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

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I. Abstract

II. 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 (UNHCR) as of May 2024 [1]. Refugees and asylum seekers often endure extreme hardships, compelling them to seek asylum in foreign countries [2, 3]. This vulnerable population frequently faces compounded mental health challenges due to traumatic pre-migration experiences, hazardous journeys, and difficult post-migration realities, including detention and instability of legal status [4–7].

Self-harm, encompassing various behaviours where individuals inflict harm on themselves, is a particularly alarming manifestation of these mental health challenges. Rates of self-harm are significantly elevated among asylum seekers and refugees compared to general populations, especially among those who are detained, with rates up to 216 times higher in offshore detention facilities than in the general population [8–10].

Methods of suicide and self-harm among refugees differ based on available means, cultural factors, and motivating factors [11]. Common methods include cutting, self-battery, attempted hanging, self-poisoning by medication or chemicals, and intentional ingestion of foreign objects [9].

Intentional ingestion of foreign objects (IIFO) is defined as non-accidental ingestion of a true foreign body (non-nutritive items)[12]. Most ingested foreign bodies (80–90%) pass spontaneously, but 10–20% require endoscopic removal and up to 1% need surgery. Timely assessment and intervention are critical [13, 14]. In refugee contexts, however, geographic isolation and limited access to advanced care complicate timely management, potentially increasing morbidity and mortality [15].

Globally, rates of IIFO are increasing. In the United States, rates doubled in 2017, with 14% of cases deemed intentional [16]. A 2009 review found intentional ingestions in up to 92% of adults from lower socioeconomic populations, suggesting that rates may be even higher among refugees and asylum seekers [17].

Management of IIFO has been evolving since 1635, when Daniel Schwaban recorded the first gastrotomy on a man who had swallowed a knife [18]. In 1738, Gorsauld is credited as the first surgeon to perform a cervical esophagotomy for the removal of a foreign body (FB) [19]. In 1906, José Goyanes extracted a coin impacted in the esophagus using a rigid esophagoscope for the first time [20]. The early 20th century saw the emergence of rigid esophagoscopy as the first large-scale method for foreign body extraction, with further case series detailing technical refinements appearing in the literature [21, 22]. Among the most extraordinary documented cases is that by Chalk, who reported a psychiatric patient ingesting 2,533 objects weighing a total of 21,268 grams [23]. The largest single ingested item reported measured 28 cm in length [24].

Clinical outcomes are influenced by various factors, including patient age, comorbidities, object characteristics (size, shape, composition, anatomical location), and the time elapsed since ingestion and current guidance advises invasive foreign object extraction guidance based on these factors [13].

Literature to date largely focuses on IIFO in prisons or psychiatric contexts, with sparse data from displaced or asylum-seeking populations. In detention, where traditional communication channels are obstructed, ingestion may serve as a form of protest or distress signal [25]. Conversely, in psychiatric settings, ingestion may reflect mental illness or affective dysregulation [26–30].

Psychiatric conditions most frequently associated with intentional ingestion of foreign objects (IIFO) include psychosis, malingering, pica, and personality disorders [26, 31].

Malingering can present in various forms, particularly in prison populations where manipulation to trigger medical transfer is a noted motivation [26, 31, 32]. In such cases, the optimal management often involves brief medical intervention with minimal reinforcement, followed by prompt return to custody [33]. In contrast, individuals with obsessive-compulsive disorder (OCD) may describe escalating anxiety prior to ingestion followed by a sense of relief afterward [31].

In cases involving borderline personality disorder, Gitlin et al. [26] suggest that IIFO may function as an affect regulation strategy, particularly during episodes of perceived abandonment. While such behaviour may appear life-threatening, it should not be presumed to indicate suicidal intent [31].

In rare and severe cases, some authors have proposed a palliative care approach to repeated IIFO, recognising the limited prognosis associated with treatment-resistant psychiatric illness and the cumulative harms of repeated surgical intervention [34].

Despite the rising prevalence, the heterogeneity in populations engaging in, and the potential severity of IIFO, there is limited research exploring how motivations for ingestion differ across populations and how these motivations may influence clinical outcomes [35–37]. Varying motivations likely influence clinical management, including decisions around the need for endoscopic or surgical intervention. For instance, if ingestion is primarily intended as protest, patients may avoid behaviours that risk

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severe harm, potentially lowering the threshold for conservative management.

This systematic review aimed to address these gaps in the literature by evaluating how motivation for IIFO influences clinical outcomes. Specifically, we aim to examine how different motivations impact rates of endoscopic and surgical interventions, in the hope of informing future clinical strategies and healthcare responses.

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.

III. Methods

This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [38]. 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 PICO framework.

This review included studies involving human participants of any age who had non-accidental ingestion of a true foreign body (non-nutritive items). Studies were only included if they reported on all of the following data: demographic/population data; motivations for ingestion; object characteristics; and outcomes (whether conservative, endoscopic, or surgical treatment was used). All settings were eligible, and a wide range of study designs were accepted.

Studies were excluded if the full text was not available in English, as this would limit the ability to assess methodology and extract reliable data. Accidental ingestions, non-human studies, and ingestions undertaken in controlled research settings were excluded to ensure that the review focused solely on real-world, intentional ingestion events relevant to clinical practice.

Ingestions that were not explicitly intentional, or where intent could not be confidently inferred (e.g., young children with no relevant history or psychiatric comorbidities), were excluded to maintain a clear focus on non-accidental ingestion as the exposure of interest. Studies involving the ingestion or co-ingestion of substances such as drugs or poisons were also excluded to avoid confounding physiological effects and to ensure consistency with the review's focus on physical foreign bodies. Similarly, studies in which the primary cause of death was unrelated to the ingestion event—such as concurrent suicide by other means—were excluded to avoid misattributing outcomes to foreign body ingestion.

