A Systematic Review of Aircraft Disinsection Safety, Toxicity and Tolerability

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Introduction

- Vehicular conveyances, encompassing marine, rail, ground, and aircraft transportation contribute to the global spread of vector-borne infectious diseases, including dengue, chikungunya, and Zika via movement of infected people as well as transmission-capable adult vectors
- Treatment of aircraft with insecticide in a procedure referred to as 'disinsection' is recommended to prevent conveyance of arthropod vectors internationally and to mitigate the globalization of vector-borne infectious diseases
- Despite the widespread use of disinsection, comprehensive guidance documents regarding the safety and toxicity of such procedures to human health are largely unavailable
- We undertook a systematic review to synthesize the literature around the human health effects of conveyance disinsection

Methods

- The systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines and was registered in the International Prospective Register of Systematic Reviews, PROSPERO (CRD42024543998)
- Six electronic databases (PubMed, Embase, Medline, Scopus, LILACS, CINAHL) were searched from inception to May 31, 2024 without language restriction
- Document organization, and deduplication, as well as title and abstract, and full-text screening was executed using the online platform Covidence
- Articles were independently double screened by two reviewers and any discrepancies were resolved through discussion and in the event of non-agreement, by a tertiary arbitrator
- The quality assessment tool GRADE (Grading of Recommendations, Assessment, Development and Evaluations) was implemented to assess the quality and bias of evidence

