Does motivation matter? A systematic review and meta-analysis of outcomes following intentional foreign object ingestion.

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I. Abstract

Background

Intentional ingestion of foreign objects (IIFO) is clinically distinct from accidental ingestion, yet its outcome profile and drivers of morbidity remain poorly defined. Whether motivation itself alters risk has never been examined systematically.

Objectives

To synthesise all available evidence on outcomes after intentional foreign-object ingestion, and to determine whether patient motivation, object characteristics, or demographic factors modify those outcomes.

Methods

A comprehensive search of PubMed, Embase, CENTRAL, Web of Science, Scopus, PsycINFO, and Google Scholar (1906–31 March 2025) combined free-text and controlled-vocabulary terms for foreign bodies, intentional ingestion, and clinical interventions.

Inclusion: human studies of any design, any age, reporting non-accidental ingestion of true foreign bodies.

Exclusion: accidental or substance ingestion, animal studies, non-English full texts, pre-1906 reports, and studies lacking motivation, object, or outcome data.

Outcomes: endoscopy, surgery, conservative management, complications, mortality.

Case reports (n = 72; 72 patients) and case series (n = 3; 90 patients) were extracted with a prespecified codebook; risk of bias was appraised with JBI checklists augmented by automated logic filters. Effect measures for case reports were odds ratios (ORs) with 95 % confidence intervals (CIs) derived from 2 × 2 tables (χ^2 or Fisher's exact test). Multivariate case-level associations were explored with logistic regression. To enable valid series-level meta-analysis despite small sample sizes, individual case reports were flattened and grouped alongside other series. Series-level proportions were pooled using random-effects models with restricted maximum likelihood (REML) estimation and Hartung–Knapp adjustments to confidence intervals, appropriate for small-study meta-analysis. DerSimonian–Laird estimates were also computed for comparison. Univariate meta-regression examined study-level modifiers.

Results

Across 162 unique individuals, pooled series-level event rates using REML were: endoscopy 47.3 % (95 % CI: 4.3–94.7), surgery 30.6 % (95 % CI: 12.0–58.9), conservative management 41.6 % (95 % CI: 4.4–91.7), complications 34.7 % (95 % CI: 1.8–93.8), mortality 2.5 % (95 % CI: 0.8–7.7).

Heterogeneity was moderate to low for all outcomes except death ($I^2 < 1\,\%$). DerSimonian–Laird estimates yielded narrower confidence intervals and higher I^2 values, consistent with known limitations in small samples.

Case-level testing showed that "intent to harm" quintupled the odds of surgery (OR ≈ 5, $p < 0.05$), whereas "other" motives reduced surgical odds by 86 %. Sharp objects increased the likelihood of endoscopy, and long objects trended toward higher surgical rates. Age 41–60 years predicted fewer surgeries (OR ≈ 0.18, $p < 0.05$). No demographic factor independently altered mortality, although detained status and severe disability exhibited non-significant trends. Meta-regression of series data did not replicate these signals, likely due to small study numbers.

Limitations

Single-reviewer screening and extraction, high clinical heterogeneity, small cell sizes, and publication bias (particularly for dramatic or anatomically challenging cases). Twenty-five predictors in four case series risked model overfitting and inflated Type I error.

Conclusions

Intention itself appears to be a key driver of adverse clinical course after foreign-object ingestion, with "intent to harm", sharp items, and object length portending more invasive management. Age between 41 and 60 years may be protective against surgery. The findings should inform risk stratification but must be interpreted cautiously given methodological limitations and the descriptive nature of much of the evidence.

Registration and Data

This protocol was not registerd with PROSPERO. Full dataset and analysis scripts are openly available at https://github.com/jackgedge/iifo_systematic_review.

Introduction

Rationale

The global displacement crisis has reached unprecedented levels, with over 100 million forcibly displaced individuals reported by the United Nations High Commissioner for Refugees

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(UNHCR) as of May 2024 [1]. Refugees and asylum seekers often endure severe hardship—including violence, persecution, and perilous journeys—compounding their vulnerability upon arrival in host countries [2, 3]. This population is at heightened risk of mental health challenges due to trauma, detention, and insecure legal status [4–7].

Self-harm is a particularly concerning manifestation of psychological distress among asylum seekers, with rates significantly exceeding those in the general population—up to 216 times higher in offshore detention settings [8–10]. Common methods include cutting, blunt trauma, hanging, self immolation, poisoning, and intentional ingestion of foreign objects (IIFO) [9, 11], influenced by access to means, cultural norms, and underlying motivations [12].

IIFO is defined as the non-accidental ingestion of non-nutritive foreign bodies [13]. While 80–90% of cases resolve spontaneously, 10–20% require endoscopic intervention and up to 1% require surgery [14, 15]. Timely access to care is essential, but often constrained in refugee contexts by geographic isolation and limited medical infrastructure, increasing the risk of complications [16].

Global rates of IIFO appear to be rising. In the United States, incidence doubled in 2017, with 14% of cases classified as intentional [17]. One review found up to 92% of adult ingestions were intentional among individuals from lower socioeconomic backgrounds, suggesting even higher prevalence in displaced populations [18].

The management of IIFO has evolved significantly since the 17^{th} century, from open gastrotomy to rigid esophagoscopy and, more recently, endoscopic techniques [19–23]. Historical case reports illustrate the extremes of this behaviour—including one psychiatric patient who ingested over 2,500 objects weighing 21 kilograms [24], and another who swallowed an item 28 cm in length [25].

Clinical outcomes depend on multiple factors: age, comorbidities, object size and characteristics, location, and time to presentation. Current guidelines recommend intervention strategies based on these variables [14]. However, most literature to date focuses on IIFO in prisons or psychiatric populations, with limited data from refugee or asylum-seeking groups.

In detention settings, ingestion may be used as a protest or distress signal when other forms of communication are blocked [26]. In psychiatric contexts, motivations may include psychosis, personality disorders, pica, malingering, or affective dysregulation [27–32]. Malingering is especially reported in prisons, often as a means to access hospital care [27, 33]. Conversely, in borderline personality disorder, ingestion may serve as an emotional regulation strategy rather than an indication of suicidal intent [27, 32]. In rare cases, repeated IIFO has led to discussions around palliative care approaches, recognising the futility of repeated surgical intervention in treatment-resistant psychiatric illness [34].

Despite increasing prevalence, the heterogeneous motivations behind IIFO—and their potential impact on clinical decision-making—remain poorly understood [35–37]. Motivation likely influences management strategies and outcomes. For instance, protest-driven ingestion may avoid high-risk behaviours, lowering the threshold for conservative management [38, 39].

This systematic review aims to address these gaps by exploring how motivation for IIFO affects clinical outcomes. Specifically, it examines associations between motivation and rates of endoscopic and surgical intervention, conservative management, complications, and mortality—toward informing more responsive and appropriate healthcare strategies for vulnerable populations.

Objectives

The primary object of this systematic review was to quantify the rates of endoscopy, surgery, death, complication and conservative management following intentional ingestion of foreign objects in human populations. The systematic review sought to examine how individual factors such as demographic/population characteristics, object characteristics and motivations for ingestion influence the likelihood of these outcomes.

Methods

This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [40]. Ethical approval was not required as all analysis was based on published data. Eligibility criteria were structured using the PICOS (Population, Intervention, Comparator, Outcome, Studies) framework.

Eligibility Criteria

Category	**Details**
Population	Any human; any age group.
Interventions or exposures	Non-accidental ingestion of a true foreign body (non-nutritive items).
Comparators / Control group	Demographics: Gender, age, detained person, psychiatric inpatient, displaced person, under influence of alcohol, psychiatric history, severely disabled, previous ingestion. Motivation: Intent to harm, psychiatric, psychosocial, protest, other. Object characteristics: Button battery, magnet, long (>5 cm), large diameter (>2.5 cm), multiple, blunt objects, sharp-pointed objects.
Outcomes of interest	Endoscopic intervention, surgical intervention, conservative management, complication rates, mortality.
Setting	Any setting.
Study designs	Any design.

TABLE I: Inclusion criteria structured using the PICOS framework.

A full list of eligibility criteria is shown in Table I. This is reproduced in a larger format for clarity in Appendix **??**. A full list of exclusion criteria is available in Appendix **??** and in the PRISMA diagram shown in Figure **??**.

Information Sources

Relevant articles were identified through a systematic search of PubMed, Web of Science, Embase, Scopus, PsycINFO, CENTRAL and Google Scholar during January 2025, with the assistance of a librarian. Included articles then had their bibliography's searched by the primary author (JGE) on 14th May 2025 to identify any potentional additional literature not uncovered in the primary search.

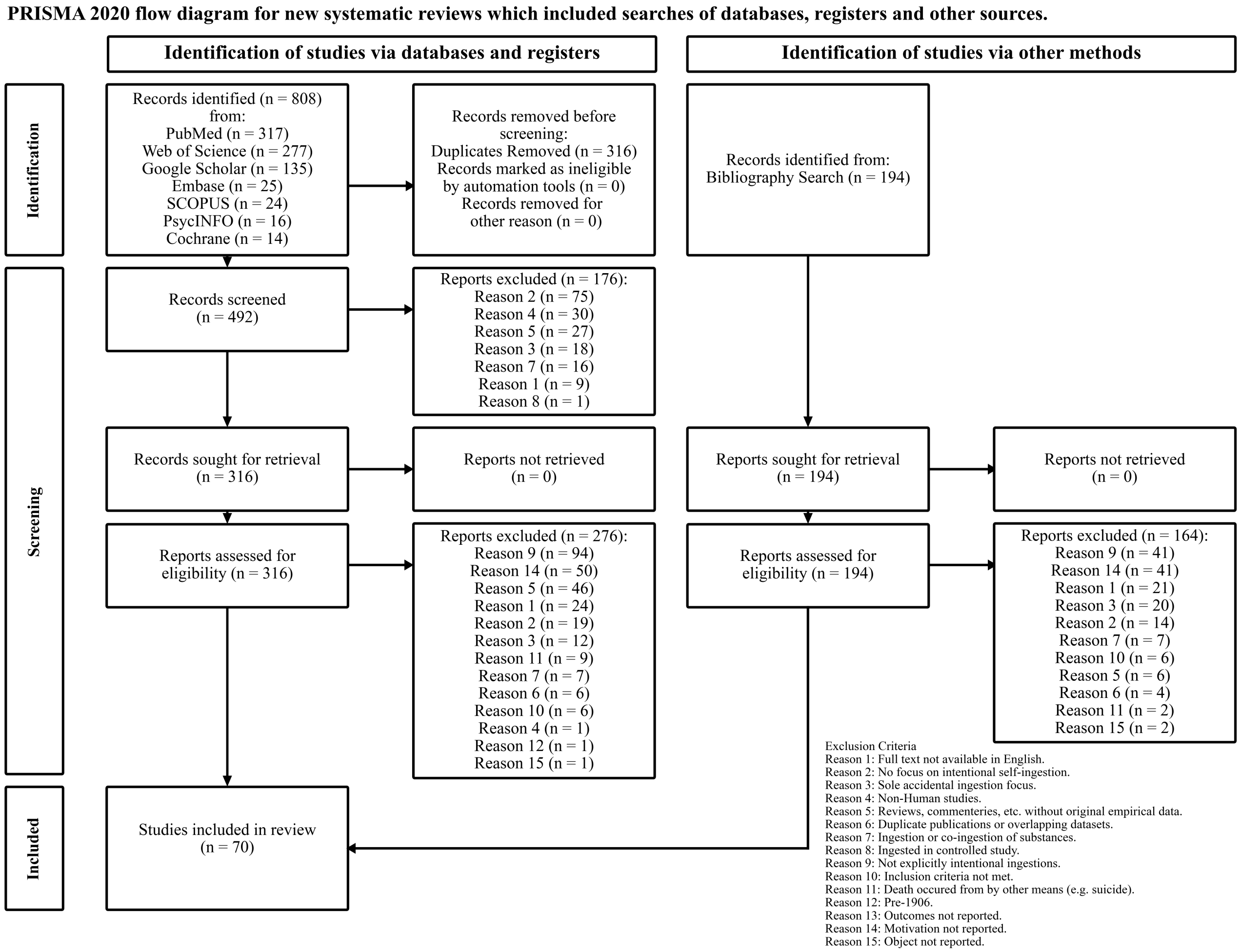

Fig. 1: PRISMA flow diagram summarising the study selection process.