Studies published before the advent of endoscopy (1906) were excluded to reduce historical bias and to avoid skewing the intervention data toward surgical outcomes, given that endoscopy was not available as a clinical management option at that time. Finally, studies were excluded if they lacked original empirical data (e.g., reviews, editorials, or commentaries), involved duplicate or overlapping datasets (with only the most comprehensive or recent version retained), or failed to report on key variables such as outcomes, motivations, or object characteristics—essential for subgroup analyses and interpretation of results.

A full list of eligibility criteria is shown in Table I. This is reproduced for in a larger format for clarity in Appendix A-A. A full list of exclusion criteria is available in Appendix A-B.

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.

Search Strategy

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

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 [39]. 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* [40]. 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* [41] 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 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*, *Gender*, *Demographic*, *Motivation*, *Object*. Full definitions of all variables are provided in Appendix C. The full dataset of extracted case-level and series-level data (including bias assesments), 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* [42]. 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

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. [39]

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 [43]. 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, we calculated the observed proportion within each series and performed a random-effects meta-analysis using the DerSimonian-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* [41] 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.

IV. 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 1.

Risk of Bias

Case Reports: 75 cases from 67 studies [32, 44–109] were evaluated using the JBI Checklist for Case Reports [42]. 4 cases were excluded. Cases were excluded at this stage as they failed to meet critical criteria in the following domains: current condition (2 cases, 50%), post intervention condition (2 cases, 50%), harms (2 cases, 50%), takeaway lessons (2 cases, 50%), history timeline (1 cases, 25%), and intervention treatment (1 cases, 25%). The excluded cases came from the following studies: [46, 82, 94]. Of the remaining cases (71), most clearly described intervention treatment (100%), history timeline (99%), post intervention condition (97%), takeaway lessons (97%), patient demographic (96%), and current condition (96%). Reporting was also strong for diagnostic assessment (92%), and harms (90%).

Case Series: Seperately, 3 studies [110–112] were evaluated using the JBI Checklist for Case Series [42]. Reporting quality was generally high across all JBI domains. All included case series fully reported clear inclusion criteria, standard condition measurement, valid id method, complete inclusion, clear demographic reporting, clear clinical info reporting, clear outcome followup reported, and appropriate statistical analysis. However, fewer studies reported consecutive inclusion, and clear site demographic reporting.

Study Characteristics

A total of 67 studies were included in the synthesis. Case reports made up 64 studies [32, 44, 45, 47–81, 83–93, 95–109], yielding 71 cases. Case Series made up 3 studies [110–112], yielding 90 cases.

Case Reports: A full list of group summary characteristics and outcomes is available in Table II.

Gender: 43 cases (60.6%) were male [32, 44, 45, 47, 48, 50, 51, 53, 55, 56, 59, 60, 64, 67–70, 72, 74, 75, 79–81, 84–87, 91, 92, 95, 97–101, 103, 106, 109], 27 cases (38.0%) were female [49, 52, 54, 57, 58, 61–63, 65, 66, 71, 73, 76–78, 83, 88–90, 93, 96, 102, 104, 105, 107], 1 case (1.4%) had no gender recorded [108].

Age Group: 25 cases (35.2%) were between 26 and 40 years of age [47, 50–52, 55, 57, 62, 63, 65, 68–70, 72, 75, 81, 85, 87, 91–93, 97, 101, 105, 107, 108], 18 cases (25.4%) were between 18 and 25 years of age [32, 44, 48, 53, 58, 64, 76, 77, 79, 85, 86, 90, 95, 102, 106], 12 cases (16.9%) were under 18 years of age [49, 61, 66, 71, 84, 88, 89, 98, 99, 104], 11 cases (15.5%) were between 41 and 60 years of age [45, 59, 60, 67, 73, 74, 80, 96, 100, 103, 109], 3 cases (4.2%) were over 60 years of age [54, 78, 83], 2 cases (2.8%) had no age documented [56].

Population: 35 cases (49.3%) had a psychiatric history [47, 49, 51–54, 60, 62, 65, 66, 68, 69, 72–76, 78–81, 84, 86, 87, 89, 90, 93, 96–98, 107–109], 19 cases (26.8%) had ingested previously [47, 51, 56, 58, 64, 66, 67, 72, 74, 75, 84, 93, 98, 100, 107–109], 12 cases (16.9%) were detained persons [32, 47, 50, 51, 85, 91, 97, 101], 7 cases (9.9%) were severely disabled [53, 78, 84, 89, 90, 107, 109], 4 cases (5.6%) were psychiatric inpatients [66, 108, 109], 3 cases (4.2%) were under the influence of alcohol [55, 64, 100], 2 cases (2.8%) were displaced people [44, 70].

Motivation: 34 cases (47.9%) had a psychiatric motivation [45, 47, 49, 51–53, 57, 58, 65–68, 72–81, 83, 84, 87, 89, 93, 96–98, 106, 109], 20 cases (28.2%) were motivated by self-harm intention [32, 45, 47, 48, 60, 62–64, 69, 83, 85, 86, 93, 97, 98, 108], 17 cases (23.9%) had a psychosocial motivation [44, 55, 58, 61, 71, 73, 79, 83, 88, 91, 92, 95, 99, 100, 102, 104, 105], 9 cases (12.7%) were motivated by protest [32, 59, 70, 85, 102], 9 cases (12.7%) had another documented motivation [49, 50, 67, 72, 90, 93, 101, 103, 107].

