizes stricter case identification methods by including only definite or highly likely cases. This conservative approach likely under-represented national incidence and explains the somewhat disparate results between our studies.[15] Nevertheless, both findings highlight a clear increase in magnet ingestions since the CPSC rule set was overturned and the urgent need for new intervention, such as that being considered in Congress.

In December of 2019, Senator Richard Blumenthal sponsored a new bill entitled, "Magnet Injury Prevention Act" (S. 3143), which would legislate the performance standard currently favored by NASGPHAN into law. More recently, in March 2020, Congressional members Tony Cárdenas and Kim Schrier introduced a companion bill to the House. Both bills are currently in committee.[17]

Though our analysis may help influence these pending policy decisions, several limitations should be acknowledged. First, NEISS contains data only from emergency departments and excludes patients evaluated in other settings (e.g., children that do not seek medical care). Second, all foreign body ingestions herein were "suspected" and cannot be confirmed. Cases from NEISS do not provide case descriptions of care beyond the emergency department (ie endoscopy, surgery, complications or other morbidity associated with SMIs). Lastly, as there is no NEISS product code for magnets, cases were obtained by reviewing brief, individual narratives and were incomplete for some entries. This precludes extraction of important product-specific data, such as magnet type, flux, and brand. An important strength of our study, and NEISS more broadly, is the ability to generate a national estimate and confidence limit for pediatric magnet ingestions.

Conclusion:

After the magnet rule set was overturned by the 10th Circuit Court in 2016, there was a significant increase of magnet ingestions by children. Small, round magnet ingestions and multiple magnet ingestions also increased, which highlights the likelihood that small, rare-earth are a major, if not primary, source of these injuries. Regulatory action is needed to prevent children from harm.

References

1. Kadaba L. The attraction of Buckyballs. The Philadelphia Inquirer Web site. https://www.inquirer.com/philly/entertainment/20091202_Harnessing_fun-damental_forces.html. Published 2009. Accessed May 01, 2020.
2. North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. Warning labels ineffective at preventing high-powered magnet ingestions. Naspghan.org Web site. https://safe.menlosecurity.com/doc/docview/viewer/docN5136871865CF756a10a978647219b8008bba264860fc14da7b24e7093ae116337399099de76d. Published 2012. Accessed May 01, 2020.
3. Consumer Product Safety Commission. Federal Register. 2012. Web site. https://www.federalregister.gov/documents/2012/09/04/2012-21608/safety-standard-for-magnet-sets.
4. Agbo C, Lee L, Chiang V, et al. Magnet-related injury rates in children: a single hospital experience. *J Pediatr Gastroenterol Nutr*. 2013;57(1):14-17.
5. Naji H, Isacson D, Svensson JF, et al. Bowel injuries caused by ingestion of multiple magnets in children: a growing hazard. *Pediatr Surg Int.* 2012;28(4):367-374.
6. Brown JC, Otjen JP, Drugas GT. Pediatric magnet ingestions: the dark side of the force. *Am J Surg.* 2014;207(5):754-759.
7. Cox S, Brown R, Millar A, et al. The risks of gastrointestinal injury due to ingested magnetic beads. *S Afr Med J.* 2014;104(4):277-278.
8. Valdes M. Toy firm settles in death of Redmond toddler. The Seattle Times Web site. https://www.seattletimes.com/seattle-news/toy-firm-settles-in-death-of-redmond-toddler/. Published 2006. Accessed May 01, 2020.
9. O'Donnell J. CPSC may ban tiny magnets that killed a child. USA Today Web site. https://www.usatoday.com/story/news/nation/2014/09/03/cpsc-high-powered-magnets-rule-buckyballs/14999189/. Published 2014. Accessed May 01, 2020.
10. Consumer Product Safety Commission. Federal Register. 2012. Web site. https://www.federalregister.gov/documents/2012/09/04/2012-21608/safety-standard-for-magnet-sets.
11. Reeves PT, Nylund CM, Krishnamurthy J, et al. Trends of Magnet Ingestion in Children, an Ironic Attraction. *Journal of Pediatric Gastroenterology and Nutrition.* 2017.
12. Shawn Skolky CS. CPSC's Zen Magnets Mandatory Recall Reversed: A Mixed District Court Decision Gives Zen Magnets a New Life and the CPSC Favorable Precedent for Mandatory Recalls. Mintz Web site. https://www.mintz.com/insights-center/viewpoints/2171/2018-06-cpscs-zen-magnets-mandatory-recall-reversed-mixed-district. Published 2018. Accessed May 01, 2020.
13. Consumer Product Safety Commission. Federal Register. 2017. Web site. https://www.federalregister.gov/documents/2017/03/07/2017-04381/safety-standard-for-magnet-sets-removal-of-final-rule-vacated-by-court.
14. Frankel T. Number of children swallowing dangerous magnets surges as industry largely polices itself. Washinton Post. Web site.

