10-7-2022

Systematic Reviews on HAI Topics: A Look At Reporting Practices

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Conflict of interest statement

None.

Abstract

Human-animal interactions (HAI) are being studied with increased frequency, evidenced by a steady increase in the number of published articles and the number of journals publishing them. Evidence synthesis methods like systematic review (SR) provide a stronger level of evidence than individual studies and are often used to inform practice guidelines. To ensure SR accuracy and reliability, they must follow rigorous, prescribed methodologies. Objectives: This study of HAI SRs was designed to determine the characteristics of HAI SRs in terms of publication patterns, human subjects, animal(s) of interest, and outcomes, and to answer: (Q1)Which methodological guideline was followed? Was a protocol written? Was the protocol registered? (Q2) Which databases were searched? Was an information professional consulted? (Q3) Were the database searches replicable? (Q4) Was grey literature included? (Q5) Were inclusion and exclusion criteria explicitly identified? How many researchers examined studies at each stage of screening? Methods: Thirteen bibliographic databases were searched for articles containing both an HAI-related term and an SR term. Authors screened 766 articles for relevance, and coded 110 articles for desired data. Results: Of 110 articles, 60 were published between 2019-2022. A majority of studies (79) referred to PRISMA and/or other methodological guidelines, while 40 made no reference to any guideline. Across all studies, 163 different databases were searched, with PubMed, PsycINFO, and CINAHL among the most frequently used. Only 20 studies referred to consultation with an information professional. A slight majority of studies (58) provided a full search strategy for at least one database. Most articles (74) did not include grey

literature searches. Most articles (80) assessed included studies for quality or risk of bias (RoB). Conclusions: The publication of SRs in HAI research is increasing, and there is room for improvement in reporting among these publications.

Keywords

evidence synthesis, systematic review, meta-analysis, human-animal interaction

Ethics approval

Ethics approval was not required for this study.

Introduction

Human-animal interactions (HAI) research is conducted by practitioners and researchers in many disciplines. Beck and Martin (2008) argued for a multidisciplinary approach to teaching about the human-animal bond because "not only many species of animals, including humans, but also global issues of the environment, economy, and human psychological and physical well-being" are affected by people's relationships with animals. DeMello (2010) highlighted the relevance of HAI to numerous disciplines in the humanities (cultural studies, film, history, philosophy, religion, gender studies), social sciences (anthropology, geography, law, psychology, social work, sociology) and the natural sciences. Yatcilla (2021) found that a sample of HAI research articles was written by authors from both academic and non-academic affiliations, and across disciplines representing the social sciences, health sciences, education, humanities, natural sciences, and agriculture. And *Anthrozoos*, the first journal established specifically for publishing HAI research, acknowledges this through its subtitle, *A Multidisciplinary Journal of the Interactions between People and Animals*. Because HAI research emerges from disparate disciplines, it is reasonable to assume that the methods used can vary based on the researchers' disciplinary domain.

The concept of evidence-based practice (EBP), the "conscious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients," arose in human medicine and has permeated many other professions (Hannes, 2020). In developing EBP, practitioners look to published articles for research-based evidence of what works, to inform how they conduct their practice. The strength of evidence provided by research articles is based in part on the research design of a project, and is often depicted through an "evidence pyramid" (Figure 1). Each type of research methodology included on the pyramid provides a stronger

level of evidence than the methodologies below it; i.e., randomized controlled trials are close to the top of the pyramid and provide stronger evidence than non-randomized controlled trials, which in turn are stronger than cohort studies, and so on. At the pinnacle of the evidence pyramid sit two non-experimental methodologies, systematic reviews (SRs) and meta-analyses (MAs). SRs and MAs are types of *evidence syntheses*. Researchers use these methodologies to gather and synthesize evidence from multiple studies on a particular topic. A SR includes exhaustive literature searches to "systematically search for, appraise and synthesize research evidence, often adhering to guidelines on the conduct of a review", while an MA employs the same methods but also provides a statistical analysis of the aggregated data (Grant & Booth, 2009). Grant and Booth (2009) describe 12 distinct review types in addition to SRs, and highlight how they differ from SRs in terms of the search for and appraisal, synthesis, and analysis of relevant studies. More recently, Sutton et al. (2019) gathered a number of "review typology" articles like Grant and Booth (2009), and synthesized them into 48 distinct review types in seven broad categories. However, because the majority of these review types follow the basic methodologies associated with SRs, we have used the term SR throughout this paper in instances where a more specific term (e.g., umbrella review, scoping review, systematic map, etc.) may be more precise.

Publication of systematic reviews and other evidence syntheses is increasing at a dramatic rate, including in the HAI field (Figure 2). In light of these recent trends, and as primary research in the HAI field builds, we can expect a continued increase in HAI evidence syntheses. Because SRs are considered the gold standard for secondary research, or research based on existing research, it is reasonable to assume there is a "correct" way to conduct them. However, Krnic Martinic et al. (2019) point out that there is no consensus definition of "systematic review." They

examined articles that analyzed groups of healthcare systematic reviews to establish a baseline definition of SR. Their attempt at an unambiguous definition is,

A systematic review is a review that reports or includes the following:

i) research question

ii) sources that were searched, with a reproducible search strategy (naming of databases, naming of search platforms/engines, search date, and complete search strategy)

iii) inclusion and exclusion criteria

iv) selection (screening) methods

v) [critical appraisal and reporting on] the quality/risk of bias of the included studies

vi) information about data analysis and synthesis that allows the reproducibility of the results.