Search Strategy

The search was conducted using keywords and MeSH terms based on the concepts underpinning this review. The search queries, keywords and MeSH terms used can be found in Appendix **??**.

Selection Process

All identified articles were collated and duplicate articles were identified and removed. Remaining articles underwent independent title and abstract screening conducted by the first author (JGE). To ensure consistency, a randomly selected 10% sample of these articles underwent independent screening by a second author (MS). Any discrepancies identified between these two reviewers were resolved by a third reviewer (GC). Inter-reviewer agreement was calculated using Cohen's Kappa [41]. Remaining articles proceeded to full text review, where the same independent screening process was repeated on full text articles.

Data Collection Process

Data were initially extracted by a single reviewer (JGE) into *Microsoft Excel* [42]. Variables for extraction were developed iteratively through engagement with the literature and analysis of consistent reporting patterns. A preliminary review of the first 30 case reports informed the development of additional data categories, which were subsequently applied to the remaining reports.

Following initial extraction, data were imported into *Python* [43] for further processing and analysis. The Python-based pipeline included data cleaning, validation, and transformation to ensure consistency across heterogeneous study formats. These structured data were then used to guide the extraction of aggregate data from case series. Studies were grouped for extraction based on their classification as case reports or case series. Where case series contained sufficiently granular data, cases were extracted individually and treated as case reports; otherwise, data were extracted at the aggregate level. Case grouping for analysis followed the criteria for inclusion as individual case reports or case series, as defined above. Relevant data from reviews and other literature types were recorded under the case report category.

Data Items

Outcome data were extracted for rates of endoscopy, surgery, conservative management, mortality, and complications. For the purposes of this study, *surgery* was defined as "any operative intervention performed in a sterile operating theatre under general or regional anaesthesia, involving incision or surgical access to body cavities (including laparotomy, laparoscopy, thoracotomy, or cervical exploration) for the purpose of removing an ingested

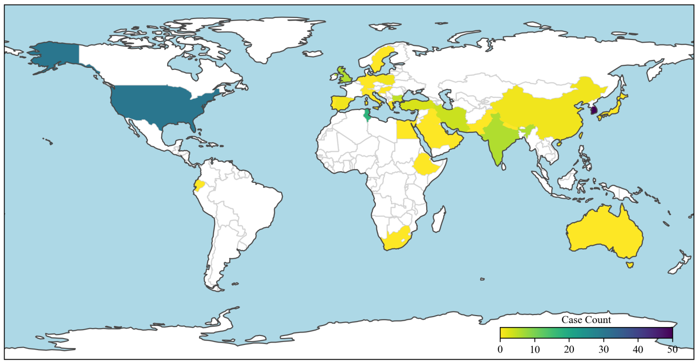

Fig. 2: Heat map of cases per country.

object or managing complications of ingestion". Procedures performed "solely via flexible or rigid endoscopy through natural orifices" were categorised as *endoscopy* and not considered surgical interventions.

Predictor variables were grouped in five subgroups: *Age Group*, *Gender*, *Demographic*, *Motivation*, *Object*. Full definitions of all variables are provided in Appendix **??**. The full dataset of extracted case-level and series-level data (including bias assessments), is available on Github.

Risk of Bias Assessment

Risk of bias was assessed manually for all included studies by a single reviewer (JGE), using the *Joanna Briggs Institute (JBI) Critical Appraisal Checklists for Case Reports and Case Series* [44]. Studies were first classified as either case reports or case series based on the level of granularity in the data. Each study was then evaluated using the corresponding JBI tool.

Effects Measures

Univariate associations between binary predictors and binary outcomes were assessed using unadjusted odds ratios (ORs) with 95% confidence intervals (CIs), via chi-square or Fisher's exact tests [41]. Multivariate logistic regression was used to identify independent predictors; adjusted odds ratios (aORs) and 95% CIs were calculated from models including age, gender, motivation, and object characteristics. All models were fitted using *statsmodels* in Python [45].

For case series, meta-analyses of proportions were conducted using random-effects models with restricted maximum likelihood (REML) estimation and Hartung–Knapp (HK) adjustment to CIs, appropriate for small numbers of studies. DerSimonian–Laird (DL) estimates were also calculated for comparison. Univariate meta-regression was used to explore associations between study-level predictors and pooled outcome rates, using inverse-variance weighted regression. Full methodological details are provided in Appendix **??**.

RESULTS

Study Selection

A total of 808 records were identified through initial database searches: PubMed (317), Web of Science (277), Google Scholar (135), Embase (25), SCOPUS (24), PsycINFO (16), and Cochrane (14). 316 duplicates were identified and removed.

Title and abstract screening was undertaken, with JGE reviewing all 492 records. A random sample of 50 records was generated for independent screening MS. Cohen's Kappa was calculated for inter-reviewer agreement between JGE and MS, yielding a value of 0.38, indicating fair agreement. Where JGE and MS disagreed, 16 records were reviewed by GC. In total, 176 records were excluded, leaving 316 for full text review.

During full text review, JGE reviewed all 316 records. A random sample of 32 records was generated for independent review by MS. Inter-reviewer agreement was again calculated using Cohen's Kappa, yielding a value of 0.21, indicating fair agreement. Where JGE and MS disagreed, 5 records were reviewed by GC. In total, 276 records were excluded during full text review. 40 records were included and proceeded to bibliography search.

The bibliographies of the 40 included papers were searched by manually JGE. Relevant bibliography items were identified, collated, and evaluated against the eligibility criteria, yielding 194 results. These 194 results were reviewed by JGE. 164 bibliography search records were excluded, leaving 30 for inclusion.

Therefore, a total of 70 records were included in this study and proceeded to bias assessment. This process is illustrated in Figure **??**.

Risk of Bias

Case Reports: 75 cases from 67 studies [33, 38, 46–108, 112, 113] were evaluated using the *JBI Checklist for Case Reports* [44]. 3 cases were excluded. Cases were excluded at this stage if they failed to describe the following domains: patient history and timeline (1 case) [112], current patient condition (2 cases) [112], interventions and treatments (1 case) [113], patient post-intervention condition (2 cases) [112], harms (2 cases) [112], and takeaway lessons (2 cases) [112]. The excluded cases came from the following studies: [112, 113]. Of the remaining 72 cases, all reported interventions and treatments (72 cases, 100%) [33, 38, 46–108]. Most clearly described patient history and timeline (71 cases, 99%) [33, 38, 46–55, 57–108], patient post-intervention condition (70 cases, 97%) [33, 38, 46–66, 69–108], takeaway lessons (70 cases, 97%) [33, 38, 46–55, 57–88, 90–108], patient demographic (69 cases, 96%) [38, 46–52, 54–105, 107, 108], and current patient condition (69 cases, 96%) [33, 38, 46–91, 93–108]. Reporting was also strong for diagnostic assessments (66 cases, 92%) [33, 38, 46–55, 57–61, 63–91, 93–108], and harms (38 cases, 90%) [49, 53–55, 58, 60, 61, 65, 66, 68, 69, 71, 75–80, 84–88, 90, 95, 96, 99, 100, 103, 105–108].

Case Series: Seperately, 3 studies [109–111] were evaluated using the *JBI Checklist for Case Series* [44]. Reporting quality was generally high across all JBI domains. All included case series fully reported clear inclusion criteria, standard condition measurements, valid patient identification methods, complete inclusion, clear demographic information, clear clinical information, clear outcome and follow-up, and approprate statistical analysis [109–111]. However, fewer studies (2) reported consecutive inclusion, and clear site demographic information [109, 110].

Study Characteristics

A total of 68 studies were included in the synthesis. 65 studies were case reports, yielding 72 cases [33, 38, 46–108]. A full list of group summary case-level characteristics and outcomes

TABLE II: Grouped summary of case-level variables and outcomes.

