


Laboratory animals search filter for different literature databases: PubMed, Embase, Web of Science and PsycINFO

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Abstract

Systematic reviews are important tools in animal research, but the ever-increasing number of studies makes retrieval of all relevant publications challenging. Search filters aid in retrieving as many animal studies as possible. In this paper we provide updated and expanded versions of the SYRCLE animal filters for PubMed and Embase. We provide the Embase filter for both Embase.com and via Ovid. Furthermore, we provide new animal search filters for Web of Science (WoS) and APA PsycINFO via psycnet.apa.org and via Ovid. Compared with previous versions, the new filters retrieved 0.5–47.1% (19 references for PubMed, 837 for WoS) more references in a real-life example. All filters retrieved additional references, comprising multiple relevant reviews. A random sample from WoS found at least one potentially relevant primary study. These animal search filters facilitate identifying as many animal studies as possible while minimising the number of non-animal studies.

Keywords

Search filter, systematic review, supplements to animal research, ethics & welfare

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Background

Systematic reviews are used to answer research questions by searching, selecting, appraising and synthesising all available relevant research.¹ Systematic reviews differ from traditional or narrative reviews in several ways, including the fact that systematic reviews use explicit search strategies to search for publications in multiple databases.

A systematic search consists generally of multiple search components, usually based on the critical components of a PICO/PECO (Population, Intervention/Exposure, Comparator, Outcome) question.² For each search component, a separate search string needs to be developed. Each component-specific search string includes an extensive collection of appropriate search terms. Search terms can be divided into standardised subject terms and free-text terms. The use of appropriate terminology is the cornerstone of an effective search. Using inappropriate terms may result in missing relevant studies or in identifying too many

irrelevant studies and increase the number of studies required to screen or read for making inclusion/exclusion decisions in systematic reviews.

Creating search strategies for systematic reviews is a balancing act between sensitivity and precision. While it is generally advised to focus on sensitivity to find as

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many relevant references as possible,² the sacrificing of precision can result in retrieving a large number of references and unnecessarily extend the screening process beyond a reasonable time frame.

The study by Bramer et al. showed that information specialists spend roughly 13 h in developing a comprehensive systematic search.³ Search filters for specific fields or subjects of interest can help to optimise the search process and save time in development of the search. They aim to identify all available literature concerning a specific topic, and at the same time avoid capturing too many irrelevant papers. In 2010, two filters for retrieving animal studies in the most frequently used biomedical databases, PubMed⁴ and Embase,^{5,6} have been published.

These two search filters, developed by the same researchers, had the same aim, identifying all experimental animal studies, but needed to be tailored to the characteristics of these databases. PubMed and Embase each have their own search syntax, thesaurus and field tags. Thesaurus terms (sets of terms in a hierarchical structure, which permits searching at various levels of specificity) enable scientists to easily identify indexed papers concerning a specific topic. For example, in PubMed each indexed reference receives an average of 10–12 terms to describe a paper. These “Medical Subject Headings” (MeSH) terms are controlled by the National Library of Medicine. However, searching solely using thesaurus terms is not advised, because the indexing may contain errors.⁷ In addition, the most recently submitted papers will not have been indexed yet, and thus have no MeSH terms, and subsequently will not be found when using solely MeSH terms.

Some databases have their own filters for animal studies. However, these filters are not necessarily extensive. The PubMed “Other Animals” filter only uses “animals[MeSH Terms:noexp]”, potentially missing non-indexed studies. The filter developed by SYRCLE has been shown to retrieve more relevant papers than the standard PubMed filter.⁴ Embase has a quick limit for “animals” and filters for different animal study types (animal cell, animal experiment, animal model, and animal tissue). The animal quick limit has changed since the publication of the previous SYRCLE animal filter for Embase.⁵ It is quite extensive⁸ but it also includes terms that are not relevant for laboratory animal science, such as invertebrates, and, just as the PubMed filter, it retrieves only indexed studies.

In short, search filters aid in retrieving more relevant studies and reduce the time needed for creating a search strategy. They also enable faster screening of the results as non-relevant papers are omitted. Our new filters are more appropriate for laboratory animals systematic

reviews than the filter provided by the databases themselves by being more extensive, combining both thesaurus terms and title, abstract and keyword (TiAbKw) terms and by basing the new filters on laboratory animals as defined by the European Union.⁹

The aim of the current work is to share our laboratory animal search filters for PubMed, Embase via Embase.com and Ovid, Web of Science (WoS) and APA PsycINFO via psycnet.apa.org (from here on, PsycNet PsycINFO) and Ovid. These filters retrieve studies that use laboratory animals as defined by directive EU 2010/63/EU, which comprise all vertebrates and cephalopods. Consequently, invertebrate animals such as *Drosophila melanogaster* are not included in these filters. The previously developed SYRCLE animal filters for PubMed and Embase are updated whereas the filters for WoS and PsycINFO are new.