Because systematic reviews are considered reliable and comprehensive syntheses of existent research, it is critical that they are conducted according to a high level of methodological rigor. But just as there is no universally accepted definition of systematic review, there is no universally recognized set of rules to conduct them. Articles providing methodological recommendations for SRs appear in a wide range of disciplinary journals, including those in education (Xiao & Watson, 2019), psychology (Perestelo-Perez, 2013; Siddaway et al., 2019), preventive medicine (Dekhordi et al., 2021), orthopedics (Prill et al., 2021),and endodontology (Aggarwal et al., 2021), among others. And a range of formal guidelines for conducting SRs do exist. Organizations that sponsor systematic reviews on specific topics, such as Cochrane

(www.cochrane.org) and the Joanna Briggs Institute (jbi.global), which both address healthcare research, provide explicit guidelines for the reviews they accept (see Aromataris & Munn, 2020; Higgins et al, 2019). Similarly, the Campbell Collaboration provides guidelines for evidence synthesis projects in social intervention research (see Campbell Collaboration, 2019). Many systematic reviews refer to "PRISMA," or the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses*, a checklist of items that should be included in an evidence synthesis report. PRISMA was developed by an international panel of health care researchers in 2009 (Liberati et al, 2009) and updated in 2020 (Page et al., 2021) . While the PRISMA checklist and its related extensions for SR protocols, search strategies, and other aspects were intended to support the broad spectrum of healthcare research, references to PRISMA can be found in systematic review reporting in many non-healthcare disciplines.

There are similarities among most published SR methodological recommendations related to how relevant studies are identified, selected for inclusion, and evaluated. Following such recommendations ensures that SRs are comprehensive, transparent, unbiased, and replicable, which are the hallmarks of a SR (Higgins et al, 2019; Krnic Martinic et al, 2019). These steps include consulting with an information professional to select appropriate databases and grey literature sources to ensure a comprehensive search. Writing a SR protocol which is published or registered supports transparency, which is further strengthened by detailed reporting of methods. Using multiple screeners to examine each article against highly specific inclusion and exclusion criteria, and assessing the quality of each included study, are steps taken to minimize bias. And the authors' sharing of full search strategies and the inclusion and exclusion criteria establish the replicability of the SR's methods.

Objectives

This study examines a sample of HAI SRs to determine:

Q0: What are the characteristics of HAI SRs in terms of publication patterns, human subjects, animal(s) of interest, and outcomes?

Q1: Which methodological guideline was followed? Was a protocol written? Was the protocol registered (and if so, where)?

Q2: Which databases were searched? Was an information professional consulted?

Q3: Were the database searches replicable?

Q4: Was grey literature included?

Q5. Were inclusion and exclusion criteria explicitly identified? How many researchers examined studies at each stage of screening?

Q6: Were included studies assessed for risk of bias? Which tool or checklist was used?

Methods

To identify systematic reviews on HAI-related topics, we conducted literature searches in multiple databases including Abstracts in Social Gerontology (EBSCO), CAB Abstracts (Web of Science), Cumulative Index to Nursing and Allied Health Literature (EBSCO), Child Development & Adolescent Studies (EBSCO), Education Resources Information Center (EBSCO), International Bibliography of the Social Sciences (ProQuest), ProQuest Dissertations and Theses Global (ProQuest), PsycInfo (EBSCO), Published International LIterature on Traumatic Stress (ProQuest), Medline (PubMed), Sociological Abstracts (ProQuest), Sociological Source Ultimate (EBSCO), and Web of Science Core Collection (Web of Science). The search strategy (("human animal" OR "animal human" OR "animal assist*" OR "animal

facilitat*" OR anthrozoology) AND ("systematic review*" OR "meta analysis" OR "meta analyses" OR metaanalysis OR metaanalyses)) was designed to capture articles with at least one HAI-related term and one SR-related term, and was tailored for each database. Only papers designated as an evidence synthesis in the title, abstract, or keywords were included in this study.

A total of 766 articles were retrieved. After duplicates were removed, 390 articles were screened for relevance to the current study. Each author initially screened half of this set, then cross-checked the other's decisions. In instances where the authors did not agree on inclusion, a consensus was reached through discussion. Each author then extracted qualitative data from half of the remaining 110 papers using a Google Forms data extraction template.

Results

A total of 110 papers were coded, 104 journal articles and six theses. The majority (62, 56.36%) of included studies were identified by their authors as systematic reviews, with meta-analyses (16, 14.55%), mixed systematic reviews/meta-analyses (16, 14.55%), and scoping reviews (7, 6.36%) as the remaining most common review types. Additional review types, as identified by their authors, included systematic literature reviews (4, 3.64%), and semi-systematic reviews, evidence-based reviews, qualitative systematic reviews, systematic mapping reviews, and umbrella reviews (1, <1% each).

Q0: What are the characteristics of HAI SRs in terms of publication patterns, human subjects, animal(s) of interest, and outcomes?

These papers were published between 2007 and 2022, with over half published between 2019-2022. The 104 journal articles were published by 69 journals, with *Anthrozoos* publishing the largest number (10, 9.52%), followed by *Complementary Therapies in Clinical Practice* (6, 5.71%), and *International Journal of Environmental Research and Public Health* and *Review Journal of Autism and Developmental Disorders* (4, 3.81% each).

The topics of the included studies varied across human populations, animals, and interventions. Studies addressed a range of human populations, including those in specific settings (e.g., prisons) and those with physical or mental conditions. Humans were studied across the lifespan, with children or adolescents featured in 26 (23.64%) studies, older adults in 13 (11.82%), adults in 6 (5.45%), and unspecified ages in 72 (65.45%). The most common conditions include dementia (17, 15.45%), autism or autism spectrum disorder (14, 12.73%), chronic illnesses (7, 6.36 %), depression or other mental health disorders (5, 4.55%), chronic pain (5, 4.55%), brain/spinal cord injuries or disorders (5, 4.55%), and attention deficit hyperactivity disorder or developmental disabilities (3, 2.73% each). Specific populations that were not otherwise identified as having a physical or mental condition were studied less frequently: prison inmates (3, 2.73%), farmers (2, 1.82%), pet owners (2, 1.82%), and students (2, 1.82%). In several instances (9, 8.18%) populations were not specified, where subjects were described as people, humans, individuals, etc.

Dogs were included in 30 studies (27.27%), horses in 14 (12.73%), robotic animals in 9 (8.18%), and farm or food animals in 4, 5.45%. A slight majority of studies (57, 51.82%) referred simply to “animals.”