https://www.washingtonpost.com/business/economy/number-of-children-swallowing-dangerous-magnets-surges-as-industry-largely-polices-itself/2019/12/25/77327812-2295-11ea-86f3-3b5019d451db_story.html. Published December 25, 2019. Accessed May 01, 2020.

15. Consumer Product Safety Commission. CPSC.gov. 2020. Web site. https://cpsc.gov/s3fs-public/Informational%20Briefing%20Package%20Regarding%20Magnet%20Sets.pdf?FKVcZpHmPKWCZNb7JEl6Ir0a31WV72PI.
16. Hussain, S. Z., Bousvaros, A., Gilger, M., Mamula, P., Gupta, S., Kramer, R., & Noel, R. A. (2012). Management of ingested magnets in children. Journal of pediatric gastroenterology and nutrition, 55(3), 239-242.
17. Blumenthal R. S.3143 - Magnet Injury Prevention Act. December 19, 2019. Congress.gov Web site. https://www.congress.gov/bill/116th-congress/senate-bill/3143. Accessed May 01, 2020.
18. Reeves PT, Nylund CM, Krishnamurthy J, et al. Trends of Magnet Ingestion in Children, an Ironic Attraction. *J Pediatr Gastroenterol Nutr*. 2018;66(5):e116-e121.
19. 2014 United States National Census Data. United States Census Bureau Web site. https://www.census.gov/population/projections/data/national/2014/summarytables.html. Published 2014. Accessed May 01, 2020.
20. Durand WM, Stey PC, Chen ES, et al. Trend analysis of aggregate outcomes in complex health survey data. *AMIA Summits on Translational Science Proceedings.* 2018;2018:349.
21. SAS/STAT user's guide, version 9.2. In. Statistical Analysis System Institute: SAS Institute; 2009.

Legends:

Figure 1.

National estimated number of pediatric magnet ingestion emergency department visits in the US from 2009-2019. From 2009-2010, the raw number of cases of Multiple suspected magnet ingestion were less than 30 (raw range, 0-20) and thus not accurately estimable. The time between the double, vertical dotted line represents the study period when the magnet rule set was in effect and small rare-earth magnets were off the market.

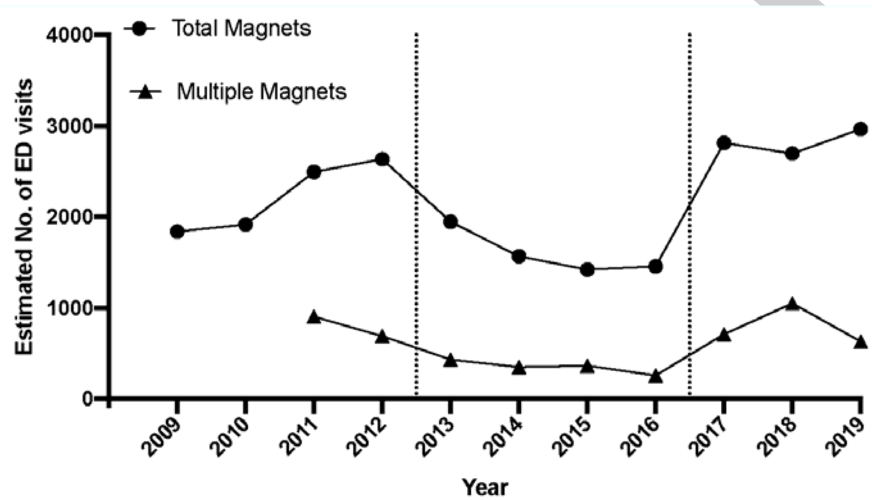

Table 1. Pediatric magnet ingestion-related emergency department visits in the United States, 2009-2019 Actual sample size and national estimates are reported for total, small/round and multiple magnet ingestion-related emergency department visits. (CI = Confidence interval; ED = emergency department)

