BIOSECURITY MEASURES AGAINST SALMONELLA SPP, PATHOGENIC E. COLI AND HEPATITIS E VIRUS ON PIG FARMS

AUTHORS

Elizabeth S. L. Waller 1, Nikolaus Huber 2, Marina Meester 3, Elena L. Sassu 4, Guido Carreira-Correira 5, Gergana Krumovna-Valcheva 6, Giuseppe Aprea 7, Daniela D'Angelantonio 7, Petra Vasickova 8, Veit Zoche-Golob 5, Silvia Scattolini 7, Emily Mariott 1, Richard P. Smith 1, Elke Burow 5

AFFILIATIONS

1 Department of Epidemiological Sciences, Animal Plant and Health Agency, Weybridge, United Kingdom 2 University of Veterinary Medicine, Institute of Food Safety, Food Technology and Veterinary Public Health, Unit of Veterinary Public Health and Epidemiology, Vienna, Austria 3 Austrian Agency for Health and Food Safety (AGES), Division for Animal Health, Vienna, Austrian 4 Utrecht University, Faculty of Veterinary Medicine, Department of Population Health Sciences, Utrecht, the Netherlands 5 German Federal Institute for Risk Assessment (BfR), Department of Biological Safety, Berlin, Germany 6 National Diagnostic and Research Vveterinary medicine Medical Institute, National Food Safety Centre, Sofia, Bulgaria 7 Experimental Zooprophylactic Institute of Abruzzo and Molise, Unit of Hygiene in food technology and animal feeds, Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "G. Caporale", Teramo, Italy 8 Veterinary Research Institute, *DEPT MISSING*, Brno, Czech Republic

01 INTRODUCTION

Salmonella spp., pathogenic Escherichia coli (PEC), and hepatitis E virus (HEV) are important zoonoses, impacting the health and wellbeing of livestock, farmers and the general public.

Understanding the impact of limiting the exposure of livestock species to zoonotic pathogens through the use of biosecurity measures (BSMs) to reduce the risk of pathogenic spread to and within a farm is central to protect human, animal and environmental health.

To the authors' knowledge, the effectiveness of BSMs has not yet been systematically reviewed and quantified in a comprehensive way.

02 OBJECTIVES & AIMS

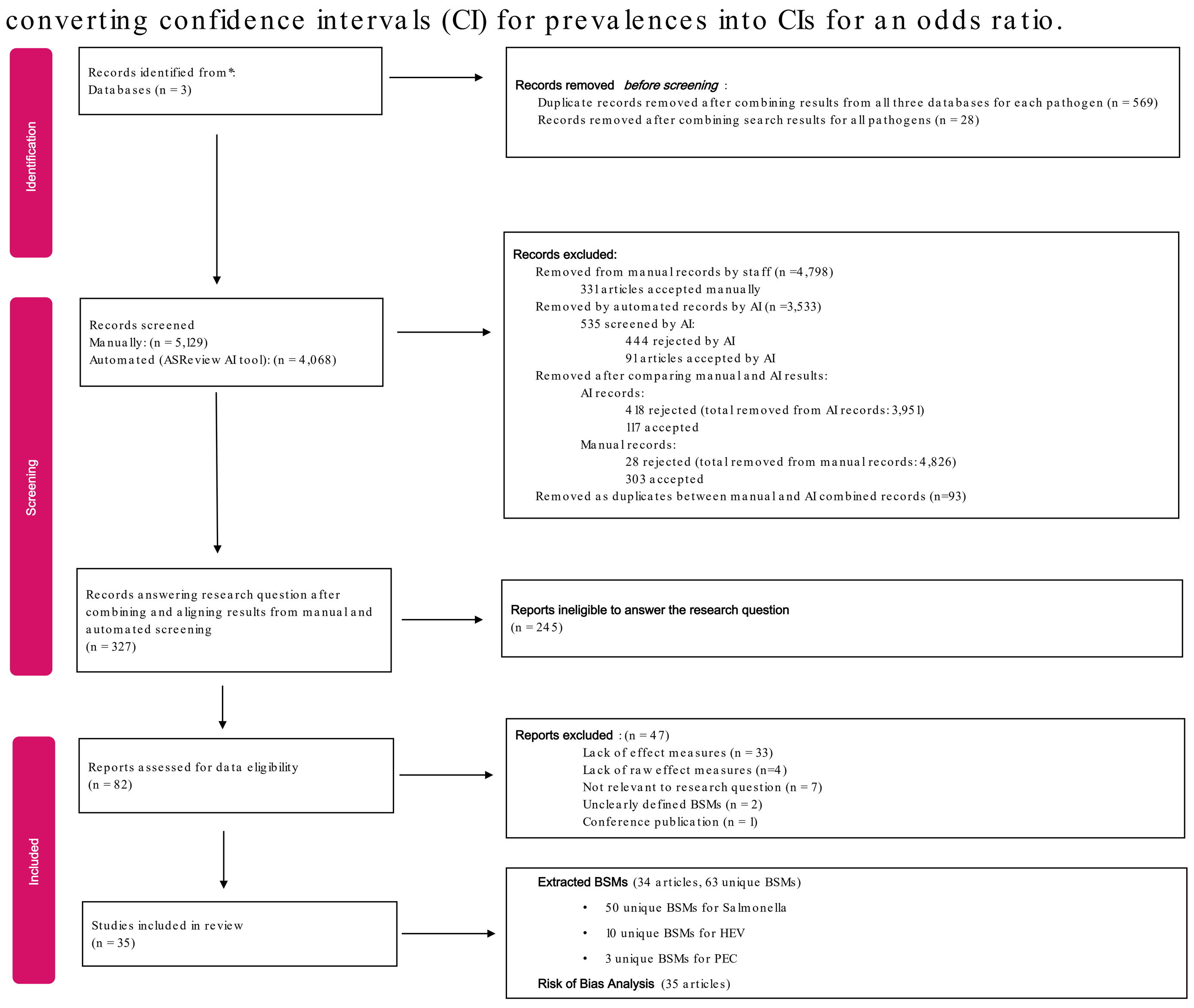
This study aimed to identify and quantify effective biosecurity measures (BSMs) which impact the occurrence of these pathogens on swine farms, using published data from Europe, the United States, and Canada.