Variable	Count	Percentage	References
Gender			
Male	43	60%	[33, 46–82]
Female	28	39%	[38, 83–107]
Unknown	1	1%	[108]
Age Group			
<18	13	18%	[68, 76, 77, 83, 84, 88, 92, 93, 99, 100, 105]
18–25	18	25%	[33, 46, 49, 52, 57, 65, 69, 70, 74, 81, 87, 95, 96, 101, 104]
26–40	25	35%	[38, 48, 50, 51, 53, 59–62, 64, 67, 69, 71–73, 75, 79, 86, 89–91, 102, 106–108]
41–60	11	15%	[47, 55, 56, 58, 63, 66, 78, 80, 82, 94, 103]
60+	3	4%	[85, 97, 98]
Unknown	2	3%	[54]
Population			
Detained Person	12	17%	[33, 48, 50, 51, 69, 72, 75, 79]
Psychiatric Inpatient	4	6%	[82, 92, 108]
Displaced Person	2	3%	[46, 61]
Under Influence of Alcohol	3	4%	[53, 57, 78]
Psychiatric History	36	50%	[38, 48, 51, 52, 56, 59, 60, 62–68, 70, 71, 75, 76, 82–85, 89, 91, 92, 94, 95, 97, 100–103, 107, 108]
Severely Disabled	7	10%	[52, 68, 82, 97, 100, 101, 107]
Previous Ingestor	19	26%	[48, 51, 54, 57, 58, 62–64, 68, 76, 78, 82, 87, 92, 102, 107, 108]
Motivation			
Intent to harm	21	29%	[33, 47–49, 56, 57, 60, 69, 70, 75, 76, 83, 89, 90, 98, 102, 108]
Protest	9	12%	[33, 55, 61, 69, 104]
Psychiatric	34	47%	[38, 47, 48, 51, 52, 58, 59, 62–68, 71, 75, 76, 81, 82, 84, 86, 87, 91, 92, 94–98, 100, 102, 103]
Psychosocial	17	24%	[46, 53, 65, 72–74, 77, 78, 87, 88, 93, 94, 98, 99, 104–106]
Other	9	12%	[50, 58, 62, 79, 80, 84, 101, 102, 107]
Object			
Button Battery	2	3%	[54, 55]
Magnet	9	12%	[55, 68, 76, 77, 84, 88, 99, 100, 105]
Long (>5cm)	32	44%	[47, 49, 50, 52, 56–58, 60, 61, 64, 65, 67, 70–72, 78, 79, 81–83, 86, 89, 90, 92, 96, 97, 100, 102, 103, 107]
Large (>2.5cm) Diameter	51	71%	[33, 46–52, 54, 56–58, 61–67, 69–73, 76, 78, 79, 82, 83, 86, 88–90, 92, 96, 97, 99–103, 106–108]
Sharp	34	47%	[33, 38, 48, 51, 53, 56–60, 62–65, 67, 69–71, 74, 81–83, 86, 87, 91, 92, 94, 96]
Multiple	44	61%	[38, 51, 52, 55, 56, 58–60, 62–71, 74–78, 80–82, 84, 85, 87, 88, 93–96, 98–100, 103, 105, 108]
Outcome			
Endoscopy	31	43%	[46, 50–56, 61–63, 68, 72, 73, 75, 76, 79, 80, 82, 86, 89, 91, 94, 96, 98, 100–103, 106]
Surgery	44	61%	[33, 47–49, 52, 56, 57, 59–61, 64, 65, 67–71, 74, 76–78, 81, 83–86, 88–92, 96, 97, 99, 104–108]
Death	2	3%	[58, 66]
Conservative	7	10%	[38, 58, 66, 87, 92, 93, 95]
Complication	48	67%	[49, 51–61, 64–71, 74, 76–79, 81, 84–86, 88, 90–93, 96, 97, 99, 100, 102–107]

is available in Table **??**. 3 studies were case series, yielding 90 cases [109–111]. A full list of grouped series-level characteristics and outcomes is available in Table **??**. Geographically, cases of ingestion (case reports and case series) were reported in 35 unique countries, most being from South Korea (n=52, 32.1%), United States of America (n=32, 19.8%), and Tunisia (n=19, 11.7%). A full breakdown of cases per country is shown in Table **??** and Figure **??**.

Synthesis

Univariate Association Testing: Overall, sample size restricted case report analysis. A full table of case-level univariate association testing results for is available in Table **??**. In the age-based subgroup analysis, being between 41 and 60 years of age was significantly associated with reduced odds of undergoing surgery (OR = 0.18, 95% CI [0.04, 0.76], p = 0.019). Further comparison of this subgroup (n = 11) against the remaining case reports (n =

TABLE III: Grouped aggregate series-level summary.

Variable	Pooled	Case Reports	Elghali *et al.* (2016) [109]	Karp *et al.* (1991) [110]	Lee *et al.* (2007) [111]
Total Cases	162	72	19	19	52
Gender	162	72	19	19	52
Male	133 (82)	43 (60)	19 (100)	19 (100)	52 (100)
Female	28 (17)	28 (39)	0 (0)	0 (0)	0 (0)
Unknown	1 (1)	1 (1)	0 (0)	0 (0)	0 (0)
Age Group	126	164	70	81	110
Maximum	100 (62)	100 (139)	27 (142)	40 (211)	50 (96)
Mean	19 (12)	30 (42)	24 (126)	24 (126)	—
Minimum	7 (4)	7 (10)	19 (100)	17 (89)	25 (48)
Median	—	27 (38)	—	—	35 (67)
Demographic	204	83	23	37	61
Detained Person	102 (63)	12 (17)	19 (100)	19 (100)	52 (100)
Psychiatric History	65 (41)	36 (50)	2 (12)	18 (95)	9 (18)
Previous Ingestor	21 (13)	19 (26)	2 (11)	—	—
Severely Disabled	7 (4)	7 (10)	—	—	0 (0)
Psychiatric Inpatient	4 (2)	4 (6)	0 (0)	0 (0)	0 (0)
Under Influence of Alcohol	3 (2)	3 (4)	—	—	—
Displaced Person	2 (1)	2 (3)	—	—	—
Motivation	178	90	19	19	50
Protest	79 (49)	9 (12)	17 (89)	3 (16)	50 (97)
Psychiatric	46 (28)	34 (47)	0 (0)	12 (63)	0 (0)
Intent to harm	27 (17)	21 (29)	2 (11)	4 (21)	0 (0)
Psychosocial	17 (10)	17 (24)	0 (0)	0 (0)	0 (0)
Other	9 (6)	9 (12)	0 (0)	0 (0)	0 (0)
Object					
Sharp	102	34	16	19	33
Multiple	69	44	1	—	24
Long (>5cm)	64	32	0	—	32
Large (>2.5cm) Diameter	51	51	—	—	—
Magnet	9	9	0	—	0
Button Battery	2	2	0	—	0
Outcome	230	132	21	19	58
Endoscopy	78 (48)	31 (43)	1 (5)	—	46 (88)
Surgery	59 (36)	44 (61)	4 (21)	5 (26)	6 (12)
Complication	54 (33)	48 (67)	—	—	6 (12)
Conservative	36 (22)	7 (10)	15 (79)	14 (74)	0 (0)
Death	3 (2)	2 (3)	1 (5)	0 (0)	0 (0)

n (%)

61) revealed several distinguishing characteristics.

Notably, there was a marked increase in the proportion of male patients (over 20%). Motivations were more frequently psychiatric, and there was a higher incidence of previous ingestions. Patients in this age group were more likely to be psychiatric inpatients and to have a documented psychiatric history. They more commonly ingested multiple objects, while the objects were less frequently sharp or of large diameter. Additionally, this subgroup included fewer detained individuals. In the motivation subgroup, intent to harm was significantly associated with increased odds of undergoing surgery (OR = 5.40, 95% CI [1.36, 21.43], p = 0.024); another documented motivation was significantly associated with reduced odds of undergoing surgery (OR = 0.14, 95% CI [0.03, 0.75], p = 0.023).

Further descriptive analysis of this subgroup (n=21 vs n=51) revealed significantly higher rates of ingestions involving large-diameter and sharp objects. These object characteristics are widely recognised as high-risk and may partially explain the increased likelihood of surgical intervention observed in this group. Deeper analysis of the "other" motivation subgroup (n = 9 vs n = 63) revealed several notable differences. This group had significantly fewer cases involving intent to harm, protest, or psychosocial motivations—nearly 20% lower in each category. In contrast, there was a higher proportion of females, individuals with a history of severe disability, and those with prior ingestions.

These findings suggest that the absence of an explicit intention to self-harm may contribute to the reduced odds of surgery observed in this subgroup. Conversely, the presence of repeat ingestion—a known clinical red flag—may signal elevated risk, potentially offsetting this protective effect in some contexts.

Meta-analysis of Proportions: Given that small sample size severely effected the case-level analysis, for series-level analyses,

TABLE IV: Univariate association test results.

Variable	Conservative	Endoscopy	Surgery	Death	Complication
Gender					
Male	0.23 [0.04, 1.30] (p=0.110)	1.42 [0.54, 3.72] (p=0.632)	0.93 [0.36, 2.46] (p=1.000)	—	1.41 [0.52, 3.81] (p=0.671)
Female	4.57 [0.82, 25.41] (p=0.101)	0.78 [0.30, 2.03] (p=0.786)	0.97 [0.37, 2.57] (p=1.000)	—	0.84 [0.31, 2.28] (p=0.932)
Unknown	—	—	—	—	—
Age Group					
<18	1.96 [0.34, 11.45] (p=0.602)	0.33 [0.08, 1.33] (p=0.194)	2.45 [0.61, 9.84] (p=0.328)	—	1.84 [0.46, 7.44] (p=0.522)
18–25	1.23 [0.22, 6.94] (p=1.000)	0.29 [0.08, 0.98] (p=0.074)	2.80 [0.82, 9.62] (p=0.163)	—	1.41 [0.44, 4.56] (p=0.773)
26–40	0.28 [0.03, 2.51] (p=0.409)	2.25 [0.84, 6.04] (p=0.171)	0.93 [0.34, 2.51] (p=1.000)	—	0.83 [0.30, 2.31] (p=0.930)
41–60	2.49 [0.42, 14.83] (p=0.289)	2.70 [0.71, 10.22] (p=0.188)	**0.18 [0.04, 0.76] (p=0.019)***	—	0.54 [0.15, 2.00] (p=0.488)
60+	—	0.65 [0.06, 7.51] (p=1.000)	1.29 [0.11, 14.88] (p=1.000)	—	1.00 [0.09, 11.61] (p=1.000)
Unknown	—	—	—	—	0.49 [0.03, 8.18] (p=1.000)
Demographic					
Detained Person	—	0.99 [0.28, 3.53] (p=1.000)	0.86 [0.24, 3.08] (p=1.000)	—	0.63 [0.17, 2.26] (p=0.510)
Psychiatric Inpatient	—	0.44 [0.04, 4.54] (p=0.634)	2.25 [0.22, 22.99] (p=0.634)	—	0.15 [0.01, 1.50] (p=0.103)
Displaced Person	—	—	0.67 [0.03, 12.84] (p=1.000)	—	0.50 [0.03, 9.77] (p=1.000)
Under Influence of Alcohol	—	0.88 [0.07, 10.69] (p=1.000)	1.00 [0.08, 12.27] (p=1.000)	—	—
Psychiatric History	0.96 [0.20, 4.70] (p=1.000)	0.80 [0.29, 2.20] (p=0.861)	1.35 [0.48, 3.74] (p=0.756)	0.71 [0.04, 11.97] (p=1.000)	0.70 [0.24, 2.03] (p=0.696)
Severely Disabled	—	4.13 [0.74, 23.06] (p=0.115)	0.81 [0.17, 3.93] (p=1.000)	—	1.31 [0.23, 7.35] (p=1.000)
Previous Ingestor	1.69 [0.30, 9.38] (p=0.665)	0.83 [0.26, 2.65] (p=0.986)	0.74 [0.23, 2.36] (p=0.832)	1.61 [0.09, 27.40] (p=1.000)	0.34 [0.10, 1.23] (p=0.179)
Motivation					
Intent to harm	—	0.49 [0.16, 1.55] (p=0.347)	**5.40 [1.36, 21.43] (p=0.024)***	—	0.84 [0.28, 2.56] (p=0.988)
Protest	—	0.33 [0.06, 1.74] (p=0.279)	5.50 [0.64, 47.15] (p=0.137)	—	4.71 [0.55, 40.44] (p=0.251)
Psychiatric	7.07 [0.80, 62.31] (p=0.105)	1.44 [0.55, 3.77] (p=0.624)	0.47 [0.17, 1.27] (p=0.212)	—	0.67 [0.24, 1.85] (p=0.608)
Psychosocial	1.20 [0.21, 6.84] (p=1.000)	0.89 [0.29, 2.72] (p=1.000)	0.63 [0.21, 1.93] (p=0.603)	—	0.94 [0.30, 2.99] (p=1.000)
Other	1.19 [0.13, 11.18] (p=1.000)	3.04 [0.70, 13.29] (p=0.161)	**0.14 [0.03, 0.75] (p=0.023)***	7.75 [0.44, 136.41] (p=0.236)	0.58 [0.14, 2.40] (p=0.469)
Object					
Button Battery	—	—	—	—	—
Magnet	—	1.07 [0.26, 4.35] (p=1.000)	2.46 [0.47, 12.80] (p=0.467)	—	—
Long (>5cm)	0.45 [0.08, 2.51] (p=0.446)	0.80 [0.31, 2.05] (p=0.820)	2.43 [0.90, 6.56] (p=0.128)	1.23 [0.07, 20.40] (p=1.000)	1.88 [0.67, 5.24] (p=0.342)
Large (>2.5cm) Diameter	0.23 [0.05, 1.17] (p=0.081)	1.41 [0.48, 4.16] (p=0.727)	1.65 [0.57, 4.80] (p=0.518)	—	0.92 [0.30, 2.85] (p=1.000)
Sharp	1.56 [0.32, 7.51] (p=0.700)	**0.34 [0.13, 0.90] (p=0.048)***	2.16 [0.82, 5.72] (p=0.187)	1.12 [0.07, 18.65] (p=1.000)	1.09 [0.41, 2.90] (p=1.000)
Multiple	4.26 [0.48, 37.48] (p=0.235)	0.50 [0.19, 1.30] (p=0.233)	1.03 [0.39, 2.71] (p=1.000)	—	2.60 [0.95, 7.13] (p=0.104)