The vast majority (105, 95.45%) of study outcomes addressed the benefit of HAI to human health or wellbeing, while only four (3.64%) studies addressed animal health or welfare. One paper did not study either, but instead focused on the characteristics of therapy animals.

Q1: Which methodological guideline was followed? Was a protocol written? Was the protocol registered (and if so, where)?

Most articles reported following one or more methodological guidelines. A majority (63, 58.18%) of articles reported using PRISMA or PRISMA-ScR guidelines alone or in combination with others. Cochrane was referenced by 4 (3.64%) studies, and 12 additional guidelines were identified once each (.90%).

Protocols were not available for the majority of the studies represented here. While it does not necessarily demonstrate they did not write or follow one, 81 (73.64%) authors made no mention of a protocol in their manuscript, and five (4.55%) explicitly stated that no protocol was used. A few (6, 5.45%) made reference to a protocol, but either did not communicate where it was registered or specified it was not registered. Only 18 studies (13.64%) both created a protocol and made it available. Of these, 15 (13.64%) were registered in the *International Prospective Register of Systematic Reviews* (PROSPERO) (https://www.crd.york.ac.uk/prospero/), one each (<1%) in Cochrane and Open Science Framework (osf.oi). One (<1%) protocol was not registered but is available through the first author.

Q2: Which databases were searched? Was an information professional consulted?

In all but one instance (109, 99%) authors identified the databases used in their searches. Across all studies, 163 different databases were searched (mean = 7 databases, median = 6 databases).

Databases that are available on multiple search platforms were aggregated into one entry. For example, PubMed and Medline (searchable through multiple platforms including PubMed, Web of Science and Ovid) were combined because PubMed contains Medline plus additional content from PubMed Central and the NCBI Bookshelf (National Library of Medicine, n.d.). Similarly, references to "Cochrane" or the multiple subsets of the Cochrane Library (namely, Database of Systematic Reviews, Central Register of Controlled Trials, and Clinical Answers) were combined into one entry. References to databases Web of Science, Web of Science Core Collection, or Web of Knowledge were also aggregated.

The top ten databases searched within these HAI SRs included PubMed/Medline (109, 99.06%), PsycInfo (70, 63.64%), CINAHL (55, 50%), Web of Science/Knowledge (52, 47.27%), Scopus (46, 41.85%), Cochrane Library (37, 33.64%), EMBASE (35, 31.82%), Google Scholar (20, 18.18%), ERIC (21, 19.09%), and PsycArticles (14, 12,73%).

A strong majority (90, 81.82%) of included studies did not report or indicate collaboration with an information professional.

Q3: Were the searches replicable?

A slim majority (58, 52.73%) of articles provided a complete search strategy, including keywords or phrases, controlled vocabulary terms (if applicable), and search syntax, for at least one database. Another 45 (40.91%) provided a summary of the search terms without including database-specific syntax or other details, while seven (6.36%) articles provided no information related to how the literature was searched other than providing a list of included databases.

Q4: Was grey literature included?

Most studies (74, 67.27%) did not mention searching the grey literature or explicitly stated grey literature was not searched for unpublished studies on relevant topics. Of the 36 (32.72%) articles that reported searching grey literature, only 26 (23.64 %) listed their sources, and only 8 (7.27%) included the respective search strategies.

Q5. Were inclusion and exclusion criteria explicitly identified? How many researchers examined studies at each stage of screening?

Inclusion and/or exclusion criteria were identified in all but 6 (5.45%) studies.

A large number (43, 39.10%) of review authors made no mention of how many screeners evaluated each article at the title/abstract stage. Thirty-nine (36.36%) used 2 screeners, 8 (7.27) used 1, and 7 (5.45%) used more than 2. In one instance (<1%), authors specified that all articles were screened by a single individual, with a portion also screened by a second. Details for the remaining 12 (11.82%) were cloudy, with some authors specifying number of reviewers without indicating screening phase, and others using phrases like “articles were screened by all authors,” without including how many viewed each individual record.

Description of the full-text screening stage largely mirrored that of the title/abstract; 46 (41.82%) did not specify number of screeners, 4 (3.64%) specified 1, 38 (34.55%) specified 2, 7 (6.36%) specified more than 2, 2 specified that a portion of the records were screened by a second reviewer, and 13 (11.81%) had imprecise descriptions.

Q6: Were included studies assessed for risk of bias (ROB)? Which tool or checklist was used?

Over a quarter (30, 27.27%) of studies either did not assess the quality of individual studies or did not report doing so. For the 80 (72.73%) that did, a wide range of assessment tools were used singly or in combination. The most commonly used tools were developed by Cochrane (23 instances) and the Joanna Briggs Institute (10), as well as the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) (6), the Downs and Black checklist (4), the Oxford Centre for Evidence Based Medicine (OCEBM) checklist (4), and the Critical Appraisal Skills Programme (CASP) checklists (4). Fewer articles either used other published tools, modified existing tools, or developed their own.

Discussion

Q0: What are the characteristics of HAI SRs in terms of publication patterns, human subjects, animal(s) of interest, and outcomes?

The publication pattern seen here confirms that the publication rate of HAI SR/M-As has been increasing, and increasing especially rapidly in the past few years. This growth mimics that of other fields, and is not surprising. The list of animal species of interest is also unsurprising, given the close proximity humans have to companion animals (including small pets and horses). What is more compelling is the appearance of robotic animals, such as the Japanese robotic seal PARO (parorobots.com), that introduces a unique opportunity for animal therapy that would not otherwise be available to some.

Two broad topics of research are largely absent from this body of literature. HAI SRs focus almost exclusively on human health and wellbeing, leaving ample opportunity for exploration of how animals respond to interactions with humans. While animal welfare is of growing interest to

both the public and scientific communities, as anecdotally evidenced by greater emphasis on conditions surrounding animal agriculture and the humane treatment of pets, a lack of research makes it difficult to get a realistic view of how HAIs affect the welfare of these animals. And, while a wide range of human conditions was studied, there was little emphasis on individuals outside of specific populations (e.g., older adults, prison populations, those with autism, etc.). It would be interesting to see syntheses of studies on how HAIs affect the general population, without a focus on treatment.