03 METHODOLOGY

Table 1: Eligibility criteria for the searching and screening of the literature. *Reduction of the introduction and spread of microorganisms between farm **Reduction of the transmission or spread within a farm ***Increasing of the ability of the animals to cope with the pathogens. Only one pathogen was searched at a time in conjunction with the rest of the search query terms.

Category	Inclusion Criteria	Exclusion Criteria
Location	• European Union and associated political territories (EU) • United Kingdom (UK) • United States of America (USA) • Canada	• Any countries outside of the EU/ UK/ USA/ Canada
Design	• Peer reviewed journal articles • Analytical and Experimental studies	• Reviews • Systematic analyses • Qualitative research articles • Conference proceedings
Content	• Primary*/ external biosecurity measures (preventing spread between farms)	• Tertiary* biosecurity measures (increase resistance or immunity of the animals against pathogens). Only feed and water additives, i.e. organic acids, were included.
	• Secondary*/ internal biosecurity measures (preventing spread within farms) Use of feed and water additives	• Any biosecurity measures which were being applied in the slaughterhouse (i.e. not on the farm)
Species	• Domestic pigs (sus domesticus)	• Wild boar (sus scrofus) or any other species
Languages	• English, French, Spanish, German, Dutch, Bulgarian, Italian	• Studies not understandable to at least one author in the team

Figure 1: PRISMA flow diagram showing the workflow of the systematic review. Adapted from Page et al, 2021. NB: Only 34 articles had BSMs extracted due to issues converting confidence intervals (CI) for prevalences into CIs for an odds ratio.



BSMs with an effect measure (e.g. Odds ratio) and a 95% CI under 1 were deemed to be effective against the pathogen ("Category 1" measures). Moderately effective BSMs ("Category 2") were where the effect measure was under 1 but the 95% CI straddled 1. All other measures were assigned to Category 3, and found to be non-effective.

04 ANALYSIS

Figure 2: Forest plot of biosecurity measures against Salmonella spp., HEV, and E. coli when considering the production stage at which the biosecurity measure was implemented. BSMs applied at the breeding stage are shown in orange, weaning stages in purple, fattening stages in blue, and at a general stage (where the stage was not specified) in green. Three effect measures were extracted: Odds ratios (represented by a triangle), risk ratios (represented by a square), and hazard ratios (represented by a circle).