Results

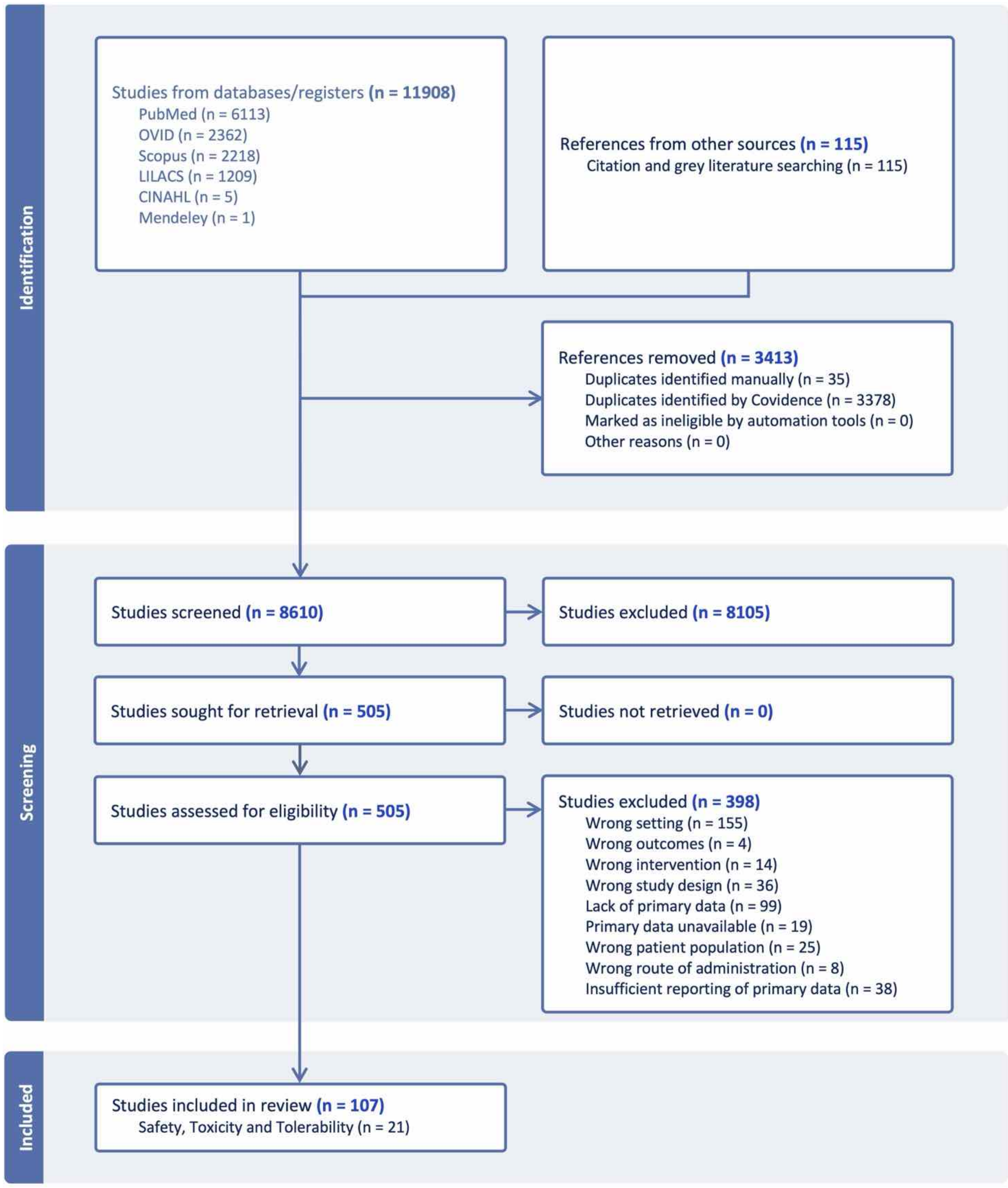

Figure 1. PRISMA Flowchart

Results

Insecticide compared to control (no insecticide) during disinsection of conveyances

Population: humans
Setting: aircraft
Intervention: disinsection
Comparison: no disinsection
Outcome: objective and subjective human health effects

Stratification	No. of studies[a]	Absolute number (%)	Broad human health effects (N, %)	Overall risk of bias	Inc.	Ind.	Imp.	Certainty of evidence (GRADE)	References
Morbidity	3	22/62 (35.5%)	Early retirement (8/42, 19.1) Long-term disability (8/42, 19.1) Hospitalization (14/20, 70) Workdays lost (~78)	Serious	Very high	Very high	Very high	Very low ⊕◯◯◯	Kilburn 2004 Przyborowski 1962 Woodyard 2001
Adverse events	3	16/30 (53.2%)	Blood cell disease (1/1, 100) Anaphylaxis (1/9, 11.1) Seizures (14/20, 70)	NA[b]	NA	NA	NA	NA[b]	Przyborowski 1962 Vanden Driessche 2010 Woodyard 2001
Objective toxicity (per physical examination or laboratory investigation)	9	72/105 (68.6%)	Anaemia, not quantified (16/33, 48.5) Epileptic encephalogram (1/20, 5) Eye conjunctivitis (3/16, 18.8) Impaired cardiovascular function (3/20, 15) Impaired pulmonary function (6/25, 24) Lip oedema (1/4, 25) Skin erythema (2/16, 12.5) Serum/urine insecticide metabolites detected (15/15, 100) (37–87 ppb/0.30–81.5 ppb, respectively)	Very serious	Very high	Very high	Very high	Very low ⊕◯◯◯	Edmundson 1970 Kilburn 2004 Maddock 1961 Przyborowski 1962 Smith 1972 Sutton 2007 Vanden Driessche 2010 Wei 2012 Woodyard 2001
Subjective symptoms	8	119/123 (96.8%)	Cardiovascular (5/12, 41.7) Dermatological (24/54, 44.4) Epistaxis (3/9, 33.3) Fever (2/20, 10) Gastrointestinal (15/51, 29.4) Hair loss (12/33, 36.4) Musculoskeletal (1/20, 5) Neurological (54/102, 52.9) Ocular (13/21, 61.9) Respiratory (20/27, 74.1) SCIP (38/38, 100)	Very serious	Very high	Very high	Very high	Very low ⊕◯◯◯	Bonta 2003 Brooke 1971 Kilburn 2004 Maddock 1961 Przyborowski 1962 Sutton 2007 Vanden Driessche 2010 Woodyard 2001
Subjective tolerability	1	84/591 (14.2%)	Malodour (84/591, 14.2)	Very serious	Very high	Very high	Very high	Very low ⊕◯◯◯	Sullivan 1972

Table 1. Summary of findings: safety, toxicity and tolerability of disinsection

Abbreviations: **NA:** not applicable; **ppb:** part per billion; **SCIP:** symptoms consistent with insecticide poisoning. GRADE Working Group grades of evidence: **Inc:** inconsistency; **Ind:** indirectness; **Imp:** imprecision. *a. Insufficient data reported from remaining studies represented in Table 4A and 4B to be considered in calculation; b. Case series only, risk of bias and GRADE cannot be determined.*