Object Characteristics: 50 cases (70.4%) ingested a large diameter object (>2.5cm) [32, 44, 45, 47, 48, 50, 51, 53, 56, 57, 60–64, 66, 67, 70, 72, 74, 75, 77–81, 85–93, 96, 98, 100, 101, 105, 107–109], 44 cases (62.0%) ingested multiple objects [49, 51–54, 58–61, 67–69, 71–77, 79–81, 83–89, 95–100, 103, 104, 106, 108, 109], 33 cases (46.5%) ingested a sharp object [32, 47, 51, 52, 55, 57, 58, 60, 64–69, 72–75, 77, 79, 81, 85–87, 95, 106, 109], 31 cases (43.7%) ingested a long object (>5cm) [45, 48, 50, 53, 57, 60, 62–64, 66, 67, 69, 70, 75, 77–79, 81, 86, 87, 89, 91, 93, 96, 100, 101, 106, 107, 109], 9 cases (12.7%) ingested a magnet [49, 59, 61, 84, 88, 89, 98, 99, 104], 2 cases (2.8%) ingested a button battery [56, 59].

Outcomes: 48 cases (67.6%) experienced a complication [48, 49, 51, 53–57, 59–61, 63–71, 75, 77–81, 84–89, 93, 95, 96, 98–102, 104–107], 43 cases (60.6%) underwent surgery [32, 45, 47–49, 53, 54, 57, 60–66, 68–70, 75, 77–79, 81, 84–88, 95, 98–100, 102, 104–108], 31 cases (43.7%) underwent endoscopy [44, 50, 51, 53, 55–57, 59, 60, 62, 65, 70, 72–74, 77, 83, 84, 89–93, 96–98, 101, 103, 105, 109], 7 cases (9.9%) were managed

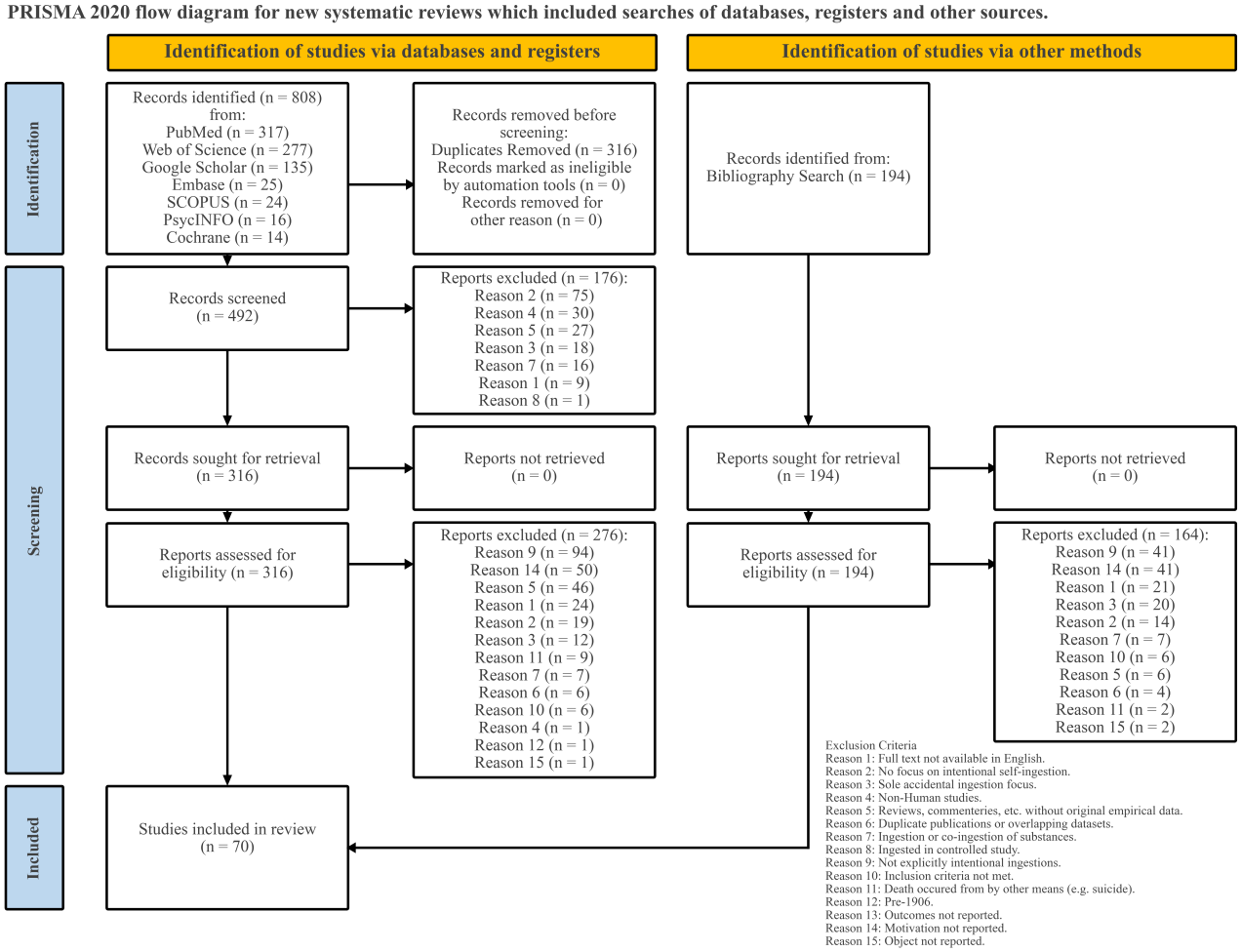

Fig. 1: PRISMA flow diagram summarising the study selection process.

conservatively [52, 58, 66, 67, 71, 76, 80], 2 cases (2.8%) died [67, 80].