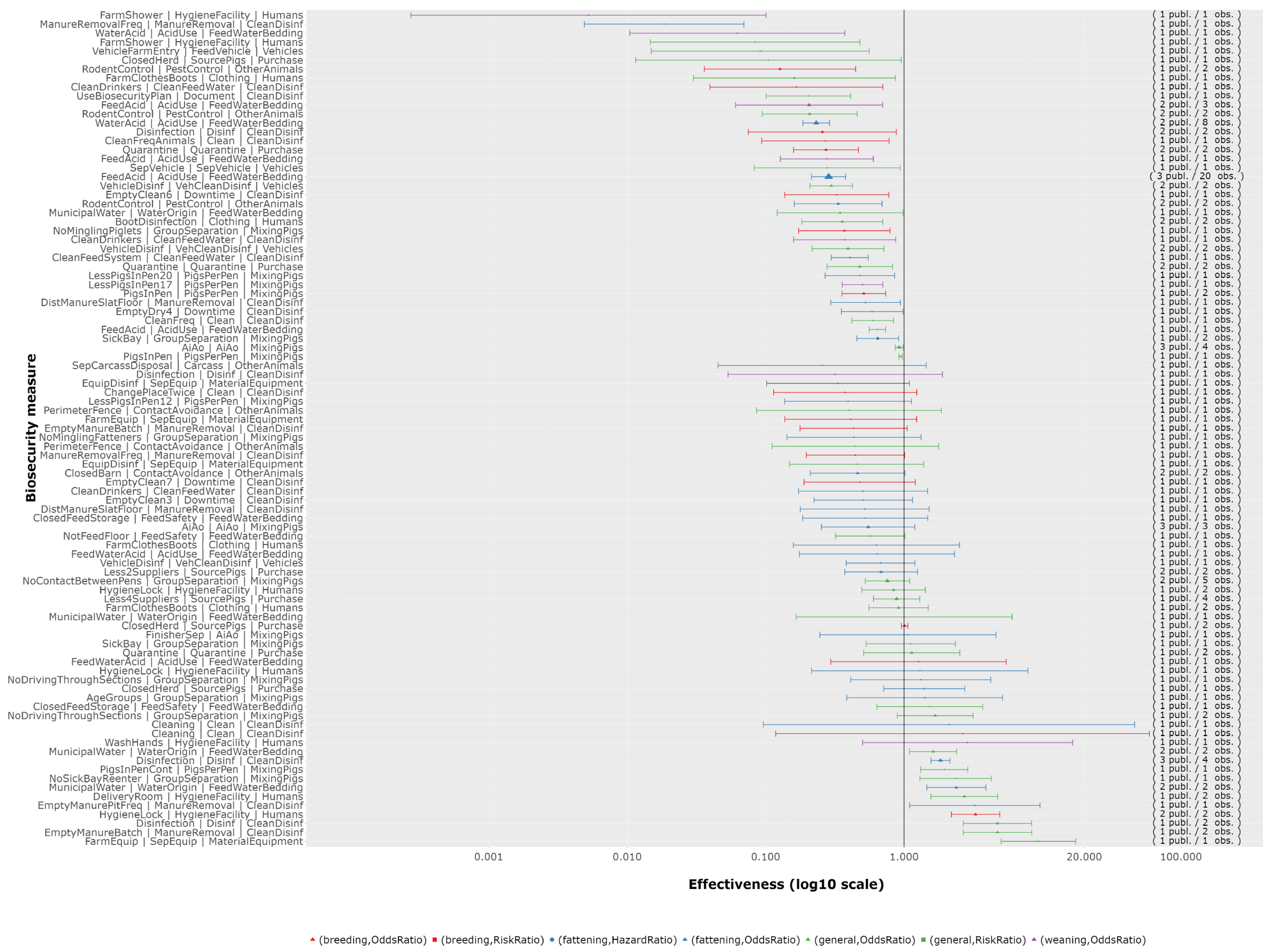
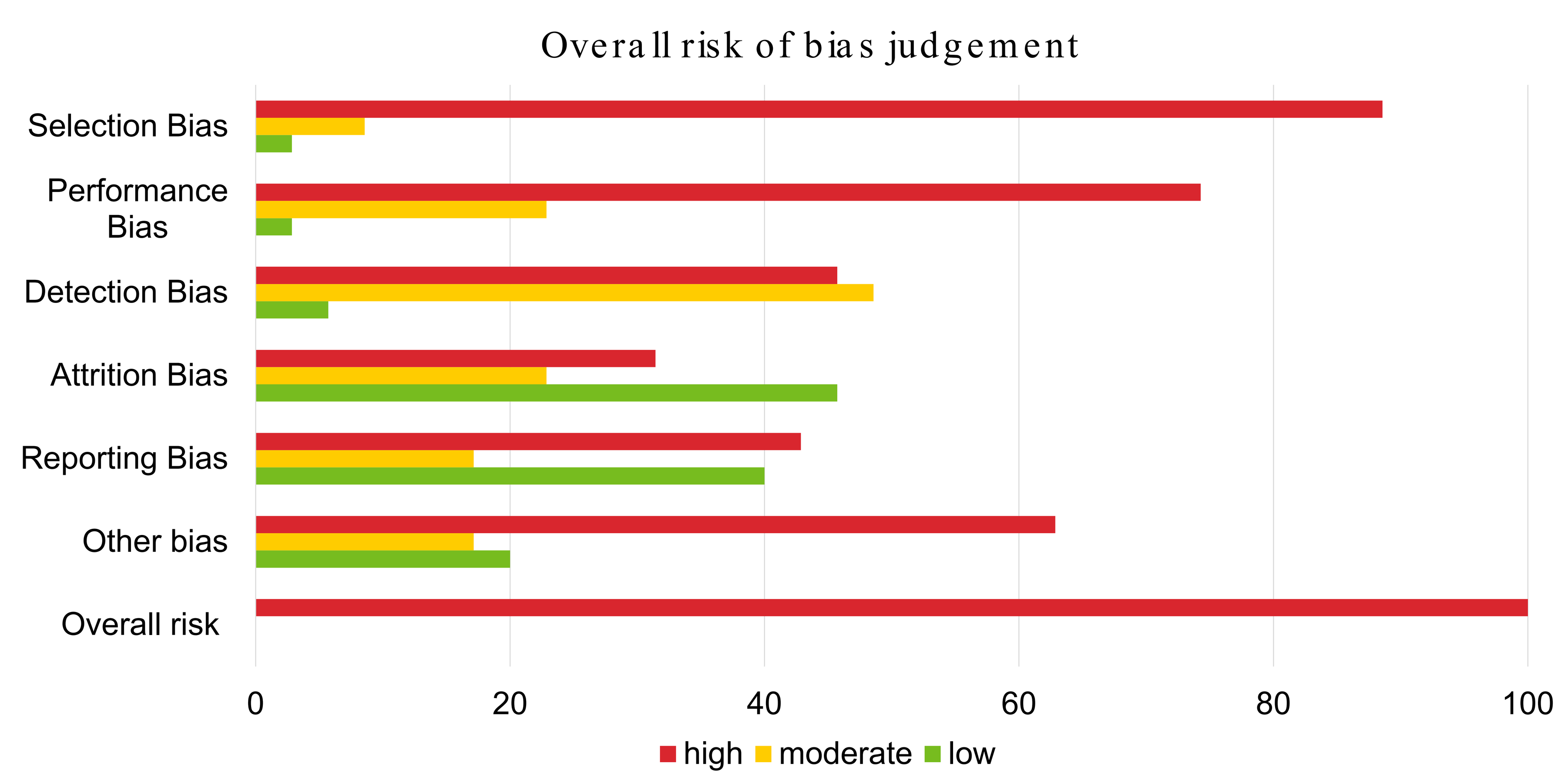