Methods and results

For databases that use a thesaurus, the thesaurus terms are specific to that database. Although the TiAbKw terms may be the same for different databases they cannot be used interchangeably without adaptations to the specific database, due to differences in syntax. Also, some databases have multiple access providers (e.g. Embase can be accessed via Embase.com, Ovid and EBSCO) which can utilise different syntax.

A new version of PubMed was launched on 18 May 2020. This paper provides the search filter for the new version of PubMed. The old version will be called PubMed Legacy from here on. Additionally, new filters for WoS and APA PsycINFO are provided. WoS is a broad subject database which indexes many journals that are not indexed in PubMed and Embase (e.g. veterinary ones), but it does not have a thesaurus. APA PsycINFO is a database focused on psychology, relevant for laboratory animal neuroscience studies, and has a thesaurus. A summary of these databases is provided in Table 1.

The filters that easily can be copied-and-pasted into the databases can be found in the Supplementary material online and on the Open Science Framework (<https://osf.io/q6uxs/>).

Filter updates for PubMed and Embase

The PubMed and Embase filters were updated based on the definition of “animals for scientific purposes” as defined by directive 2010/63/EU,⁹ which includes all vertebrates and cephalopods, and excludes non-vertebrates such as *Drosophila* and worms. The thesaurus trees (MeSH for PubMed, Emtree for Embase) were checked for relevant changes since the last

Table 1. Short summary of literature databases relevant to systematic reviews on laboratory animals.

Database	Thesaurus	Notes on syntax	Suggested used
PubMed	Yes (MeSH)	Note: [tiab] also comprises author-provided keywords	Medical
Embase	Yes (Emtree)		Medical
WoS	No	TS= (topic search) searches for title, abstract, authors, keywords and WoS keywords	Science and biology. Indexes relevant chemistry and veterinary journals.
PsycINFO	Yes (index terms)	Keywords searches for title, keywords, index terms and abstract	Psychology. Indexes relevant behavioural journals.

WoS: Web of Science.

Table 2. Changes to the thesaurus terms for the PubMed and Embase filters compared with the previous version.

Changed	Reason for change
PubMed	
Added: Eutheria[MeSH Terms:noexp]	New term below "Mammals" in the MeSH-tree
Added: Pongo	New term below "Hominidae" in the MeSH-tree
Added: Proboscidea Mammal[MeSH Terms:noexp]	New term below "Mammals" in the MeSH-tree. Not exploded to exclude mammoths and mastodons
Added: Cingulata	Replaces the "Xenarthra" MeSH-term
Added: Cephalopoda	Not present in the previous animal filter
Removed: Invertebrates	Out of scope for the new filter with focus on laboratory animals
Removed: Chordata, Nonvertebrate	Out of scope for the new filter with focus on laboratory animals
Removed: Xenarthra	Term replaced by "Cingulata"
Removed: Pongo pygmaeus	Now included in "Pongo"
Embase	
Added: monotreme/exp	Replaces the "monotremate" term
Added: cephalopod/exp	Not present in the previous animal filter

versions of the respective filter. The changes are presented in Table 2.

For the TiAbKw part of the filter, the following changes were made: first, missing relevant plural terms were added; second, relevant thesaurus terms not yet present in the TiAbKw terms were added; third, a Dutch governmental report¹⁰ was used to add species used for laboratory animal research but not previously present in the filters. Last, the term "in vivo" was added.

A term frequency analysis was performed for the occurrence of all the terms included in the PubMed animal search filter. This was used to check whether any of the terms included in the filter gave an unexpectedly high number of hits, which could reflect errors or a low sensitivity.

Table 3 shows the percentages of total hits retrieved in the frequency analysis for the 10 terms giving the most hits. A small proportion of all the terms retrieve the majority of all references. The term frequency analysis from PubMed shows that "mouse" and "mice" are

Table 3. The percentages of total hits for the 10 terms giving the most hits in PubMed.

Term	Percentage of total hits
mouse	15.06
rat	13.61
animal	10.70
in vivo	8.80
doe	7.52
rabbit	2.48
murine	2.21
pig	2.08
dog	2.07
bovine	1.94

the most common terms, with 15.1% of all hits. This is followed by "rat"/"rats" with 13.61% and "animal"/"animals" with 10.7%.