Q1: Which methodological guideline was followed? Was a protocol written? Was the protocol registered (and if so, where)?

Many authors of articles included in this study referred to PRISMA as their source of guidance on SR methodology. However, PRISMA does not prescribe the exact steps of a SR, but provides a checklist for the transparent *reporting* of each stage of a SR project. I.e., PRISMA is implemented when *writing* a SR, not when designing it. The PRISMA-P extension for protocols presents a checklist of 27 distinct items that should be considered when writing a SR protocol (Shamseer et al., 2015), and it would be more accurate for authors to refer to PRISMA-P in the context of SR *protocol* design, which in turn structures the SR methodology.

According to Shamseer et al. (2015) "Protocols of systematic reviews and meta-analyses allow for planning and documentation of review methods, act as a guard against arbitrary decision making during review conduct, enable readers to assess for the presence of selective reporting against completed reviews, and, when made publicly available, reduce duplication of efforts and potentially prompt collaboration" (p 1). Allers et al. (2018) found that, while SR reports that referred to a published protocol took longer from database searches to article submission, these

SRs also tended to exhibit better reporting. Cochrane, the Joanna Briggs Institute, and the Campbell Collaboration all require that SR researchers write and register a protocol before the start of an evidence synthesis project, and these organizations provide documentation on what the protocol should include. PRISMA-P has been available on the PRISMA website since 2015. Despite this emphasis on the importance of protocols, it is concerning that so few of the papers in this study both referred to a written protocol and indicated where readers could access it.

Q2: Which databases were searched? Was an information professional consulted?

Most studies reported searching several databases. Two studies searched only one database. While SR guidelines do not list a minimum number of databases to search, the *Cochrane Handbook* warns against relying on results from just one database, like Medline, to ensure not only that "as many relevant studies as possible are identified, but also to minimize selection bias for those that are found" (Lefebvre et al, 2022).

There is little consistency in how authors recorded each database and its associated search platform. This inconsistency led to duplication in numerous studies that searched both Medline and PubMed, even though PubMed fully contains the Medline database. Web of Science (formerly called Web of Knowledge), can refer to either a suite of databases provided by Clarivate ("Core Collection") or a platform that hosts numerous subject databases like Medline, Zoological Record, and others. The content searched on Web of Science can vary based on institutional subscriptions, so authors should take care to list exactly which subfiles were searched. In this study, only two papers out of 52 did so.

Google Scholar was referred to in 20 studies. GS is a search engine rather than a database, and Google does not provide explicit details about which data sites are being searched. Therefore, it is not certain whether search strategies retrieve the same results from user to user. Bramer et al. (2013) highlight weaknesses of GS compared to PubMed for conducting replicable searches for systematic reviews. They concluded that Scholar works well enough that it need not be excluded from SR searches, but that Scholar alone is insufficient for inclusion in SR search strategies.

Fewer than 20% of the included studies reported consultation or collaboration with a librarian or information professional, despite evidence that doing so usually improves the outcome. Some systematic review guidelines recommend including a librarian or information specialist on the review team (e.g., Lefebvre et al., 2019; National Center for Education Evaluation, 2022). Koffel (2015) and Rethlefsen et al. (2015) both found that librarian involvement on systematic review projects was associated with greater adherence to reporting guidelines, especially with regard to the construction and recording of database search strategies, which in turn improves the transparency and reproducibility of a SR. And working with a librarian whose expertise includes knowledge of subject databases and their coverage can help ensure that an appropriate balance of information sources is included in the search strategy, while avoiding duplication.

Aamodt et al. (2019) found that SRs with a librarian co-author were associated with lower risk of bias compared to SRs that either only acknowledged a librarian or made no mention of consulting with a librarian. Spencer and Eldredge (2018) found that librarians and information professionals can play a variety of roles on a systematic review team, not only as the search specialist. These include research question formulation, project planning, and citation management, among others. Ma et al. (2018) found that librarians often provide expertise on

research data management and scholarly communications, which SR teams may also find valuable.

Q3: Were the database searches replicable?

Providing adequate information about the database searches is important because it allows readers to assess the comprehensiveness of a SR's methods (Koffel & Rethlefsen, 2016). Almost half of the included studies did not provide reproducible search strategies in the text or in supplemental information. While the original PRISMA checklist requires a "full electronic search strategy for at least one database, including any limits used, such that it could be repeated" (Liberati et al., 2009), only 42 (63.63%) of the 66 articles that referred to PRISMA complied with this requirement.

The PRISMA guidelines for search strategies were recently expanded to include reporting the full search strategies for *every* database searched (Page et al, 2021). And PRISMA-S, the PRISMA extension for searching, goes into much more detail about information that should be made available, including whether search strategies were based on prior work (e.g., a previous review), whether the search strategies were subjected to peer review, and more (Rethlefsen et al., 2021). However, both updated PRISMA and PRISMA-S were published in 2021, likely after the most recent studies included here had been submitted for publication.

Q4: Was grey literature included?

Few studies reported searching for grey literature. Grey literature includes non peer-reviewed resources, both published and unpublished, that are not available through commercial or academic publications. Resource formats include government reports, dissertations and theses,

conference proceedings, unpublished studies, technical reports, and many others. Because SRs aim to synthesize *all* relevant information pertaining to a research question, grey literature represents an important component of the search and retrieval process. In some cases grey literature accounts for a substantial proportion of included studies, and has a significant impact on review outcomes (McAuley et al, 2000; Paez, 2017). Without it, reviews are at risk of missing those studies that are most likely to contain data contrary to published research, because publication bias often precludes their publication (Easterbrook, 1991; Paez, 2017). By skipping grey literature searching, review conclusions may inaccurately be skewed toward the positive-effect (Easterbrook et al., 1991).