TABLE II: Grouped summary of variables and outcomes.

Variable	Count	Percentage	References
Gender			
Male	43	60.6%	[32, 44, 45, 47, 48, 50, 51, 53, 55, 56, 59, 60, 64, 67–70, 72, 74, 75, 79–81, 84–87, 91, 92, 95, 97–101, 103, 106, 109]
Female	27	38.0%	[49, 52, 54, 57, 58, 61–63, 65, 66, 71, 73, 76–78, 83, 88–90, 93, 96, 102, 104, 105, 107]
Unknown	1	1.4%	[108]
Age Group			
<18	12	16.9%	[49, 61, 66, 71, 84, 88, 89, 98, 99, 104]
18–25	18	25.4%	[32, 44, 48, 53, 58, 64, 76, 77, 79, 85, 86, 90, 95, 102, 106]
26–40	25	35.2%	[47, 50–52, 55, 57, 62, 63, 65, 68–70, 72, 75, 81, 85, 87, 91–93, 97, 101, 105, 107, 108]
41–60	11	15.5%	[45, 59, 60, 67, 73, 74, 80, 96, 100, 103, 109]
60+	3	4.2%	[54, 78, 83]
Unknown	2	2.8%	[56]
Population			
Detained Person	12	16.9%	[32, 47, 50, 51, 85, 91, 97, 101]
Psychiatric Inpatient	4	5.6%	[66, 108, 109]
Displaced Person	2	2.8%	[44, 70]
Under Influence of Alcohol	3	4.2%	[55, 64, 100]
Psychiatric History	35	49.3%	[47, 49, 51–54, 60, 62, 65, 66, 68, 69, 72–76, 78–81, 84, 86, 87, 89, 90, 93, 96–98, 107–109]
Severely Disabled	7	9.9%	[53, 78, 84, 89, 90, 107, 109]
Previous Ingestor	19	26.8%	[47, 51, 56, 58, 64, 66, 67, 72, 74, 75, 84, 93, 98, 100, 107–109]
Motivation			
Intent to harm	20	28.2%	[32, 45, 47, 48, 60, 62–64, 69, 83, 85, 86, 93, 97, 98, 108]
Protest	9	12.7%	[32, 59, 70, 85, 102]
Psychiatric	34	47.9%	[45, 47, 49, 51–53, 57, 58, 65–68, 72–81, 83, 84, 87, 89, 93, 96–98, 106, 109]
Psychosocial	17	23.9%	[44, 55, 58, 61, 71, 73, 79, 83, 88, 91, 92, 95, 99, 100, 102, 104, 105]
Other	9	12.7%	[49, 50, 67, 72, 90, 93, 101, 103, 107]
Object			
Button Battery	2	2.8%	[56, 59]
Magnet	9	12.7%	[49, 59, 61, 84, 88, 89, 98, 99, 104]
Long (>5cm)	31	43.7%	[45, 48, 50, 53, 57, 60, 62–64, 66, 67, 69, 70, 75, 77–79, 81, 86, 87, 89, 91, 93, 96, 100, 101, 106, 107, 109]
Large (>2.5cm) Diameter	50	70.4%	[32, 44, 45, 47, 48, 50, 51, 53, 56, 57, 60–64, 66, 67, 70, 72, 74, 75, 77–81, 85–93, 96, 98, 100, 101, 105, 107–109]
Sharp	33	46.5%	[32, 47, 51, 52, 55, 57, 58, 60, 64–69, 72–75, 77, 79, 81, 85–87, 95, 106, 109]
Multiple	44	62.0%	[49, 51–54, 58–61, 67–69, 71–77, 79–81, 83–89, 95–100, 103, 104, 106, 108, 109]
Outcome			
Endoscopy	31	43.7%	[44, 50, 51, 53, 55–57, 59, 60, 62, 65, 70, 72–74, 77, 83, 84, 89–93, 96–98, 101, 103, 105, 109]
Surgery	43	60.6%	[32, 45, 47–49, 53, 54, 57, 60–66, 68–70, 75, 77–79, 81, 84–88, 95, 98–100, 102, 104–108]
Death	2	2.8%	[67, 80]
Conservative	7	9.9%	[52, 58, 66, 67, 71, 76, 80]
Complication	48	67.6%	[48, 49, 51, 53–57, 59–61, 63–71, 75, 77–81, 84–89, 93, 95, 96, 98–102, 104–107]

Case Series: 3 case series were included in the synthesis [110–112], yielding 90 cases. The mean age for this cohort is 24.0 (range: 17.0-50.0) years. 100.0% were male gender (90); 0.0% were female gender (0); 0.0% were unknown gender (0). 90 cases (100.0%) were detained at the time of ingestion [110–112], 88 cases (98.3%) were intentional ingestions [110–112], 30 cases (33.2%) had a psychiatric history documented [110–112], 2 cases (2.2%) had a history of prior ingestion [110]. 0 recorded cases were psychiatric inpatients. 0 recorded cases were displaced people. 0 recorded cases were under the influence of alcohol at the time of ingestion. 0 recorded cases had a severe disability history.

Motivation: 70 cases (78.3%) reported protest motivation [110–112], 12 cases (13.3%) reported psychiatric motivation [111], 6 cases (6.7%) reported self-harm motivation [110, 111]. 0 recorded cases reported psychosocial motivation. 0 recorded cases unknown. 0 recorded cases reported other motivation. 0 recorded cases reported other motivation with known psychiatric history. 0 recorded cases reported other with severe disability history.