Figure 3: Risk of Bias rating per risk of bias domain and study type (observational n = 30, experimental n = 5) for all studies included in the final selection stage of the systematic literature review.



05 RESULTS

- The majority of articles (29, 82.9%) addressed the control of Salmonella spp, with two for PEC and four on HEV. Most BSMs (130, 82.3%) also concerned Salmonella spp control (Fig 2).
- Eight main types of BSMs were identified, which were as follows: (a) humans, i.e. interventions that involved humans, such as hand washing, showering, etc.; (b) mixing of pigs; (c) cleaning and disinfection; (d) vehicles; (e) feed, water and bedding, (f) purchase of animals; (g) equipment and (h) other animals.
- Overall, 74 (47%) of these BSMs were classified as being effective (Category 1) measures, 43 (27%) as moderately effective (Category 2) measures and 41 (26%) as non-effective (Category 3) measures.
- All articles were assessed as having a high risk of bias (Fig 3). Scores were highest in the Selection and Performance bias domains mainly due to a lack of or unclear process behind the randomization of animal selection in the observational studies assessed.

06 CONCLUSIONS

- Most biosecurity measures identified in the literature pertained to Salmonella control.
- There is a real paucity of studies analysing biosecurity measures on HEV and PEC control in pig farms.
- Future studies must focus on better reporting of experimental methodology.
- Category 1 measures should be prioritized for further investigation in experimental and longitudinal studies to strengthen the understanding of the effectiveness of these BSMs against pathogens.

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