It is disconcerting that so few authors in this study reported searching and including grey literature. However, it is also reasonable to assume that grey literature may be more critical in some fields than in others, such as clinical medicine, where reviews are used in evidence-based decision-making. Grey literature may be less prevalent or impactful in the HAI domain. Despite this possibility, it is always a best practice to search and include any relevant grey literature sources in a review.

Q5. Were inclusion and exclusion criteria explicitly identified? How many researchers examined studies at each stage of screening?

Clearly defined and communicated inclusion and exclusion criteria are another component that contributes to a SR's replicability and minimization of bias. Explicit criteria are meant to eliminate subjective interpretation of each article's eligibility for inclusion, and maximize the likelihood of interrater agreement (McDonagh et al., 2008). Using clear inclusion and exclusion criteria make it possible to replicate a SR's methods more precisely, whether replication is

performed by the review's authors, peer reviewers, or others who later update or duplicate the study.

A large number of authors did not clearly indicate how many researchers evaluated each record at each stage of screening. Reporting the number of reviewers who screened each record is an "essential element for systematic reviews regardless of the selection process used" (Page et al, 2021 page 7). To avoid the unintentional but inherent bias of any single reviewer, and thus minimize the risk of individual articles being included or excluded erroneously, best practice suggests that more than one individual examines at least a portion of the manuscripts (Gartlehner et al., 2020; Waffenschmidt et al., 2019). In what may be considered the gold standard, each article is reviewed by two independent reviewers, with discrepancies resolved by a third (Liberati et al, 2009). Another approach is to have a second researcher review only a portion of the records, allowing screeners to determine how well their decisions correlate. Yet another is to have only a single reviewer screen every record, which may dramatically decrease the time necessary to screen articles but increase the potential for errors (Gartlehner et al., 2020; Waffenschmidt et al., 2019).

Clearly many authors did not follow best *reporting* guidelines, but it is impossible to tell from these papers how well methodological screening recommendations were followed.

Q6: Were included studies assessed for risk of bias (ROB)? Which tool or checklist was used?

Risk of bias (RoB) assessment, also referred to as quality assessment or critical appraisal, is a key component of a well-structured and implemented SR, and is included in most prescriptive

SR guidelines (e.g., PRISMA guidelines, Page et al 2021). Because systematic reviews are meant to represent a comprehensive examination of evidence, it is important they include all studies that conform to their inclusion criteria. However, the weight of each included study's evidence on a review may not be equal. Therefore, multiple scales, checklists, and other tools have been created that allow researchers to systematically examine each study against predetermined indicators of quality, and, without bias, establish how each will be considered in final conclusions (Hannes, 2010; Mamikutty, 2021; Quigley et al., 2019; Zeng et al., 2015). Unfortunately, these tools are often utilized inappropriately or inadequately, weakening their value in the systematic review process (Babic et al., 2019; Babic et al., 2020; Barcot et al., 2019; Igelström et al., 2021; Marušić et al., 2020; Propadalo et al., 2019; Puljak et al., 2020; Saric et al., 2019), and individual tools may be better suited for some study types than others. For example, one tool may be more appropriate for assessing the RoB for randomized controlled trials, while other tools are better suited for assessing non-randomized trials or case reports (Zeng et al 2015). While it is beyond the scope of this paper to determine to what degree tools were selected and used correctly, it is encouraging that a large percentage of authors did report a critical evaluation of included studies. It would be interesting to explore whether there are specific tools that best lend themselves to those topics and study methods used heavily in HAI research, as is found (or at least asserted) in other fields (Hooijmans et al., 2014; Mamikutty et al., 2021; Schwingshackl et al., 2016; Woodruff & Sutton, 2014).

Limitations

The authors recognize some limitations of this paper.

This is an exploratory study that may help raise awareness among HAI researchers of the importance of good SR reporting. The small sample of included papers does not allow us to generalize across all HAI evidence synthesis articles. This study was not a systematic review, and therefore did not aim to identify and screen *all* publications of interest. Instead, we examined a manageable subset of HAI SRs based on a handful of keywords. SRs that assessed HAIs may have been omitted if they did not contain any of the keywords used in our search or were not identified by authors as a "systematic review" or "meta-analysis" in the title, abstract, or keywords.

Our objectives focused on how the steps of a SR project were reported, and did not attempt to assess the methodological quality of included SRs. However, conclusions about the quality of reporting and the quality of methodology should not be confused, because one does not necessarily signify the other. It is possible that authors of the papers included in this study did not always report best practices even when they did follow them.

References

Aamodt, M., Huurdeman, H., & Strømme, H. (2019). Librarian co-authored systematic reviews are associated with lower risk of bias compared to systematic reviews with acknowledgement of librarians or no participation by librarians. *Evidence Based Library & Information Practice*, *14*(4), 103–127. https://doi.org/10.18438/eblip29601

Aggarwal, V., Singla, M., Gupta, A., Mehta, N., & Kumar, U. (2021). How to write systematic review and meta-analysis. *Endodontology*, *33*(2), 55. https://doi.org/DOI: 10.4103/endo.endo_86_21

Allers, K., Hoffmann, F., Mathes, T., & Pieper, D. (2018). Systematic reviews with published protocols compared to those without: More effort, older search. *Journal of Clinical Epidemiology*, *95*, 102–110. https://doi.org/10.1016/j.jclinepi.2017.12.005

Aromataris, E., & Munn, Z. (2020). *JBI Manual for Evidence Synthesis*. Joanna Briggs Institute. https://synthesismanual.jbi.global

Babic, A., Tokalic, R., Amílcar Silva Cunha, J., Novak, I., Suto, J., Vidak, M., Miosic, I., Vuka, I., Poklepovic Pericic, T., & Puljak, L. (2019). Assessments of attrition bias in Cochrane systematic reviews are highly inconsistent and thus hindering trial comparability. *BMC Medical Research Methodology*, *19*(1), 76. https://doi.org/10.1186/s12874-019-0717-9