	Total Magnet Ingestions		**Small/Round Magnet Ingestions**		**Multiple Magnet Ingestions**	
	Actual (%)	Estimated (95% CI)	Actual (%)	Estimated (95% CI)	Actual (%)	Estimated Cases (95% CI)
Total	1,113 (100)	23,756 (16,878 – 30,635)	148 (100)	3,709 (2,342 – 5,076)	333 (100)	6,100 (3,889 – 8,311)
Age, Years						
0-4	599 (45.0)	14,590 (10,902 - 18,278)	83 (7.6)	2,477 (1,511 - 3,444)	118 (7.2)	2,323 (1,504 – 3,142)
5-8	451 (31.3)	10,152 (7,320 – 12,984)	57 (4.2)	1,371 (666 – 2,075)	78 (4.5)	1,464 (792 - 2,137)
9-13	349 (21.1)	6,843 (4,839 – 8,847)	48 (3.4)	1,099 (582 – 1,615)	147 (7.9)	2,575 (1,545 – 3,605)
14-17	39 (2.6)	842 (402 – 1,281)	5 (0.6)	199 (0 – 409)	21 (1.3)	436 (120-751)
Sex						
Male	642 (57.7)	14,079 (9,559 – 18,598)	82 (55.4)	1,827 (814-2,841)	193 (58)	3,513 (2,379 – 4,647)
Race						
White	611 (54.9)	13,526 (9,932 – 17,120)	90 (60.1)	2,398 (1,377-3,419)	208 (62.5)	4,070 (2,390 – 5,751)
Black	61 (5.5)	822 (374 – 1,270)	7 (4.7)	108 (0-238)	11 (3.3)	239 (25 – 453)
Unreported	328 (29.5)	7,114 (2,451 – 11,777)	32 (21.6)	731 (316-1,146)	84 (25.2)	1,398 (463 – 2,333)
Other	113 (10.2)	2,294 (994 – 3,594)	19 (12.8)	472 (96-849)	30 (9)	393 (59 – 726)
Location						
Home	649 (58.3)	16,403 (10,605 – 22,201)	87 (58.8)	2,550 (1,592-3,509)	184 (55.3)	4,203 (2,372 – 6,034)
Disposition						
Admitted	238 (21.4)	2,785 (1,135 – 4,434)	31 (20.9)	271 (94-447)	134 (40.2)	1,535 (600 – 2,470)
Released	853 (76.7)	19,780 (14,260 – 25,300)	112 (75.7)	3,149 (1,924-4,373)	187 (56.2)	3,861 (2,382 – 5,340)
Transferred	22 (2)	1,192 (537 – 1,846)	5 (3.4)	290 (0 – 652)	12 (3.6)	705 (215 – 1,195)
Escalation of Care	260 (23.4)	3,976 (2,226 – 5,726)	36 (24.3)	561(62 – 1,059)	146 (43.8)	2,240 (1,227 – 3,252)

Table 2. Annualized Age distribution of magnet ingestion-related emergency department visits in the United States, 2013-2016 (off-market period) and 2017-2019 (on-market period). Results are expressed as number of raw cases; national estimate with associated 95% confidence interval. Instances associated raw cases numbering less than 30 have a tendency to generate large confidence intervals and should be interpreted with caution.

	Total Magnet Ingestions		**Small/Round Magnet Ingestions**		**Multiple Magnet Ingestions**	
	2013-2016	2017-2019	2013-2016	2017-2019	2013-2016	2017-2019
Total	315; 1,598 (1045 – 2150)	415; 2,826 (1,824 – 3,828)	33; 164 (66 – 263)	65; 541 (261 – 822)	95; 350 (200 – 500)	136; 797 (442 – 1,152)
Age (Years)						
0-4	136; 715 (455 – 974)	164; 1,180 (716 – 1,644)	13; 68 (5 – 131)	20; 182 (62 – 302)	35; 157 (68 – 246)	38; 229 (88 – 371)
5-8	90; 453 (259 – 647)	118; 775 (392 – 1,158)	10; 75 (4 – 146)	172; 172 (54 – 290)	24; 69 (17 – 121)	31; 179 (51 – 307)
9-13	79; 390 (199 – 581)	119; 773 (512 – 1,035)	10; 21 (3 – 40)	19; 167 (48 – 286)	31; 113 (43 – 183)	62; 376 (195 – 558)
14-17	10; 40 (0 – 83)	14; 98 (12 – 184)	0	2; 20 (0 – 57)	5; 11 (0 – 21)	5; 13 (0 – 28)