Object Characteristics: 68 cases (75.6%) involved sharp object ingestion [110–112], 32 cases (35.6%) involved long (>5cm) object ingestion [112], 25 cases (27.8%) involved ingestion of multiple objects [110, 112], 17 cases (18.9%) involved short (<5cm) object ingestion [110, 112], 16 cases (17.8%) involved short (<5cm) sharp object ingestion [110]. 0 recorded cases involved button battery ingestion. 0 recorded cases involved magnet ingestion. 0 recorded cases involved large diameter (>2.5cm) object ingestion. 0 recorded cases involved long (>5cm) sharp object ingestion.

Outcomes: 47 cases (52.2%) underwent endoscopic intervention [110, 112], 29 cases (32.2%) were managed conservatively [110, 111], 15 cases (16.7%) underwent surgical intervention [110–112], 7 cases (7.8%) had an 'other' outcome [110, 112], 6 cases (6.7%) had an injury that required intervention [112], 6 cases (6.7%) nan [112], 2 cases (2.2%) had a perforation [110, 112], 2 cases (2.2%) underwent endoscopy and surgery [110, 112], 1 case (1.1%) died [110], 1 case (1.1%) had an obstruction [110].

Synthesis

Case Reports:

Univariate Association Testing: A full table of grouped case-level univariate association testing results for the is available in Table III. In the age group subgroup, 41–60 age group was significantly associated with reduced odds of surgery (OR = 0.19, 95% CI [0.04, 0.78], p = 0.020). In the motivation subgroup, intent to harm motivation was significantly associated with increased odds of surgery (OR = 5.10, 95% CI [1.28, 20.33], p = 0.032); other motivation was significantly associated with reduced odds of surgery (OR = 0.15, 95% CI [0.03, 0.77], p = 0.024). There were no significant associations with outcomes in the gender, object, and population subgroups.

Multivariate Logistic Regression: A full table of grouped series-level logistic regression results is available in Table IV. In the motivation subgroup, intent to harm motivation was significantly associated with increased odds of surgery (aOR = 15.95, 95% CI [1.32, 192.48], p = 0.029). In the object subgroup, long (>5cm) object ingestion was significantly associated with increased odds of surgery (aOR = 7.66, 95% CI [1.04, 56.32], p = 0.045); multiple object ingestion was significantly associated with increased odds of complication (aOR = 14.79, 95% CI [2.08, 105.31], p = 0.007); long (>5cm) object ingestion was significantly associated with increased odds of complication (aOR = 16.50, 95% CI [1.76, 154.43], p = 0.014). In the population subgroup, detained person was significantly associated with reduced odds of complication (aOR = 0.04, 95% CI [0.00, 0.69], p = 0.028). There were no significant associations with outcomes in the age group, and gender subgroups.

Case Series:

Meta-analysis of Proportions: A plot of series-level meta-analysis of pooled outcome proportions is shown in Figure 2. Meta-analyses of proportions was performed for endoscopy, surgery, and conservative. The pooled proportion of patients undergoing endoscopy was 41.6% (95% CI 0.6%–98.9%), with substantial heterogeneity (I^2 = 94.9%). The pooled proportion of patients undergoing surgery was 17.8% (95% CI 10.4%–28.8%), with low heterogeneity (I^2 = 17.4%). The pooled proportion of patients conservative management was 76.2% (95% CI 60.2%–87.1%), with low heterogeneity (I^2 <0.5%). Meta-analyses could not be performed for death and complication because fewer than two studies reported data on these outcomes.

Meta Regression: A full table of grouped aggregate series-level results for univariate meta-regression is available in Table VI. In the gender subgroup, male gender was associated with a reduced likelihood of conservative management (OR = 0.87, 95% CI [0.78, 0.97], p = 0.040). All other comparisons in this subgroup were non-significant. In the population subgroup, being a detained person was associated with an increased likelihood of conservative management (OR = 1.62, 95% CI [1.11, 2.37], p = 0.040). All other comparisons in this subgroup were non-significant. In the motivation subgroup, intent to harm was associated with a reduced likelihood of conservative management (OR = 0.82, 95% CI [0.77, 0.87], p = 0.014); intent to harm was associated with an increased likelihood of undergoing surgery (OR = 1.12, 95% CI [1.05, 1.18], p = 0.015); psychiatric motivation was associated with an increased likelihood of undergoing surgery (OR = 1.07, 95% CI [1.03, 1.11], p = 0.017); psychosocial motivation was associated with a reduced likelihood of conservative management (OR = 0.82, 95% CI [0.70, 0.96], p = 0.040); another documented motivation was associated with a reduced likelihood of conservative management (OR = 0.69, 95% CI [0.51, 0.92], p = 0.040); another documented motivation was associated with an increased likelihood of undergoing surgery (OR = 1.25, 95% CI [1.02, 1.52], p = 0.041); psychosocial motivation was associated with an increased likelihood of undergoing surgery (OR = 1.12, 95% CI [1.01, 1.25], p = 0.041). All other comparisons in this subgroup were non-significant. In the object subgroup, Sharp object ingestion was associated with a reduced likelihood of conservative management (OR = 0.80, 95% CI [0.65, 1.00], p = 0.049). All other comparisons in this subgroup were non-significant.

Investigation of Heterogeneity: Heterogeneity was explored across study results using two complementary approaches.

First, meta-analyses of proportions were conducted for each outcome of interest across included case series. Between-study heterogeneity was quantified using the I^2 statistic and τ^2 variance. The degree of heterogeneity varied substantially across outcomes:

- Substantial heterogeneity ($I^2 = 95\%$) was observed for endoscopy.