Barcot, O., Boric, M., Poklepovic Pericic, T., Cavar, M., Dosenovic, S., Vuka, I., & Puljak, L. (2019). Risk of bias judgments for random sequence generation in Cochrane systematic reviews

were frequently not in line with Cochrane Handbook. *BMC Medical Research Methodology*, *19*(1), 170–179. https://doi.org/10.1186/s12874-019-0804-y

Beck, A. M., & Martin, F. (2008). Current human–animal bond course offerings in veterinary schools. *Journal of Veterinary Medical Education*, *35*(4), 483–486. https://doi.org/10.3138/jvme.35.4.483

Boden, C., & Murphy, S. A. (2012). The latent curriculum: Breaking conceptual barriers to information architecture. *Partnership: The Canadian Journal of Library and Information Practice and Research*, *7*(1). https://doi.org/10.21083/partnership.v7i1.1519

Bramer, W. M., Giustini, D., Kramer, B. M., & Anderson, P. (2013). The comparative recall of Google Scholar versus PubMed in identical searches for biomedical systematic reviews: A review of searches used in systematic reviews. *Systematic Reviews*, *2*(1), 115. https://doi.org/10.1186/2046-4053-2-115

Campbell Collaboration. (2019). *Campbell Collaboration Systematic Reviews: Policies and Guidelines, version 1.4*. The Campbell Collaboration. https://doi.org/10.4073/cpg.2016.1

Campbell, S. M., Kung, J. Y. C., & Dennett, L. (2016). A curriculum for introductory systematic review searching for researchers. *Journal of the Canadian Health Libraries Association*, *37*(1), 2–5. https://doi.org/10.5596/c16-003

DeMello, M. (2010). *Teaching the Animal: Human-Animal Studies Across the Disciplines*. Lantern Books.

Easterbrook, P. J., Berlin, J. A., Gopalan, R., & Matthews, D. R. (1991). Publication bias in clinical research. *Lancet (London, England)*, *337*(8746), 867–872. https://doi.org/10.1016/0140-6736(91)90201-y

Gartlehner, G., Affengruber, L., Titscher, V., Noel-Storr, A., Dooley, G., Ballarini, N., & König, F. (2020). Single-reviewer abstract screening missed 13 percent of relevant studies: A crowd-based, randomized controlled trial. *Journal of Clinical Epidemiology*, *121*, 20–28. https://doi.org/10.1016/j.jclinepi.2020.01.005

Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*, *26*(2), 91–108. https://doi.org/10.1111/j.1471-1842.2009.00848.x

Hannes, K. (2020). Evidence-based practice. In P. Atkinson, S. Delamont, A. Cernat, J. W. Sakshaug, & R. A. Williams, *SAGE Research Methods Foundations*. SAGE Publications Ltd. https://doi.org/10.4135/9781526421036846490

Higgins, J. P. T., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2019). *Cochrane Handbook for Systematic Reviews of Interventions* (Second edition.). The Cochrane Collaboration.

Hooijmans, C. R., Rovers, M. M., de Vries, R. B. M., Leenaars, M., Ritskes-Hoitinga, M., & Langendam, M. W. (2014). SYRCLE's risk of bias tool for animal studies. *BMC Medical Research Methodology*, *14*, 43. https://doi.org/10.1186/1471-2288-14-43

Igelström, E., Campbell, M., Craig, P., & Katikireddi, S. V. (2021). Cochrane's risk of bias tool for non-randomized studies (ROBINS-I) is frequently misapplied: A methodological systematic review. *Journal of Clinical Epidemiology*, *140*, 22–32. https://doi.org/10.1016/j.jclinepi.2021.08.022

Koffel, J. B. (2015). Use of recommended search strategies in systematic reviews and the impact of librarian involvement: A cross-sectional survey of recent authors. *PLoS ONE*, *10*(5), e0125931. https://doi.org/10.1371/journal.pone.0125931

Koffel, J. B., & Rethlefsen, M. L. (2016). Reproducibility of search strategies is poor in systematic reviews published in high-impact pediatrics, cardiology and surgery journals: A cross-sectional study. *PLoS ONE*, *11*(9), e0163309. https://doi.org/10.1371/journal.pone.0163309

Krnic Martinic, M., Pieper, D., Glatt, A., & Puljak, L. (2019). Definition of a systematic review used in overviews of systematic reviews, meta-epidemiological studies and textbooks. *BMC Medical Research Methodology*, *19*(1), 203. https://doi.org/10.1186/s12874-019-0855-0

Lefebvre, C., Glanville, J., Briscoe, S., Littlewood, A., Marshall, C., Metzendorf, M.-I., Noel-Storr, A., Rader, T., Thomas, J., Wieland, L. S., Featherstone, Robin, & Paynter, Robin. (2022). Searching for and selecting studies. In Higgins, J.P.T., Thomas, J., Cumpston, M., Li, T, Page, M J, & Welch, V A, *Cochrane Handbook for Systematic Reviews of Interventions, version 6.3* (pp. 67–107). Cochrane. https://doi.org/10.1002/9781119536604.ch4

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *Journal of Clinical Epidemiology*, *62*(10), e1–e34. https://doi.org/doi: 10.1016/j.jclinepi.2009.06.006

Logullo, P., MacCarthy, A., Kirtley, S., & Collins, G. S. (2020). Reporting guideline checklists are not quality evaluation forms: They are guidance for writing. *Health Science Reports*, *3*(2), e165. https://doi.org/10.1002/hsr2.165

Long, B. A. & Donne, E. (2020). *Hierarchy of Evidence Pyramid* [Graphic image]. doi:10.26207/gr3e-6b54

Ma, J., Stahl, L., & Knotts, E. (2018). Emerging roles of health information professionals for library and information science curriculum development: A scoping review. *Journal of the Medical Library Association*, *106*(4), 432–444. https://doi.org/10.5195/jmla.2018.354