OR: Odds Ratio; CI: Confidence Interval; p: p-value. * indicates $p < 0.05$. Bold = statistically significant. — = missing or unstable estimate.

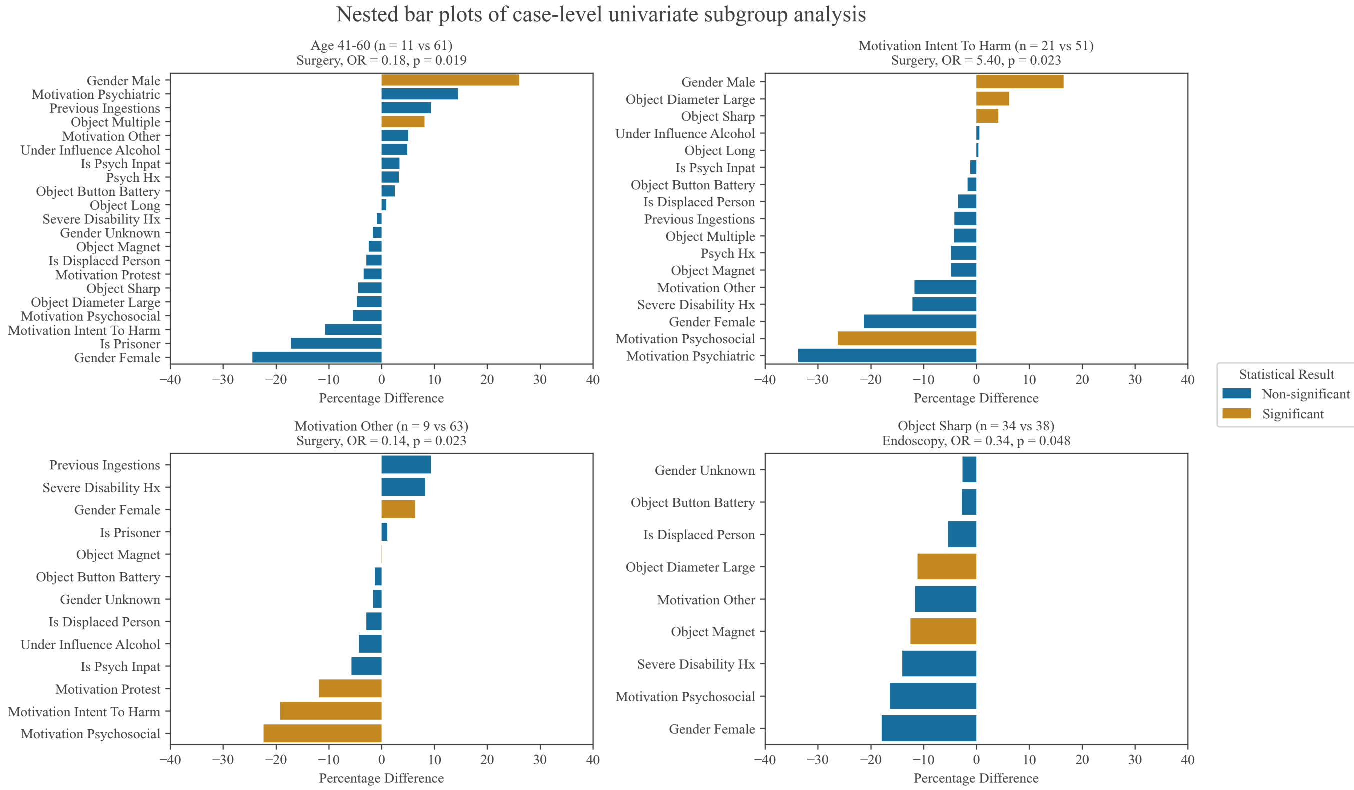

Fig. 3: Nested bar plots showing percentage differences in population characteristics between key subgroups and the comparison group. Each subplot visualises the relative increase or decrease of specific variables within a given subgroup, highlighting significant deviations ($p < 0.05$) from the broader case report population.

to increase numbers, case reports were flattened into a series and presented alongside other case series. This is demonstrated in Table **??**.

Meta-analyses of proportions were performed using random-effects models with restricted maximum likelihood (REML) estimation and Hartung-Knapp (HK) adjustments for confidence intervals, appropriate for small numbers of studies [114]. In general, REML yielded wider confidence intervals and lower heterogeneity estimates than the DerSimonian Laird (DL) method, reflecting greater uncertainty in pooled estimates from small samples.

A plot of aggregate series-level meta-analysis of pooled outcome proportions is shown in Figure **??**. For comparison, DL estimates were also calculated, yielding narrower confidence intervals and higher I^2 values. These are included in Table **??** and **??** of Appendix **??**.

Using REML with HK adjusted confidence intervals, meta-analysis of proportions was undertaken on endoscopy, surgery, death, complication, and conservative. The pooled proportion of patients that endoscopy was 47.3% (95% CI 4.3%–94.7%), with moderate heterogeneity (I^2 = 34.1%). The pooled proportion of patients that surgery was 30.6% (95% CI 12.0%–58.9%), with low heterogeneity (I^2 = 15.9%). The pooled proportion of patients that death was 2.5% (95% CI 0.8%–7.7%), with low heterogeneity (I^2 <0.5%). The pooled proportion of patients that complication was 34.7% (95% CI 1.8%–93.8%), with moderate heterogeneity (I^2 = 35.2%). The pooled proportion of patients that conservative management was 41.6% (95% CI 4.4%–91.7%), with moderate heterogeneity (I^2 = 25.7%).

Meta Regression: A full table of grouped aggregate series-level results for univariate meta-regression is available in Table **??**. In the gender subgroup, there were no significant associations with outcomes. In the demographic subgroup, severe disability was associated with a reduced likelihood of death (OR = 0.59, 95% CI [0.41, 0.84], p = 0.034); displacement status was associated with a reduced likelihood of death (OR = 0.22, 95% CI [0.08, 0.61], p = 0.034); alcohol influence was associated with a reduced likelihood of death (OR = 0.32, 95% CI [0.15, 0.69], p = 0.034). All other comparisons in this subgroup were non-significant. In the motivation subgroup, there were no significant associations with outcomes. In the object subgroup, multiple was associated with a reduced likelihood of death (OR = 0.98, 95% CI [0.98, 0.99], p = 0.014); large diameter was associated with a reduced likelihood of death (OR = 0.93, 95% CI [0.88, 0.98], p = 0.034). All other comparisons in this subgroup were non-significant.

Assessment of Reporting Bias

Risk of bias due to missing results (arising from reporting biases) was not formally assessed through funnel plot inspection or quantitative methods such as Egger's test, as the number of included case series per outcome was too small to support these analyses (fewer than 10 series per outcome). Furthermore, case series are prone to selective reporting and variable outcome definitions, which may contribute to reporting bias; however, the heterogeneity in reporting precluded a more formal assessment.

For the meta-regressions, the inclusion of aggregate case report data partially mitigated the risk of missing results at the series level but could not address potential reporting biases within the

TABLE V: Case counts per country.

Country	Case Count	Percentage	References
South Korea	52	32	[111]
United States of America	32	20	[38, 48, 55, 60, 62, 63, 66, 68, 75, 77, 94, 97, 104, 110]
Tunisia	19	12	[109]
United Kingdom	7	4	[54, 61, 72, 85, 88, 90]
India	7	4	[67, 71, 80, 86, 87, 95, 96]
Bulgaria	6	4	[33, 69]
Iran	5	3	[58, 59, 92]
Turkey	4	2	[46, 52, 76, 107]
Spain	2	1	[56, 108]
Poland	2	1	[65, 106]
China	2	1	[64, 98]
Pakistan	1	1	[81]
Switzerland	1	1	[105]
Taiwan	1	1	[89]
South Africa	1	1	[74]
Saudi Arabia	1	1	[103]
Qatar	1	1	[49]
Portugal	1	1	[101]
Sweden	1	1	[99]
Australia	1	1	[51]
Oman	1	1	[83]
Netherlands	1	1	[53]
United Arab Emirates	1	1	[84]
Japan	1	1	[100]
Italy	1	1	[73]
Israel	1	1	[93]
Iraq	1	1	[47]
Hungary	1	1	[57]
Greece	1	1	[102]
Germany	1	1	[82]
Ethiopia	1	1	[70]
Egypt	1	1	[50]
Ecuador	1	1	[91]
Croatia	1	1	[79]
Nepal	1	1	[78]

individual case reports or across studies. Overall, the potential for reporting bias remains a limitation of the syntheses presented in this review and should be considered when interpreting results.

Certainty of Evidence

A formal assessment of certainty in the body of evidence (e.g. using the GRADE approach) was not performed, as the included evidence was primarily derived from case reports and case series, which are inherently subject to a high risk of bias and lack of control groups. Additionally, heterogeneity across studies was substantial for several outcomes, and reporting was inconsistent across series.