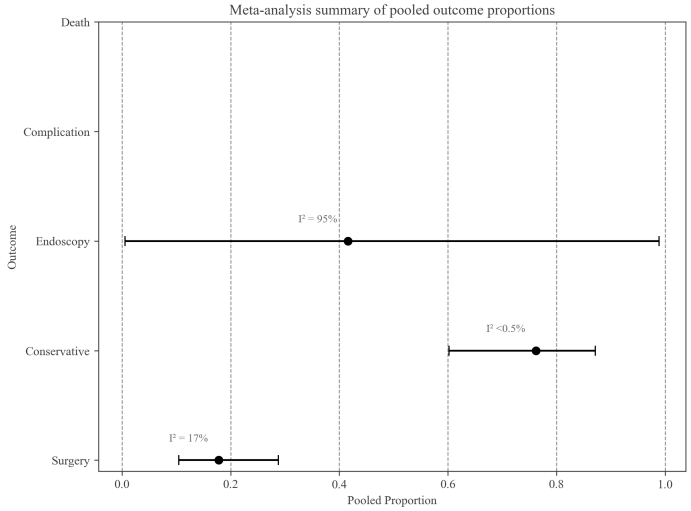

Fig. 2: Case series meta-analysis of pooled outcome proportions.

- Heterogeneity was moderate for surgery ($I^2 = 17\%$).
- Heterogeneity was low ($I^2 = 0\%$) for conservative management.
- Meta-analyses could not be meaningfully conducted for death and complications due to insufficient data.

Second, to investigate potential sources of heterogeneity, we performed univariate meta-regressions for each outcome. Given the small number of case series available, we combined series-level data with collapsed aggregate case reports to increase the number of contributing studies. Meta-regressions examined associations between outcome proportions and patient-level predictors including gender, population characteristics, ingestion motivations, and object type.

Significant associations between certain predictors and outcomes were identified, particularly in relation to motivation and surgery or conservative management outcomes. This suggests that clinical heterogeneity in patient characteristics likely contributed to observed between-study differences.

No additional subgroup or sensitivity analyses were performed, given the limited number of studies and inconsistent reporting of potential study-level moderators.

Sensitivity Analyses: Formal sensitivity analyses were not performed due to the limited number of included case series and the small number of studies available for several outcomes. Given the small number of eligible series and heterogeneity in reporting, the meta-analyses of proportions and meta-regressions were considered primarily descriptive in nature.

To partially address robustness, we incorporated aggregate case report data into the meta-regression models to increase the effective number of series contributing to each outcome. This allowed exploratory assessment of predictor-outcome relationships across a larger pooled dataset. However, no additional sensitivity analyses (e.g. leave-one-out analyses, exclusion of small studies, or alternative meta-analytic models) were conducted, as such analyses would not have been statistically meaningful in the context of the available data.

TABLE III: Grouped Univariate Association Testing results.

Variable	Endoscopy	Surgery	Death	Conservative	Complication
Gender					
Male	1.34 [0.51, 3.53] (p=0.722)	0.99 [0.37, 2.62] (p=1.000)	—	0.22 [0.04, 1.25] (p=0.104)	1.28 [0.47, 3.52] (p=0.824)
Female	0.82 [0.31, 2.18] (p=0.887)	0.92 [0.34, 2.44] (p=1.000)	—	4.77 [0.86, 26.63] (p=0.097)	0.93 [0.34, 2.59] (p=1.000)
Unknown	—	—	—	—	—
Age Group					
<18	0.37 [0.09, 1.50] (p=0.267)	2.21 [0.54, 8.99] (p=0.341)	—	2.16 [0.37, 12.72] (p=0.337)	2.76 [0.55, 13.81] (p=0.313)
18–25	0.28 [0.08, 0.95] (p=0.065)	2.90 [0.84, 9.97] (p=0.147)	—	1.20 [0.21, 6.80] (p=1.000)	1.34 [0.41, 4.34] (p=0.847)
26–40	2.17 [0.81, 5.85] (p=0.195)	0.96 [0.36, 2.61] (p=1.000)	—	0.28 [0.03, 2.45] (p=0.409)	0.78 [0.28, 2.18] (p=0.831)
41–60	2.62 [0.69, 9.95] (p=0.192)	0.19 [0.04, 0.78] (p=0.020)*	—	2.44 [0.41, 14.57] (p=0.295)	0.51 [0.14, 1.90] (p=0.319)
60+	0.63 [0.05, 7.32] (p=1.000)	1.32 [0.11, 15.25] (p=1.000)	—	—	0.96 [0.08, 11.13] (p=1.000)
Unknown	—	—	—	—	0.47 [0.03, 7.84] (p=0.546)
Population					
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	0.84 [0.30, 2.33] (p=0.942)	1.29 [0.46, 3.59] (p=0.827)	0.74 [0.04, 12.33] (p=1.000)	0.99 [0.20, 4.86] (p=1.000)	0.75 [0.26, 2.21] (p=0.806)
Severely Disabled	4.02 [0.72, 22.47] (p=0.120)	0.83 [0.17, 4.04] (p=1.000)	—	—	1.25 [0.22, 7.02] (p=1.000)
Previous Ingestor	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)	1.69 [0.30, 9.38] (p=0.665)	0.34 [0.10, 1.23] (p=0.179)
Motivation					
Intent to harm	0.53 [0.17, 1.67] (p=0.419)	5.10 [1.28, 20.33] (p=0.032)*	—	—	0.97 [0.31, 3.01] (p=1.000)
Protest	0.32 [0.06, 1.69] (p=0.277)	5.68 [0.66, 48.72] (p=0.136)	—	—	4.47 [0.52, 38.51] (p=0.249)
Psychiatric	1.37 [0.52, 3.61] (p=0.699)	0.49 [0.18, 1.33] (p=0.248)	—	6.86 [0.78, 60.48] (p=0.105)	0.61 [0.22, 1.70] (p=0.487)
Psychosocial	0.86 [0.28, 2.63] (p=1.000)	0.65 [0.21, 1.99] (p=0.644)	—	1.17 [0.21, 6.69] (p=1.000)	0.89 [0.28, 2.84] (p=1.000)
Other	2.96 [0.68, 12.95] (p=0.165)	0.15 [0.03, 0.77] (p=0.024)*	7.62 [0.43, 134.24] (p=0.239)	1.17 [0.12, 10.99] (p=1.000)	0.55 [0.13, 2.29] (p=0.458)
Object					
Button Battery	—	—	—	—	—
Magnet	1.04 [0.25, 4.24] (p=1.000)	2.53 [0.49, 13.17] (p=0.467)	—	—	—
Long (>5cm)	0.84 [0.33, 2.18] (p=0.912)	2.32 [0.86, 6.30] (p=0.154)	1.27 [0.08, 21.10] (p=1.000)	0.47 [0.08, 2.60] (p=0.452)	2.14 [0.74, 6.19] (p=0.245)
Large (>2.5cm) Diameter	1.46 [0.49, 4.32] (p=0.679)	1.60 [0.55, 4.66] (p=0.556)	—	0.24 [0.05, 1.19] (p=0.085)	0.98 [0.32, 3.05] (p=1.000)
Sharp	0.35 [0.13, 0.94] (p=0.061)	2.07 [0.78, 5.50] (p=0.221)	1.16 [0.07, 19.24] (p=1.000)	1.61 [0.33, 7.78] (p=0.697)	1.20 [0.44, 3.25] (p=0.923)
Multiple	0.46 [0.17, 1.21] (p=0.181)	1.09 [0.41, 2.91] (p=1.000)	—	4.11 [0.47, 36.14] (p=0.240)	2.40 [0.86, 6.66] (p=0.150)