Mamikutty, R., Aly, A. S., & Marhazlinda, J. (2021). Selecting risk of bias tools for observational studies for a systematic review of anthropometric measurements and dental caries among children. *International Journal of Environmental Research and Public Health*, *18*(16), 8623. https://doi.org/10.3390/ijerph18168623

Marušić, M. F., Fidahić, M., Cepeha, C. M., Farcaş, L. G., Tseke, A., & Puljak, L. (2020). Methodological tools and sensitivity analysis for assessing quality or risk of bias used in systematic reviews published in the high-impact anesthesiology journals. *BMC Medical Research Methodology*, *20*(1), 121. https://doi.org/10.1186/s12874-020-00966-4

McAuley, L., Pham, B., Tugwell, P., & Moher, D. (2000). Does the inclusion of grey literature influence estimates of intervention effectiveness reported in meta-analyses? *The Lancet*, *356*(9237), 1228–1231. https://doi.org/10.1016/S0140-6736(00)02786-0

McDonagh, M., Peterson, K., Raina, P., Chang, S., & Shekelle, P. (2008). Avoiding Bias in Selecting Studies. In *Methods Guide for Effectiveness and Comparative Effectiveness Reviews*. Agency for Healthcare Research and Quality (US). http://www.ncbi.nlm.nih.gov/books/NBK126701/

National Center for Education Evaluation. (2022). *What Works Clearinghouse Procedures and Standards Handbook, Version 5.0*. Institute of Education Sciences. https://ies.ed.gov/ncee/wwc/Docs/referenceresources/Final_WWC-HandbookVer5.0-0-508.pdf

National Library of Medicine. (n.d.). *MEDLINE, PubMed, and PMC (PubMed Central): How are they different?* MEDLINE/PubMed Resources; U.S. National Library of Medicine. Retrieved September 23, 2022, from https://www.nlm.nih.gov/bsd/difference.html

Paez, A. (2017). Gray literature: An important resource in systematic reviews. *Journal of Evidence-Based Medicine, 10*(3), 233–240. https://doi.org/10.1111/jebm.12266

Page, M. J., Moher, D., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … McKenzie, J. E. (2021). PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. *BMJ*, n160. https://doi.org/10.1136/bmj.n160

Perestelo-Pérez, L. (2013). Standards on how to develop and report systematic reviews in psychology and health. *International Journal of Clinical and Health Psychology*, *13*(1), 49–57. https://doi.org/10.1016/S1697-2600(13)70007-3

Prill, R., Karlsson, J., Ayeni, O. R., & Becker, R. (2021). Author guidelines for conducting systematic reviews and meta-analyses. *Knee Surgery Sports Traumatology Arthroscopy*, *29*(9), 2739–2744. https://doi.org/10.1007/s00167-021-06631-7

Propadalo, I., Tranfic, M., Vuka, I., Barcot, O., Pericic, T. P., & Puljak, L. (2019). In Cochrane reviews, risk of bias assessments for allocation concealment were frequently not in line with

Cochrane's Handbook guidance. *Journal of Clinical Epidemiology*, *106*, 10–17. https://doi.org/10.1016/j.jclinepi.2018.10.002

Puljak, L., Ramic, I., Arriola Naharro, C., Brezova, J., Lin, Y.-C., Surdila, A.-A., Tomajkova, E., Farias Medeiros, I., Nikolovska, M., Poklepovic Pericic, T., Barcot, O., & Suarez Salvado, M. (2020). Cochrane risk of bias tool was used inadequately in the majority of non-Cochrane systematic reviews. *Journal of Clinical Epidemiology*, *123*, 114–119. https://doi.org/10.1016/j.jclinepi.2020.03.019

Quigley, J. M., Thompson, J. C., Halfpenny, N. J., & Scott, D. A. (2019). Critical appraisal of nonrandomized studies—A review of recommended and commonly used tools. *Journal of Evaluation in Clinical Practice*, *25*(1), 44–52. https://doi.org/10.1111/jep.12889

Rethlefsen, M. L., Kirtley, S., Waffenschmidt, S., Ayala, A. P., Moher, D., Page, M. J., Koffel, J. B., Blunt, H., Brigham, T., Chang, S., Clark, J., Conway, A., Couban, R., de Kock, S., Farrah, K., Fehrmann, P., Foster, M., Fowler, S. A., Glanville, J., … PRISMA-S Group. (2021). PRISMA-S: An extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews. *Systematic Reviews*, *10*(1), 39. https://doi.org/10.1186/s13643-020-01542-z

Saric, F., Barcot, O., & Puljak, L. (2019). Risk of bias assessments for selective reporting were inadequate in the majority of Cochrane reviews. *Journal of Clinical Epidemiology*, *112*, 53–58. https://doi.org/10.1016/j.jclinepi.2019.04.007

Sarkis-Onofre, R., Catalá-López, F., Aromataris, E., & Lockwood, C. (2021). How to properly use the PRISMA Statement. *Systematic Reviews*, *10*(1), 1–3.

Schwingshackl, L., Knüppel, S., Schwedhelm, C., Hoffmann, G., Missbach, B., Stelmach-Mardas, M., Dietrich, S., Eichelmann, F., Kontopantelis, E., Iqbal, K., Aleksandrova, K., Lorkowski, S., Leitzmann, M. F., Kroke, A., & Boeing, H. (2016). Nutrigrade: A scoring system to assess and judge the meta-evidence of randomized controlled trials and cohort studies in nutrition research. *Advances in Nutrition (Bethesda, Md.)*, *7*(6), 994–1004. https://doi.org/10.3945/an.116.013052

Siddaway, A. P., Wood, A. M., & Hedges, L. V. (2019). How to do a systematic review: A best practice guide for conducting and reporting narrative reviews, meta-analyses, and meta-syntheses. *Annual Review of Psychology*, *70*(1), 747–770. https://doi.org/10.1146/annurev-psych-010418-102803

Spencer, A. J., & Eldredge, J. D. (2018). Roles for librarians in systematic reviews: A scoping review. *Journal of the Medical Library Association : JMLA*, *106*(1), 46–56. https://doi.org/10.5195/jmla.2018.82