The small number of available case series per outcome, the inclusion of aggregate case report data, and the observational nature of the data all limit the certainty of the synthesised results. As such, the findings of this review should be interpreted as exploratory and hypothesis-generating, rather than providing high-confidence estimates of effect.

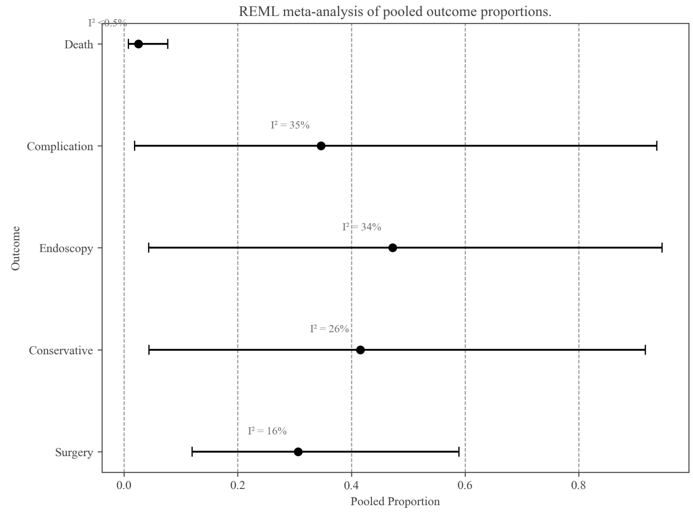

Fig. 4: Meta-analyses of proportions using random-effects models with restricted maximum likelihood (REML) estimation and Hartung-Knapp (HK) adjustments for confidence intervals.

Discussion

Interpretation of Results

Strengths: The present review represents, to the author's knowledge, the largest synthesis of IIFO cases published to date, aggregating evidence from 162 ingestion cases.

The main strength of this review lies in its robust methodology. Where motivation was unclear, cases were excluded—ensuring that the effects measured were genuinely reflective of intentionality. This strict inclusion criterion helps isolate intentional ingestion as an independent clinical phenomenon. Additionally, by avoiding age restrictions, this review includes a wide age range (from 7 to 100 years), improving the generalisability of its findings across the lifespan.

A broad search strategy was implemented, covering multiple databases, bibliographies, and grey literature sources. This increases the likelihood that the findings reflect a wide cross-section of the literature and reduces the impact of publication bias due to indexing alone.

Despite substantial heterogeneity in the review population, outcome proportions were pooled using random-effects meta-analysis with restricted maximum likelihood estimation and Hartung–Knapp adjustments—techniques appropriate for small numbers of studies and high between-study variance. Following IIFO, patients underwent endoscopy in 47.3% of cases (95% CI 4.3%–94.7%), surgery in 30.6% (95% CI 12.0%–58.9%), and conservative management in 41.6% (95% CI 4.4%–91.7%). Complications occurred in 34.7% of cases (95% CI 1.8%–93.8%), and 2.5% of patients died (95% CI 0.8%–7.7%). These figures are substantially higher than previously reported in the literature [14, 15].

Given the methodological rigour of this review—including strict exclusion of non-intentional cases—and despite the wide uncertainty intervals, the findings strongly suggest that *intentionality alone* is a key driver of morbidity and mortality following foreign body ingestion.

Associations Between Motivation and Outcome: While the univariate meta-regression (predominantly conducted on detained

TABLE VI: Grouped univariate meta-regression results for series-level data.

Variable	Conservative	Endoscopy	Surgery	Death	Complication
Gender					
Unknown	0.07 [0.00, 1.31] (p=0.060)	0.24 [0.00, 73.96] (p=0.396)	3.69 [0.40, 33.62] (p=0.157)	0.40 [0.00, 242.22] (p=0.321)	5.87 [0.00, 2346415554513.95] (p=0.554)
Female	0.91 [0.82, 1.01] (p=0.060)	0.95 [0.77, 1.17] (p=0.396)	1.05 [0.97, 1.13] (p=0.157)	0.97 [0.77, 1.22] (p=0.321)	1.07 [0.41, 2.77] (p=0.554)
Male	0.99 [0.94, 1.05] (p=0.515)	1.00 [0.95, 1.05] (p=0.941)	1.00 [0.97, 1.03] (p=0.866)	0.99 [0.95, 1.04] (p=0.284)	0.99 [0.80, 1.22] (p=0.683)
Demographic					
Severely Disabled	0.82 [0.42, 1.60] (p=0.164)	0.73 [0.41, 1.33] (p=0.095)	1.29 [0.07, 22.46] (p=0.458)	**0.59 [0.41, 0.84] (p=0.034)***	1.29 [0.03, 58.51] (p=0.554)
Displaced Person	0.56 [0.08, 3.85] (p=0.164)	0.95 [0.59, 1.53] (p=0.385)	0.91 [0.08, 9.80] (p=0.697)	**0.22 [0.08, 0.61] (p=0.034)***	0.90 [0.03, 23.23] (p=0.749)
Under Influence of Alcohol	0.65 [0.15, 2.75] (p=0.164)	0.96 [0.67, 1.38] (p=0.385)	0.93 [0.16, 5.54] (p=0.697)	**0.32 [0.15, 0.69] (p=0.034)***	0.92 [0.08, 10.58] (p=0.749)
Psychiatric Inpatient	0.52 [0.26, 1.07] (p=0.060)	0.70 [0.17, 2.93] (p=0.396)	1.39 [0.80, 2.41] (p=0.157)	0.80 [0.16, 3.95] (p=0.321)	1.56 [0.00, 1237.66] (p=0.554)
Psychiatric History	0.97 [0.87, 1.08] (p=0.349)	0.99 [0.89, 1.10] (p=0.672)	1.01 [0.95, 1.07] (p=0.677)	0.98 [0.96, 1.01] (p=0.069)	1.00 [0.59, 1.70] (p=0.959)
Previous Ingestor	0.87 [0.28, 2.72] (p=0.372)	1.15 [0.94, 1.42] (p=0.071)	1.03 [0.24, 4.53] (p=0.820)	0.95 [0.73, 1.23] (p=0.236)	—
Detained Person	0.99 [0.92, 1.07] (p=0.689)	1.00 [0.95, 1.06] (p=0.926)	0.99 [0.97, 1.02] (p=0.585)	0.99 [0.93, 1.06] (p=0.420)	0.99 [0.81, 1.20] (p=0.549)
Motivation					
Other	0.75 [0.55, 1.03] (p=0.060)	0.85 [0.45, 1.61] (p=0.396)	1.16 [0.90, 1.48] (p=0.157)	0.90 [0.44, 1.84] (p=0.321)	1.22 [0.06, 23.69] (p=0.554)
Psychosocial	0.86 [0.73, 1.02] (p=0.060)	0.92 [0.66, 1.29] (p=0.396)	1.08 [0.95, 1.23] (p=0.157)	0.95 [0.65, 1.38] (p=0.321)	1.11 [0.23, 5.34] (p=0.554)
Psychiatric	0.95 [0.83, 1.07] (p=0.201)	0.97 [0.85, 1.11] (p=0.492)	1.02 [0.96, 1.09] (p=0.364)	0.98 [0.93, 1.03] (p=0.104)	1.02 [0.49, 2.10] (p=0.813)
Intent to harm	0.91 [0.74, 1.11] (p=0.168)	0.95 [0.76, 1.20] (p=0.452)	1.04 [0.93, 1.16] (p=0.325)	0.96 [0.86, 1.07] (p=0.122)	1.04 [0.30, 3.53] (p=0.775)
Protest	0.99 [0.90, 1.08] (p=0.653)	1.00 [0.94, 1.07] (p=0.852)	0.99 [0.96, 1.03] (p=0.538)	0.99 [0.91, 1.09] (p=0.436)	0.98 [0.78, 1.23] (p=0.489)
Object					
Multiple	0.97 [0.63, 1.50] (p=0.590)	0.99 [0.87, 1.12] (p=0.764)	1.01 [0.91, 1.12] (p=0.783)	**0.98 [0.98, 0.99] (p=0.014)***	1.00 [0.52, 1.91] (p=0.940)
Large (>2.5cm) Diameter	0.97 [0.88, 1.07] (p=0.164)	1.00 [0.97, 1.02] (p=0.385)	1.00 [0.89, 1.12] (p=0.697)	**0.93 [0.88, 0.98] (p=0.034)***	0.99 [0.85, 1.17] (p=0.749)
Long (>5cm)	0.98 [0.61, 1.57] (p=0.685)	1.00 [0.88, 1.14] (p=0.985)	1.00 [0.89, 1.12] (p=0.946)	0.98 [0.96, 1.01] (p=0.092)	0.98 [0.54, 1.77] (p=0.718)
Button Battery	0.25 [0.00, 992.17] (p=0.281)	0.49 [0.03, 8.60] (p=0.396)	2.15 [0.28, 16.26] (p=0.246)	0.63 [0.03, 15.56] (p=0.321)	2.42 [0.00, 1531801.41] (p=0.554)
Magnet	0.74 [0.12, 4.63] (p=0.281)	0.85 [0.45, 1.61] (p=0.396)	1.19 [0.76, 1.86] (p=0.246)	0.90 [0.44, 1.84] (p=0.321)	1.22 [0.06, 23.69] (p=0.554)
Sharp	0.99 [0.91, 1.06] (p=0.525)	1.00 [0.94, 1.06] (p=0.886)	1.00 [0.96, 1.03] (p=0.912)	0.99 [0.94, 1.05] (p=0.285)	0.99 [0.75, 1.31] (p=0.723)

OR: Odds Ratio; CI: Confidence Interval; p: p-value. * indicates $p < 0.05$. Bold = statistically significant. — = missing or unstable estimate.

males) didn't show statistically significant correlations between motivations and outcomes, signals did emerge in the univariate association testing conducted on the more varied population represented in the case reports. This population was more diverse—39% female, 17% detained individuals, and 50% with a psychiatric history—and included a wider range of object types (e.g., magnets, multiple items, long objects).

In this context, "intent to harm" was associated with a fivefold increase in the odds of surgery, whereas "other" motivations were associated with an 86% decrease in the odds of surgery. These findings suggest that motivations likely influence clinical outcomes, particularly in more heterogeneous and less institutionalised populations.

Subgroup Findings: Interestingly, among severely disabled people (defined here as individuals with reduced levels of consciousness or severe learning disabilities), univariate meta-regression showed a 41% decrease in the odds of death. While this cohort was small (*n*=7), and all cases were published as case reports, this may reflect publication bias—authors may be more likely to report complex or anatomically challenging cases [115]. However, it might also reflect the diligence of carers, earlier access to intervention, and perhaps the success of public health campaigns aimed at recognising and addressing disproportionate harms in this population.