OR: Odds Ratio. CI: Confidence Interval. p: p-value. * indicates $p < 0.05$. — indicates missing or unreported values.

TABLE IV: Grouped case-level logistic regression results.

Variable	Endoscopy	Surgery	Death	Conservative	Complication
Age Group					
<18	0.42 [0.03, 6.07] (p=0.523)	7.58 [0.52, 110.28] (p=0.138)	—	—	2.54 [0.15, 42.66] (p=0.518)
18–25	0.52 [0.03, 8.35] (p=0.646)	2.77 [0.16, 49.35] (p=0.488)	—	—	0.44 [0.03, 7.15] (p=0.566)
26–40	2.75 [0.19, 39.78] (p=0.458)	2.60 [0.16, 41.61] (p=0.500)	—	—	2.17 [0.15, 31.84] (p=0.572)
41–60	4.40 [0.25, 78.83] (p=0.314)	0.16 [0.01, 3.60] (p=0.252)	—	—	0.07 [0.00, 1.57] (p=0.093)
Gender					
Male	1.98 [0.47, 8.36] (p=0.355)	1.32 [0.25, 7.05] (p=0.743)	—	0.05 [0.00, 4.48] (p=0.187)	3.12 [0.46, 21.08] (p=0.242)
Population					
Detained Person	0.99 [0.12, 7.86] (p=0.991)	0.06 [0.00, 1.04] (p=0.053)	—	—	0.04 [0.00, 0.69] (p=0.028)*
Psychiatric History	0.64 [0.09, 4.44] (p=0.650)	2.39 [0.21, 26.70] (p=0.479)	—	—	0.43 [0.04, 4.22] (p=0.467)
Severely Disabled	5.50 [0.55, 54.89] (p=0.147)	1.13 [0.10, 12.92] (p=0.923)	—	—	0.87 [0.05, 14.73] (p=0.925)
Previous Ingestor	0.45 [0.09, 2.28] (p=0.338)	0.56 [0.08, 3.79] (p=0.555)	—	—	0.56 [0.09, 3.38] (p=0.526)
Motivation					
Intent to harm	0.63 [0.13, 3.02] (p=0.565)	15.95 [1.32, 192.48] (p=0.029)*	—	—	0.28 [0.04, 1.80] (p=0.180)
Protest	0.41 [0.03, 4.85] (p=0.477)	5.20 [0.18, 152.56] (p=0.339)	—	—	135.93 [0.93, 19764.29] (p=0.053)
Psychiatric	3.18 [0.56, 18.19] (p=0.194)	0.10 [0.01, 1.23] (p=0.072)	—	—	0.56 [0.10, 3.29] (p=0.526)
Psychosocial	1.06 [0.16, 7.18] (p=0.953)	0.49 [0.05, 4.84] (p=0.542)	—	—	0.41 [0.04, 3.96] (p=0.445)
Other	1.33 [0.20, 8.70] (p=0.764)	0.13 [0.01, 1.90] (p=0.135)	—	—	0.55 [0.07, 4.71] (p=0.589)
Object					
Large (>2.5cm) Diameter	2.11 [0.38, 11.74] (p=0.394)	1.08 [0.16, 7.22] (p=0.939)	—	—	1.00 [0.12, 8.35] (p=0.997)
Sharp	0.31 [0.07, 1.47] (p=0.141)	3.19 [0.45, 22.44] (p=0.243)	—	—	0.65 [0.10, 4.17] (p=0.647)
Multiple	0.38 [0.08, 1.85] (p=0.231)	2.08 [0.35, 12.27] (p=0.418)	—	10.82 [0.01, 8968.26] (p=0.487)	14.79 [2.08, 105.31] (p=0.007)*
Long (>5cm)	0.24 [0.05, 1.25] (p=0.090)	7.66 [1.04, 56.32] (p=0.045)*	0.00 [0.00, 73589776336.35] (p=0.395)	0.03 [0.00, 3.74] (p=0.155)	16.50 [1.76, 154.43] (p=0.014)*

aOR: Adjusted Odds Ratio. CI: Confidence Interval. p: p-value. * indicates $p < 0.05$. — indicates missing or unreported values.