Sutton, A., Clowes, M., Preston, L., & Booth, A. (2019). Meeting the review family: Exploring review types and associated information retrieval requirements. *Health Information and Libraries Journal*, *36*(3), 202–222. https://doi.org/DOI: 10.1111/hir.12276

Systematic Reviews. (n.d.). BioMed Central. Retrieved March 4, 2022, from https://systematicreviewsjournal.biomedcentral.com/

Waffenschmidt, S., Knelangen, M., Sieben, W., Bühn, S., & Pieper, D. (2019). Single screening versus conventional double screening for study selection in systematic reviews: A methodological systematic review. *BMC Medical Research Methodology*, *19*(1), 132. https://doi.org/10.1186/s12874-019-0782-0

Woodruff, T. J., & Sutton, P. (2014). The Navigation Guide systematic review methodology: A rigorous and transparent method for translating environmental health science into better health outcomes. *Environmental Health Perspectives*, *122*(10), 1007–1014. https://doi.org/10.1289/ehp.1307175

Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, *39*(1), 93–112. https://doi.org/10.1177/0739456X17723971

Yatcilla, J. K. (2021). A panorama of human–animal interactions research: Bibliometric analysis of HAI articles 1982–2018. *Anthrozoös*, *34*(2), 161–173. https://doi.org/10.1080/08927936.2021.1885139

Zeng, X., Zhang, Y., Kwong, J. S. W., Zhang, C., Li, S., Sun, F., Niu, Y., & Du, L. (2015). The methodological quality assessment tools for preclinical and clinical studies, systematic review and meta-analysis, and clinical practice guideline: A systematic review. *Journal of Evidence-Based Medicine*, *8*(1), 2–10. https://doi.org/10.1111/jebm.12141

Figure 1: Hierarchy of Evidence Pyramid. (Long & Donne, 2020)

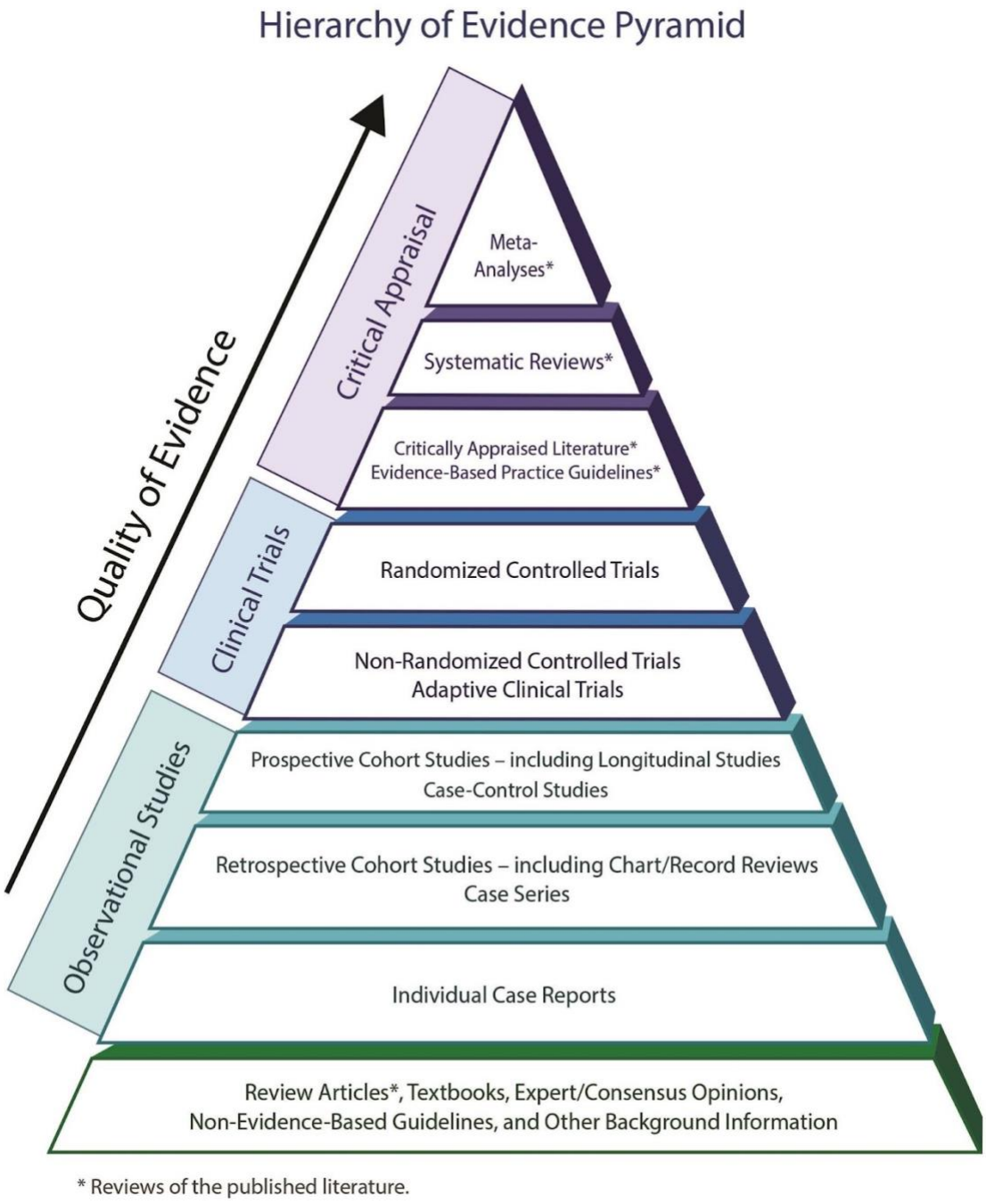

Figure 2: SRs and HAI-specific SRs in PubMed. Based on PubMed searches: SRs = (systematic review OR meta-analysis); HAI-specific SRs = (systematic review OR meta-analysis) AND (human animal).