Also noteworthy, displaced individuals had reduced odds of death (OR 0.22, 95% CI 0.08–0.61, p = 0.034) in the meta-regression. This is unlikely to be solely due to their displacement status. The two cases underpinning this result [46, 116] are strikingly different. One involved a person who swallowed a pen in protest of an asylum decision and developed a double duodenal perforation, requiring surgery; the other involved a man who swallowed $1000 wrapped in plastic for safe-keeping, who then had it endoscopically removed and returned to him. These examples illustrate well how both motivation and object characteristics can drive clinical outcomes—and why both should be considered in future analysis.

Limitations of the Review Process

Several limitations of the review process should be acknowledged.

*Selection and Screening Many studies were excluded because intentionality was not clearly stated. Given the nuanced and inconsistent language often used in clinical reporting, some relevant cases may have been omitted. This likely introduced selection bias, especially in a single-author review, where subjective judgment plays a larger role.

Although the search strategy was broad, relevant studies may still have been missed—particularly unpublished material or reports not indexed in major databases. This is a recognised limitation in rare-event research.

Screening and data extraction were carried out by a single reviewer. While detailed protocols and reproducible scripts were used to minimise error, the absence of a second full-text reviewer and data extracter increases the risk of human error and subjective bias, particularly when interpreting ambiguous descriptions of intent and motivation. Manually reviewing over 480 full texts and extracting detailed case-level data from almost half is a substantial undertaking and a recognised limitation.

Motivation Classification: The motivation categories were author-defined and applied post hoc following preliminary analysis. While this was necessary due to the lack of standardised classifications, it introduces classification bias, especially in a field as complex and subjective as IIFO. Motivational constructs such as "intent to harm", "protest", or "other" may overlap or be poorly described in reports, affecting how cases are grouped and interpreted.

Statistical Limitations: The analytical approach may have been overly complex given the volume and quality of the available literature. Conducting regression on 25 variables across only four case series risks overfitting, reducing the reliability of these models. A more parsimonious strategy might have involved collapsing object variables into a binary "high-risk vs low-risk" classification, informed by existing literature on object characteristics and classification [14, 15].

Similarly, psychiatric history was treated as a binary variable, but as noted in the introduction, psychiatric presentations associated with IIFO are varied and complex. The binary coding limits the ability to identify nuanced associations. A more granular analysis of psychiatric subtypes could provide deeper insight but would further complicate models already stretched by sample size constraints.

Other Gaps: This review did not examine the types or effectiveness of conservative management strategies, despite their prevalence and clinical relevance. Nor did it consider object location, which is known to be a critical determinant of clinical risk. Both factors are likely to affect outcomes and should be included in future studies.

Takeaway points

Ultimately, the literature on motivations in IIFO remains sparse, and clinical outcomes remain highly heterogeneous. The evidence base is not yet strong enough to draw definitive conclusions. As with many rare and complex presentations, prospective, randomised studies are needed—but these must be preceded by expert consensus on motivation frameworks.

IIFO is a nuanced and multifaceted form of self-harm. Motivation is rarely reported, and intentionality itself is often assumed rather than stated. Following this review, authors should heed the advice of experts in the field: a multidisciplinary approach is essential. Psychiatric and psychological input is needed not just for treatment, but also for accurate classification and understanding of patient motivations.

With more precise reporting of motivational and clinical variables, future reviews will be better placed to inform evidence-based guidance, ultimately improving care for this complex patient group.

Data Availability

Data collection, maniplation and analysis in this review were conducted using Python [43] in *Visual Studio Code* [117] and *Jupyter Notebooks* [118]. The manuscript was compiled using *LaTeX* [119]. Specific Python packages used include: *Pandas* [120], *scikit-learn* [121], *statsmodel* [45], *seaborn* [122], matplotlib [123] and Cartopy [124].

The data and code used in this systematic review are available on Github at http://github.com/jackgedge/iifo_systematic_review.

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APPENDIX A
ELIGIBILITY CRITERIA

A. *Inclusion Criteria*

Category	**Details**
Population	Any human. Any age group.
Interventions or exposures	Humans that have: – Non-accidental ingestion – Ingestion of a true foreign body (non-nutritive items)
Comparators / Control group	Demographic: – Gender – Age – Detained Person – Psychiatric Inpatient - Displaced Person - Under Influence of Alcohol - Psychiatric History - Severely Disabled - Previous Ingestion Motivation: – Intent to harm – Psychiatric – Psychosocial – Protest – Other Object characteristics: – Button battery – Magnet – Long (>5 cm) – Large diameter (>2.5 cm) – Multiple – Blunt objects – Sharp-pointed objects
Outcomes of interest	– Endoscopic intervention – Surgical intervention – Conservative management – Complication rates – Mortality rates
Setting	Any setting.
Study designs	Any design.

TABLE VII: Inclusion criteria structured using the PICO framework.

B. *Exclusion Criteria*

#	**Exclusion Criterion**
1	Full text not available in English.
2	Studies not focusing on intentional self-ingestion (into the gastrointestinal tract) of a foreign object via the oral cavity (mouth), or where it is unclear if ingestion occurred.
3	Studies focusing solely on accidental ingestion.
4	Non-human or animal studies.
5	Reviews, editorials, commentaries, and opinion pieces without original empirical data.
6	Duplicate publications or studies with overlapping datasets (only the most comprehensive or recent study was included).
7	Studies focusing on ingestion or co-ingestion of substances (e.g., poisons, medications) rather than physical foreign objects.
8	Ingestions undertaken in controlled environments as part of a voluntary study.
9	Ingestions not explicitly stated to be intentional and not suggestive of deliberate ingestion.
10	Does not meet inclusion criteria.
11	Ingestions where death resulted from other means (e.g., suicide by other method).
12	Studies published before the advent of endoscopy (1906).
13	Outcomes not reported.
14	Motivation not reported.
15	Object characteristics not reported’

TABLE VIII: Exclusion criteria for study selection.

Appendix B
Keywords and MeSH Terms

A. *PubMed*

Concept	Keywords	MeSH Terms
Foreign Bodies	"foreign obj*" "foreign bod*"	Foreign Bodies [MeSH]
Intentional Ingestion / Self-harm	"intent*" "deliberate*" "purpose*" "self-injur*" "selfharm*" "self-harm*"	Self-Injurious Behavior [MeSH]
Ingestion Behavior	"ingest*" "swallow*"	–
Interventions	"surg*" "endoscop*" "EGD" "OGD" "Esophagogastroduodenoscopy" "Oesophagogastroduodenoscopy" "manag*"	Endoscopy [MeSH] Surgical Procedures, Operative [MeSH] Conservative Treatment [MeSH] Drug Therapy [MeSH]

TABLE IX: Concepts with associated keywords and MeSH terms used in PubMed search strategy.

B. *Embase*

Concept	Keywords	EMTREE Terms
Foreign Bodies	"foreign obj*" "foreign bod*"	"foreign body"/exp
Intentional Ingestion / Self-harm	"intent*" "deliberate*" "purpose*" "self-injur*" "selfharm*" "self-harm*"	"automutilation"/exp
Ingestion Behavior	"ingest*" "swallow*"	"swallowing"/exp
Interventions	"surg*" "endoscop*" "EGD" "OGD" "Esophagogastroduodenoscopy" "Oesophagogastroduodenoscopy" "manag*"	"endoscopy"/exp "surgery"/exp "conservative treatment'/exp 'drug therapy"/exp

TABLE X: Concepts with associated keywords and EMTREE terms used in Embase search strategy.

C. Cochrane (CENTRAL)

Concept	Keywords	Cochrane MeSH Terms
Foreign Bodies	"foreign obj*" "foreign bod*" (foreign NEXT obj*) (foreign NEXT bod*)	[mh foreign bodies]
Intentional Ingestion / Self-harm	intent* deliberate* purpose* (self NEXT injur*) (self NEXT harm*)	[mh self-injurious behavior]
Ingestion Behavior	ingest* swallow*	–
Interventions	surg* endoscop* EGD Esophagogastroduodenoscopy Oesophagogastroduodenoscopy manag*	[mh endoscopy] [mh surgical procedures, operative] [mh conservative treatment] [mh drug therapy]

TABLE XI: Concepts with associated keywords and Cochrane MeSH terms used in CENTRAL search strategy.

D. Web of Science

Concept	Keywords	Search Field
Foreign Bodies	foreign obj* foreign bod*	ALL=
Intentional Ingestion / Self-harm	automutilation intent* deliberate* purpose* self-injur* selfharm* self-harm*	ALL=
Ingestion Behavior	swallowing ingest* swallow*	ALL=
Interventions	endoscopy surgery conservative treatment drug therapy surg* endoscop* EGD Esophagogastroduodenoscopy Oesophagogastroduodenoscopy manag*	ALL=

TABLE XII: Concepts with associated keywords and Web of Science fields used in the search strategy.

E. Scopus

Concept	Keywords	Search Field / Syntax
Foreign Bodies	foreign PRE/0 obj* foreign PRE/0 bod*	ALL()
Intentional Ingestion / Self-harm	intent* deliberate* purpose* self PRE/0 injur* self PRE/0 harm*	ALL()
Ingestion Behavior	ingest* swallow*	ALL()
Interventions	endoscopy surgery ’conservative’ ’treatment’ ’drug’ ’therapy’ surg* endoscop* egd esophagogastroduodenoscopy oesophagogastroduodenoscopy manag*	ALL()

TABLE XIII: Concepts with associated keywords and Scopus syntax used in the search strategy.

F. PsycINFO

Concept	Keywords	PsycINFO Descriptors
Foreign Bodies	foreign obj* foreign bod*	–
Intentional Ingestion / Self-harm	automutilation intent* deliberate* purpose* self injur* self harm*	DE "Nonsuicidal Self-Injury"
Ingestion Behavior	ingest* swallow*	DE "Ingestion"
Interventions	endoscop* conservative treatment drug therapy surg* egd esophagogastroduodenoscopy oesophagogastroduodenoscopy manag*	DE "Surgery"

TABLE XIV: Concepts with associated keywords and controlled vocabulary (Descriptors) used in PsycINFO search strategy.

G. Google Scholar

Concept	Keywords	Search Field
Foreign Bodies	"foreign obj*" "foreign bod*"	–
Intentional Ingestion / Self-harm	"intent*" "deliberate*" "purpose*" "self-injur*" "selfharm*" "self-harm*"	–
Ingestion Behavior	"ingest*" "swallow*"	–

TABLE XV: Concepts with associated keywords used in Google Scholar search strategy.