TABLE V: Grouped results

Variable	Karp *et al.* [111]	Lee *et al.* [112]	Elghali *et al.* [110]	Case Reports
Total Cases	19	52	19	71
Gender	19	52	19	71
Male	19 (100)	52 (100)	19 (100)	43 (61)
Female	0 (0)	0 (0)	0 (0)	27 (38)
Unknown	0 (0)	0 (0)	0 (0)	1 (1)
Age				
Minimum	17	25	19	7
Mean	24	—	24	31
Median	—	35	—	28
Maximum	40	50	27	100
Population	37	61	23	82
Detained Person	19 (100)	52 (100)	19 (100)	12 (17)
Psychiatric Inpatient	0 (0)	0 (0)	0 (0)	4 (6)
Displaced Person	—	—	—	2 (3)
Under Influence of Alcohol	—	—	—	3 (4)
Psychiatric History	18 (95)	9 (18)	2 (12)	35 (49)
Severely Disabled	—	0 (0)	—	7 (10)
Previous Ingestor	—	—	2 (11)	19 (27)
Motivation	19	50	19	89
Intent to harm	4 (21)	0 (0)	2 (11)	20 (28)
Protest	3 (16)	50 (97)	17 (89)	9 (13)
Psychiatric	12 (63)	0 (0)	0 (0)	34 (48)
Psychosocial	0 (0)	0 (0)	0 (0)	17 (24)
Other	0 (0)	0 (0)	0 (0)	9 (13)
Object				
Button Battery	—	0	0	2
Magnet	—	0	0	9
Long (>5cm)	—	32	0	31
Large (>2.5cm) Diameter	—	—	—	50
Sharp	19	33	16	33
Multiple	—	24	1	44
Outcome	19	58	21	131
Endoscopy	—	46 (88)	1 (5)	31 (44)
Surgery	5 (26)	6 (12)	4 (21)	43 (61)
Death	0 (0)	0 (0)	1 (5)	2 (3)
Complication	—	6 (12)	—	48 (68)
Conservative	14 (74)	0 (0)	15 (79)	7 (10)

n (%)

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

Variable	Conservative	Surgery	Endoscopy	Complication	Death
Gender					
Male	0.87 [0.78, 0.97] (p=0.040)*	1.01 [0.78, 1.32] (p=0.860)	1.18 [0.53, 2.65] (p=0.230)	—	—
Population					
Detained Person	1.62 [1.11, 2.37] (p=0.040)*	0.94 [0.85, 1.04] (p=0.128)	1.06 [0.67, 1.67] (p=0.351)	—	—
Psychiatric History	0.89 [0.49, 1.60] (p=0.237)	1.08 [1.00, 1.17] (p=0.055)	0.95 [0.33, 2.73] (p=0.661)	—	—
Displaced Person	—	—	—	—	—
Motivation					
Intent to harm	0.82 [0.77, 0.87] (p=0.014)*	1.12 [1.05, 1.18] (p=0.015)*	0.92 [0.26, 3.32] (p=0.563)	—	—
Psychiatric	0.89 [0.62, 1.27] (p=0.154)	1.07 [1.03, 1.11] (p=0.017)*	0.96 [0.44, 2.06] (p=0.590)	—	—
Psychosocial	0.82 [0.70, 0.96] (p=0.040)*	1.12 [1.01, 1.25] (p=0.041)*	0.91 [0.20, 4.25] (p=0.590)	—	—
Other	0.69 [0.51, 0.92] (p=0.040)*	1.25 [1.02, 1.52] (p=0.041)*	0.84 [0.05, 15.40] (p=0.590)	—	—
Protest	1.04 [0.01, 71.82] (p=0.931)	0.95 [0.84, 1.08] (p=0.231)	1.06 [0.68, 1.65] (p=0.357)	—	—
Object					
Sharp	0.80 [0.65, 1.00] (p=0.049)*	1.07 [0.70, 1.64] (p=0.575)	1.20 [0.03, 45.16] (p=0.631)	1.00 [0.63, 1.59] (p=0.984)	—
Multiple	—	1.06 [0.62, 1.80] (p=0.404)	0.97 [0.28, 3.39] (p=0.837)	—	—
Long (>5cm)	—	1.03 [0.30, 3.53] (p=0.788)	1.12 [0.17, 7.29] (p=0.588)	—	—

aOR: Adjusted Odds Ratio. CI: Confidence Interval. p: p-value. * indicates $p < 0.05$. — indicates missing or unreported values.

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 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.

V. Discussion

Data Availability

Data collection, maniplation and analysis in this review were conducted using Python [41] in *Visual Studio Code* [113] and *Jupyter Notebooks* [114]. The manuscript was compiled using *LaTeX* [115]. Specific packages used include: *Pandas* [116], *scikit-learn* [117], *statsmodel* [43], *seaborn* [118].

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

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* [116]. 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* [116]. 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.

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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* automutilation	ALL=
Intentional Ingestion / Self-harm	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* automutilation	–
Intentional Ingestion / Self-harm	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.

APPENDIX C
VARIABLE DEFINITIONS

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) [119]; 'N' if no diagnosis; 'UK' if data unavailable.
Is_Displaced_Person	'Y' if: meets the UN General Assembly [120] definition of 'Refugee'; or meets UNHCR [121] definition of an 'internally displaced person'; or meets the UNHCR [122] 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.