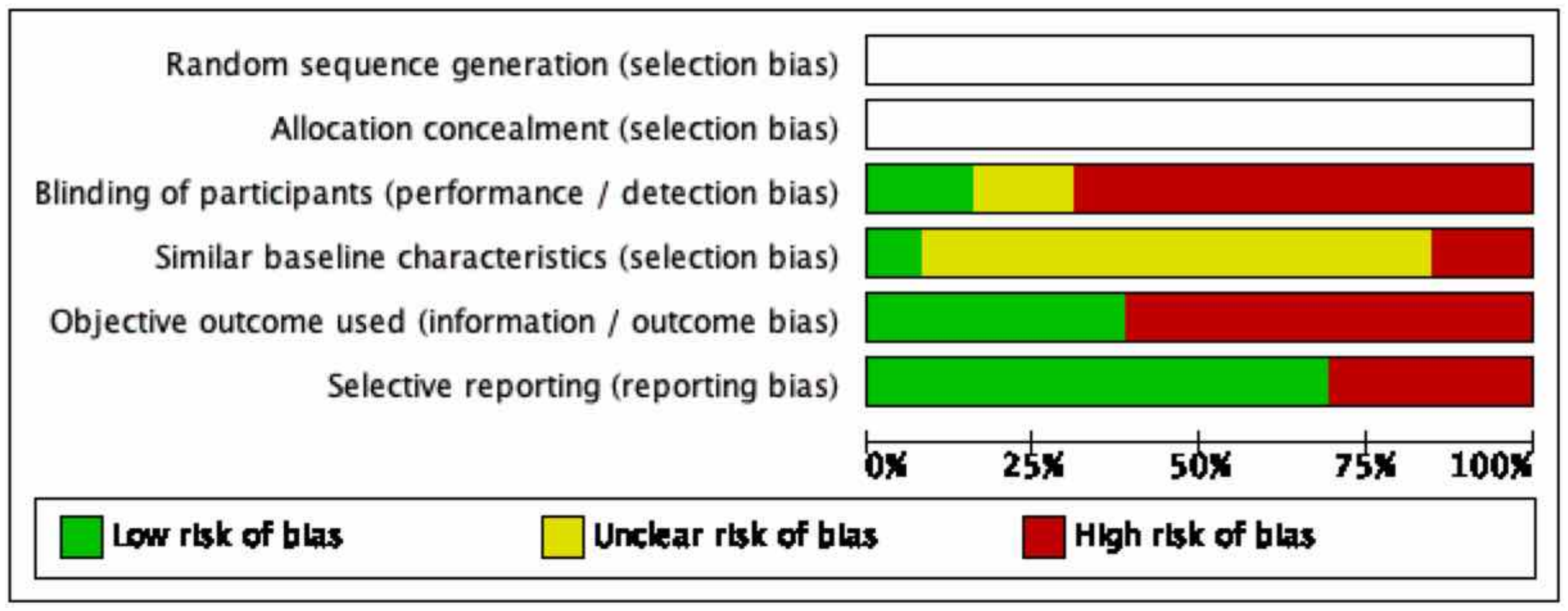

Figure 2. Summary of GRADE Risk of Bias Assessment

Discussion

- Twenty-one studies on human health effects were identified, and solely comprised of very limited post-hoc public health surveillance, small cohort studies, 1 case-control, case series, and case reports (Figure 1, Table 1)
- No high-quality studies on the safety, toxicity, or tolerability of disinsection were found, as studies were generally of poor quality, with high bias and low certainty of effects (Figure 2)
- Standard human subjects' considerations and methodological rigor were often ignored or not reported
- As a result, the systematic review identified suboptimal breadth and quality of evidence surrounding human health impacts as no high-quality studies investigating the safety, toxicity, or tolerability of disinsection were identified
- This scant literature base has a high risk of bias; however, given the reports of significant morbidity, adverse events, and toxicity putatively attributable to aircraft disinsection, well-designed clinical trials investigating the full range of human health impacts of disinsection on passengers and crew are urgently needed

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