Database Searches

PubMed Query

(“Foreign Bodies”[MeSH] OR “foreign obj*” OR “foreign bod*”)
AND
(“Self-Injurious Behavior”[MeSH] OR “intent*” OR “deliberate*” OR “purpose*” OR “self-injur*” OR “selfharm*” OR “self-harm*”)
AND
(“ingest*” OR “swallow*”)
AND
(“Endoscopy”[MeSH] OR “Surgical Procedures, Operative”[MeSH] OR “Conservative Treatment”[MeSH] OR “Drug Therapy”[MeSH] OR “surg*” OR “endoscop*” OR “EGD” OR “OGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag*”)

Embase Query (All Fields)

(’foreign body’/exp OR “foreign obj*” OR “foreign bod*”)
AND
(’automutilation’/exp OR “intent*” OR “deliberate*” OR “purpose*” OR “self-injur*” OR “selfharm*” OR “self-harm*”)
AND
(’swallowing’/exp OR “ingest*” OR “swallow*”)
AND
(’endoscopy’/exp OR ’surgery’/exp OR ’conservative treatment’/exp OR ’drug therapy’/exp OR “surg*” OR “endoscop*” OR “EGD” OR “OGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag*”)

CENTRAL (Cochrane) Query (All Fields)

([mh “foreign bodies”] OR (“foreign” NEXT “obj*”) OR (“foreign” NEXT “bod*”))
AND
([mh “self-injurious behavior”] OR “intent*” OR “deliberate*” OR “purpose*” OR (“self” NEXT “injur*”) OR (“self” NEXT “harm*”))
AND
(“ingest*” OR “swallow*”)
AND
([mh “endoscopy”] OR [mh “surgical procedures, operative”] OR [mh “conservative treatment”] OR [mh “drug therapy”] OR “surg*” OR “endoscop*” OR “EGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag*”)

Web of Science Query

Link: https://www.webofscience.com/wos/woscc/summary/4da44d48-3e09-4a94-a3bd-ff8139e94859-01387ccd63/relevance/1

ALL=(“foreign obj*” OR “foreign bod*”)
AND
ALL=(“automutilation” OR “intent*” OR “deliberate*” OR “purpose*” OR “self-injur*” OR “selfharm*” OR “self-harm*”)
AND
ALL=(“swallowing” OR “ingest*” OR “swallow*”)
AND
ALL=(“endoscopy” OR “surgery” OR “conservative treatment” OR “drug therapy” OR “surg*” OR “endoscop*” OR “EGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag*”)

Scopus Query

ALL (“foreign PRE/0 obj*” OR “foreign PRE/0 bod*”)
AND
ALL (“intent*” OR “deliberate*” OR “purpose*” OR “self PRE/0 injur*” OR “self PRE/0 harm*”)
AND
ALL (“ingest*” OR “swallow*”)
AND
ALL (“endoscopy” OR “surgery” OR “conservative” OR “treatment” OR “drug” OR “therapy” OR “surg*” OR “endoscop*” OR “EGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag*”)

PsycINFO Query

Link: https://search-ebscohost-com.ezproxy.library.qmul.ac.uk/login.aspx?direct=true&db=psyh&bquery=(foreign+obj*+OR+foreign+bod*)+AND+(DE+%26quot%3bNonsuicidal+Self-Injury%26quot%3b+OR+automutilation+OR+intent*+OR+deliberate*+OR+purpose*+OR+self+injur*+OR+self+harm*)+AND+(DE+%26quot%3bIngestion%26quot%3b+OR+ingest*+OR+swallow*)+AND+(DE+%26quot%3bSurgery%26quot%3b+OR+endoscop*+OR+conservative+treatment+OR+drug+therapy+surg*+OR+endoscop*+OR+egd+OR+esophagogastroduodenoscopy+OR+oesophagogastroduodenoscopy+OR+manag*)&type=0&searchMode=Standard&site=ehost-live

("foreign obj*" OR "foreign bod*")
AND
(DE "Nonsuicidal Self-Injury" OR "automutilation" OR "intent*" OR "deliberate*" OR "purpose*" OR "self injur*" OR "self harm*")
AND
(DE "Ingestion" OR "ingest*" OR "swallow*")
AND
(DE "Surgery" OR "endoscop*" OR "conservative treatment" OR "drug therapy" OR "surg*" OR "endoscop*" OR "EGD" OR "Esophagogastroduodenoscopy" OR "Oesophagogastroduodenoscopy" OR "manag*")

Grey Literature

Google Scholar

("foreign obj*" OR "foreign bod*")
AND
("intent*" OR "deliberate*" OR "purpose*" OR "self-injur*" OR "selfharm*" OR "self-harm*")
AND
("ingest*" OR "swallow*")

APPENDIX C
COMPUTATIONAL VARIABLE DEFINITIONS

TABLE XVI: Variables used for case report data extraction. Aggregates of which where used to create Variable_Rate and Variable_Cases.

Variable	Definition
Is_Prisoner	Documented in prison, police custody, or detained (including immigration detention) at the time of the encounter; 'N' if not detained; 'UK' if unknown.
Psych_Hx	Documented DSM-V mental disorder (including substance-related disorders) [125]; 'N' if no diagnosis; 'UK' if data unavailable.
Is_Displaced_Person	'Y' if: meets the UN General Assembly [126] definition of 'Refugee'; or meets UNHCR [127] definition of an 'internally displaced person'; or meets the UNHCR [128] definition for 'asylum seeker'; 'N' if not displaced; 'UK' if unknown.
Under_Influence_Alcohol	Evidence, suspicion, or self-report of alcohol influence at presentation; 'N' if no indication; 'UK' if unknown.
Is_Psych_Inpat	Admitted (voluntarily or involuntarily) to a psychiatric facility/ward at encounter; 'N' if not admitted; 'UK' if unknown.
Severe_Disability_Hx	History of severe learning disability or impaired consciousness; 'N' if absent; 'UK' if unknown.
Previous_Ingestions	Prior episode of foreign-body ingestion documented; 'N' if first ingestion; 'UK' if history unknown.
Motivation_Intent_To_Harm	Ingestion intended for self-harm, self-injury, or suicide; 'N' if other motive; 'UK' if unclear.
Motivation_Protest	Ingestion as protest, demonstration, or manipulation (e.g., objection to detention conditions); 'N' if not protest-related; 'UK' if unclear.
Motivation_Psychiatric	Ingestion driven primarily by an underlying psychiatric condition (psychosis, impulsivity, etc.); 'N' if not psychiatric; 'UK' if unclear.
Motivation_Psychosocial	Ingestion motivated by social or interpersonal factors (imitative acts, shock value, body-image, safekeeping, etc.); 'N' if not psychosocial; 'UK' if unclear.
Motivation_Unknown	No clear motivation identified in documentation; 'N' if specific motive recorded; 'UK' if ambiguous.
Object_Button_Battery	Button battery ingested; 'N' if not; 'UK' if object type not recorded.
Object_Magnet	Magnet ingested; 'N' if none; 'UK' if unknown.
Object_Long	Ingested object length $>$ 5 cm; 'N' if $\leq$ 5 cm; 'UK' if dimensions unknown.
Object_Sharp	Object described as sharp or pointed (e.g., blades, nails, needles); 'N' if not sharp; 'UK' if unclear.
Object_Multiple	More than one object ingested in same episode; 'N' for single object; 'UK' if number unspecified.
Object_Unknown	Where object characteristics are unknown. 'N' if known; 'UK' if Unknown.
Outcome_Endoscopy	Endoscopic intervention performed during episode; 'N' if not; 'UK' if unavailable.
Outcome_Surgery	Surgical intervention performed (operative procedure under anaesthesia); 'N' if not; 'UK' if not documented.
Outcome_Conservative	'Y' if managed without endoscopy or surgery; 'N' if either procedure performed.
Outcome_Death	Death causally related to ingestion complications; 'N' if survived; 'UK' if outcome unknown.
Outcome_Complication	'Y' if any complication directly related to ingestion or resulting from management strategy; 'N' if no complication; 'UK' if unknown.
Outcome_Unknown	Where no outcome identified; 'N' if outcome identified; 'UK' if Unknown.

Variable Definitions

Demographic

Individuals were considered detained if they were documented to be in prison, police custody, or immigration detention at the time of the encounter. If they were not detained, this was recorded as 'N'; if the status was unknown, it was marked as 'UK'. Psychiatric history was defined as a documented diagnosis of a mental disorder according to DSM-V criteria, including substance-related disorders [125]. Absence of a diagnosis was recorded as 'N', and unavailable data as 'UK'. Displacement status was defined as meeting one of the following: the UN General Assembly's definition of a 'refugee' [126], the UNHCR's definition of an 'internally displaced person' [127], or the UNHCR's definition of an 'asylum seeker' [128]. Those who did not meet these definitions were marked as 'N', and those with unknown status as 'UK'. Alcohol use was defined as any evidence, suspicion, or self-report of being under the influence of alcohol at the time of presentation. A lack of such indication was recorded as 'N', and unknown status as 'UK'. Psychiatric inpatient status was defined as being admitted (voluntarily or involuntarily) to a psychiatric facility or ward at the time of the encounter. If the person was not admitted, this was recorded as 'N'; unknown status was marked as 'UK'. A history of severe disability included documented cases of severe learning disability or impaired consciousness. Absence of such a history was recorded as 'N', and 'UK' was used when data were unavailable. Previous ingestions referred to any documented prior episode of foreign-body ingestion. If it was the first recorded incident, this was marked as 'N'; if unknown, 'UK' was used.

Motivation

Intent to harm was defined as ingestion carried out with the purpose of self-harm, self-injury, or suicide. If the ingestion was for another reason, it was recorded as 'N'. If the intent was unclear, it was marked as 'UK'. Protest-related ingestion was defined as an act of ingestion carried out as a form of protest, demonstration, or manipulation—for example, in response to detention conditions. If the ingestion was not motivated by protest, it was marked as 'N'; if unclear, as 'UK'. Psychosocial motivation included ingestion motivated by social or interpersonal dynamics—such as imitative behaviour, a desire to shock, body-image concerns, or the use of ingestion for safekeeping objects. If these factors were not involved, the case was marked as 'N'; if unclear, as 'UK'. Unknown motivation was recorded when no clear motivation was identifiable in the documentation. If a specific motive was documented, this was marked as 'N'. If the available information was ambiguous, it was recorded as 'UK'.

Object

Button battery ingestion was recorded when documentation confirmed that a button battery had been ingested. If no button battery was ingested, this was marked as 'N'; if the type of object was not recorded, it was marked as 'UK'. Magnet ingestion was identified when a magnet was reported as the ingested object. If no magnet was ingested, this was marked as 'N'; if the object type was unknown, it was marked as 'UK'. Long objects were defined as any ingested object longer than 5 cm. If the object was 5 cm or shorter, this was recorded as 'N'. If the object's dimensions were not known, the entry was marked as 'UK'. Sharp objects included those described as pointed or capable of causing injury—such as blades, nails, or needles. If the object was not sharp, it was marked as 'N'; if the description was unclear, it was recorded as 'UK'. Multiple object ingestion referred to the ingestion of more than one object during a single episode. A single ingested object was recorded as 'N', and cases with unspecified object counts were marked as 'UK'. Unknown object characteristics were recorded when no reliable information about the ingested object was available. If the object was identified, this was marked as 'N'; if unknown, it was marked as 'UK'.

Outcome

An endoscopic intervention was recorded when a procedure using flexible or rigid endoscopy via natural orifices was performed to retrieve an ingested object or assess complications. If no endoscopy was performed, this was recorded as 'N'; if the information was unavailable, it was marked as 'UK'. A surgical intervention was defined as any operative procedure carried out in a sterile operating theatre under general or regional anaesthesia. This included procedures such as laparotomy, laparoscopy, thoracotomy, or cervical exploration—either to remove an ingested object or to manage complications. If surgery was not performed, the case was marked as 'N'; if it was not documented, it was recorded as 'UK'. Conservative management referred to cases managed without either endoscopy or surgery. These were marked as 'Y'. If either procedure was performed, the case was recorded as 'N'. Mortality was defined as death causally related to ingestion or its complications. If the patient survived, this was recorded as 'N'; if the outcome was unknown, it was marked as 'UK'. Complications were recorded when there was a direct clinical consequence related to the ingestion or the treatment strategy—for example, perforation, bleeding, or infection. Absence of complications was recorded as 'N'; if the status was unclear or undocumented, it was marked as 'UK'. Finally, unknown outcome was recorded when no clinical outcome (such as discharge, intervention, or death) could be identified from documentation. If an outcome was clearly documented, this was marked as 'N'; if unknown, it was marked as 'UK'. """

Effects Measures

Case Reports:

Univariate Association Testing: For binary outcomes (endoscopy, surgery, conservative management, complications, and death), the effect measure used was the odds ratio (OR), calculated from 2x2 contingency tables. Each odds ratio was accompanied by a 95% confidence interval (CI) and a p-value derived from either a chi-square test of independence or, where expected cell counts were below 5, Fisher's exact test. [41]

This approach was used consistently across all pairwise comparisons between binary exposure variables (e.g., motivations, object types, population characteristics) and binary outcome variables. Significant associations were identified at a threshold of $p < 0.05$ and reported alongside their respective ORs and CIs. Due to the small number of deaths observed, effect estimates for death should be interpreted with caution.

Logistic Regression Modelling: To explore which factors were independently associated with clinical outcomes, the analysis looked at multivariate logistic regression analyses for five outcomes of interest: endoscopy, surgery, conservative management, complications, and death. For each outcome, a logistic regression model was developed and included the afforementioned groups of predictor variables: age group, gender, demographic, motivation, and object characteristics.

Age group, gender, and motivation variables were entered as one-hot encoded categorical variables with a reference category omitted. Population characteristics and object type variables were included as binary indicators. A constant term was included in each model. All variables were selected a priori based on clinical relevance and prior univariate (chi-square, Fisher's exact test) analyses.

Missing values in predictor variables were imputed as zero. Models were fitted using maximum likelihood estimation via the *statsmodels Python* library [45]. In the event that a model failed to converge or could not be fitted (as occurred for the death outcome due to small sample size), an empty result table was substituted to maintain consistency of reporting across outcomes.

For each predictor, the odds ratio (OR) with corresponding 95% confidence interval (CI) and p-value were reported. Results from all models were summarised in a single grouped wide table, with predictors grouped into their logical domains (age, gender, demographic, motivation, object). The intercept term (`const`) was excluded from the summary table. Significant predictors ($p < 0.05$) were flagged with an asterisk.

Case Series:

Meta-analysis of Proportions: To provide descriptive summary estimates of clinical outcomes across included case series, a meta-analyses of proportions included: endoscopy, surgery, complications, death, and conservative management. For each outcome, the observed proportion was calculated within each series and performed a random-effects meta-analysis using the Der Simonian-Laird method to pool proportions on the logit scale. Between-study heterogeneity was quantified using the I^2 statistic and between-study variance (τ^2). These analyses provided overall estimates of outcome frequencies across studies and informed interpretation of subsequent meta-regression analyses. All meta-analyses were conducted using custom *Python* [43] code implementing standard meta-analytic formulas.

Meta-Regression: It was anticipated that the number of independent case series would be small, limiting the feasibility of multivariable modelling. To increase the effective number of contributing series, the series-level data were combined with the aggregate case report data, collapsed to series level.

Univariate meta-regression was performed to explore associations between predictor variables (gender, demographic, ingestion motivations, object characteristics) and clinical outcomes (endoscopy, surgery, conservative management, complications, death). For each outcome, the logit-transformed proportion of cases was modelled using weighted least squares, with inverse variance weighting to account for differing series sizes.

Significant associations ($p < 0.05$) were reported for each predictor, grouped by conceptual domain. All other comparisons were noted as non-significant.

Appendix D
Results of Synthesis Expanded

Using the DerSimonian Laird (DL) method, meta-analysis of proportions was undertaken on endoscopy, surgery, death, complication, and conservative. The pooled proportion of patients that endoscopy was 50.4% (95% CI 26.9%–73.6%), with substantial heterogeneity (I^2 = 90.5%). The pooled proportion of patients that surgery was 30.5% (95% CI 16.5%–49.4%), with substantial heterogeneity (I^2 = 87.2%). The pooled proportion of patients that death was 2.5% (95% CI 1.1%–5.5%), with low heterogeneity (I^2 <0.5%). The pooled proportion of patients that complication was 34.6% (95% CI 13.0%–65.2%), with substantial heterogeneity (I^2 = 94.5%). The pooled proportion of patients that conservative management was 41.5% (95% CI 14.4%–75.0%), with substantial heterogeneity (I^2 = 93.1%).

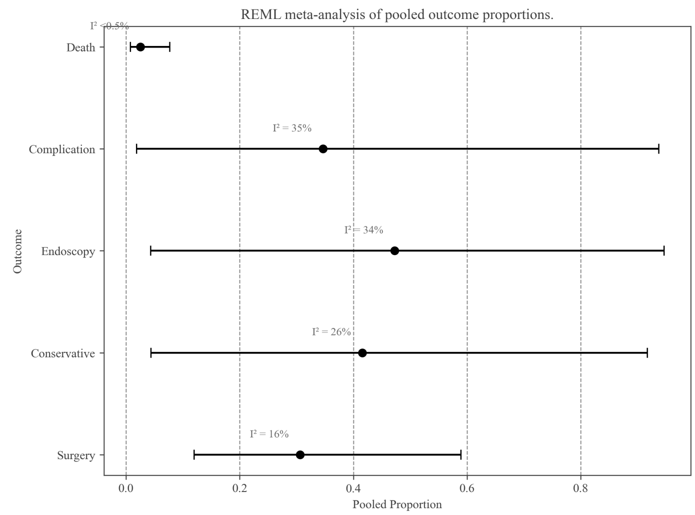

Fig. 5: Meta-analysis of proportions using random-effects models with restricted maximum likelihood (REML) estimation and Hartung-Knapp (HK) adjustments for confidence intervals.

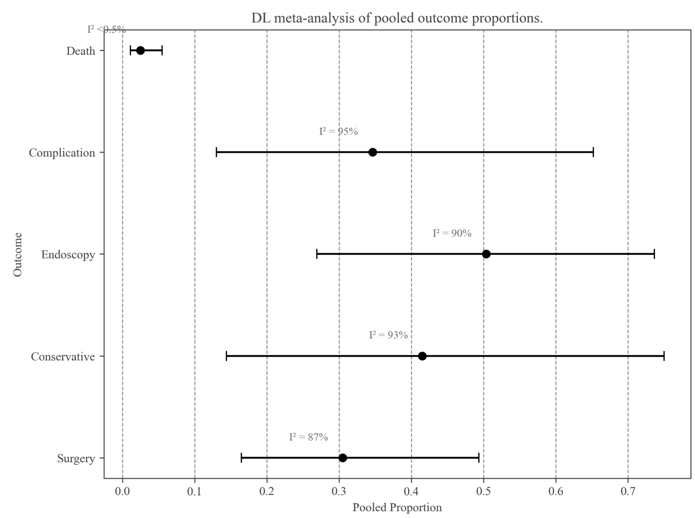

Fig. 6: Meta-analysis of proportions using the DerSimion & Laird Method.

Appendix E
Computational Risk of Bias Assessment

Case Reports: For case reports, the JBI Checklist for Case Reports was used. This tool assesses eight domains of reporting quality, including whether patient demographics were clearly described, a timeline of clinical history was provided, the presenting condition and diagnostic assessment were outlined, and whether the intervention, post-intervention condition, and any adverse events were reported. The final domain evaluates whether the case provides meaningful takeaway lessons.

In addition to manual JBI appraisal, a logic-based validation filter was applied to all case reports using *Python Pandas* [120]. This secondary filter assessed whether key variables — specifically, outcomes, object characteristics, and motivation — were completely unreported. For each domain, a binary flag was generated:

- *Outcome_Unknown* was marked `1` if all outcome-related fields were either missing or marked as unknown.
- *Object_Unknown* was marked `1` if all object-related fields (excluding *Object_Other_Long*) were missing or unknown.
- *Motivation_Unknown* was predefined in the dataset and indicated absence of motivational information.

If any of these flags were triggered, the corresponding JBI item most affected by the missing domain was marked as not reported (e.g., *Post_Intervention_Condition_Described* or *History_Timeline* set to `N`). Finally, an *Overall_Appraisal* score of *Exclude* was assigned, indicating high risk of bias and exclusion from analysis. This ensured that only case reports with sufficient information to meaningfully contribute to the review question were retained.

Case Series: For case series, the JBI Checklist for Case Series was applied. The JBI Checklist for Case Series assesses 10 domains of methodological and reporting quality. These include whether the case series defined clear inclusion criteria, applied valid and consistent methods to identify the condition, and included participants consecutively and completely. The checklist also evaluates whether participant demographics and clinical information were clearly reported, whether outcomes or follow-up results were adequately described, and whether the study setting was detailed. Finally, it considers whether the statistical analysis used was appropriate for the data presented.

In addition to manual JBI appraisal, a logic-based exclusion filter was applied using *Python Pandas* [120]. This filter assessed whether key variables — specifically, motivation, object characteristics, and outcomes — were unreported for the entire study population. For each of these domains, a derived rate variable was calculated:

- *Outcome_Unknown_Rate* was marked as `1` if all outcome-related fields were missing or marked as unknown (i.e. the entire population had an had an unknown outcome).
- *Motivation_Unknown_Rate* indicated whether motivation was absent or only partially reported across cases within the study.
- *Object_Unknown_Rate* was derived if all object-related fields were missing or unknown.

If any of these indicators were flagged, the corresponding JBI checklist item (e.g., *Clear_Outcome_Followup_Reported*, *Clear_Demographic_Reporting*, or *Clear_Clinical_Info_Reporting*) was marked as `N`, and the study received an *Overall_Appraisal* of `Exclude`. This logic-based validation ensured that case series lacking essential variables could be systematically excluded from the final analysis, maintaining consistency with the review question and minimising risk of bias in the dataset.