The term frequency analysis also revealed several terms with more hits than we expected based on the animal species alone. These terms are: "doe"/"does"

(a common verb), “turkey” (the country), “dam”/“dams” (construction) and “hind”/“hinds” (as posterior). These terms were removed from the search filters because their inclusion would result in too many irrelevant hits.

New filter development for WoS and PsycINFO

The filters for WoS and PsycINFO were based on the updated filters for PubMed and Embase.

Our tests of the WoS filters were based on the Core Collection.¹¹ All relevant thesaurus and TiAbKw terms were combined for WoS as it does not have a thesaurus structure, and subsequently duplicate terms were removed. Finally, all resulting search terms were combined in the WoS syntax.

Given that PsycINFO has its own thesaurus, the corresponding thesaurus terms from the PubMed and Embase filter were identified in PsycINFO. The explode function works differently in psycnet.apa.org compared with other platforms. In general, the explode function results in searches not only for the selected thesaurus term, but also for all narrower terms below it. In contrast, on PsycNet PsycINFO, the explode retrieves thesaurus terms to only one level lower (e.g. exploding “animals” would include “vertebrates”, but would not include the level below comprising “birds”, “mammals”, etc.). Therefore, many additional thesaurus terms needed to be included in the PsycNet PsycINFO filter compared with the other filters. As psycnet.apa.org was not able to run the entire PsycINFO filter (the query would time-out and retrieve 0 hits), the filter for PsycINFO needed to be adapted and shortened. New terms were increasingly added to the filter until the query could no longer be reliably executed. To optimise the filter, the most frequently used search terms as determined by the previously described term frequency analysis for PubMed were used for the TiAbKw search part. To test whether the results from the term frequency analysis in PubMed would translate to PsycINFO, the relative retrieval of hits of selected terms was compared. We took the 50 most common terms found by the PubMed term frequency analysis, searched for those terms in PsycINFO in the titles and abstracts and recorded the number of hits for each of these terms. The number of hits retrieved for “rat”/“rats” were set to 100% with the other number for all other terms describing the percentage of hits compared with this term. “rat” was chosen as this term gives the most hits in PsycINFO. The results of this comparison are presented in Figure 1. The results show that the relative percentages vary as expected, but in general the ranking of terms follows the same trend as for PubMed. As the ranking of the

terms follows the same trend between PubMed and PsycINFO, we are confident that the most relevant terms are included in our PsycNet PsycINFO filter.

PsycINFO via Ovid does not have the same restrictions as PsycNet PsycINFO, and all relevant TiAbKw terms were included in the Ovid-APA PsycINFO filter. Thus, researchers using the Ovid APA PsycINFO filter will retrieve more possibly relevant references than those using the psycnet.apa.org filter, which may miss references due to limitation of the platform used for searching.

Brief filter tests

To test the filters, we compared the new filters with the previous PubMed Legacy⁴ and Embase⁶ filters. We compared the full animal filters on their own, and in combination with a previously used search strategy for a systematic review on animal models for binge eating.¹² The filter tests for each database (e.g. all search tests for PubMed) were always performed on the same day.

There are no SYRCLE filters available for WoS or PsycINFO. Therefore, the filters used by Rehn et al. were used.¹² These are based on the SYRCLE animal filters and provide a real-life example. The comparisons were made using PubMed, Embase.com, PsycNet PsycINFO and WoS. As the authors had only limited access to Ovid, we were unable to make the same comparisons for Embase and PsycINFO in Ovid. The filters were tested, however, to ensure that they worked correctly.

For PubMed, the new filter retrieved 0.84% more hits compared with the previous SYRCLE filter, but the previous SYRCLE filter already retrieved 7.07% more than PubMed’s own animal filter (i.e. Other Animals). For Embase.com, the new filter retrieved 8.09% more hits. In the previous SYRCLE Embase filter only the title and abstract field terms (ti,ab) were used. We also tested the filter with the addition of the keywords field terms; this resulted in a 0.17% higher retrieval.

For WoS, the new filter was compared with the filter used by Rehn et al.,¹² which is based on a translation of the SYRCLE filters. The new animal filter retrieved 91.7% more hits compared with the translated filter. A possible explanation for this large difference is that Rehn’s filter is based on the SYRCLE PubMed Legacy filter, which includes fewer (TiAbKw) terms than the SYRCLE Embase filter.

Last, the new PsycINFO filter retrieved 5.69% more hits compared with the filter used by Rehn et al.¹²

Using a search strategy for binge eating that has been used in practice,¹² the new animal filters retrieved more references than the old ones; from 0.5% more for

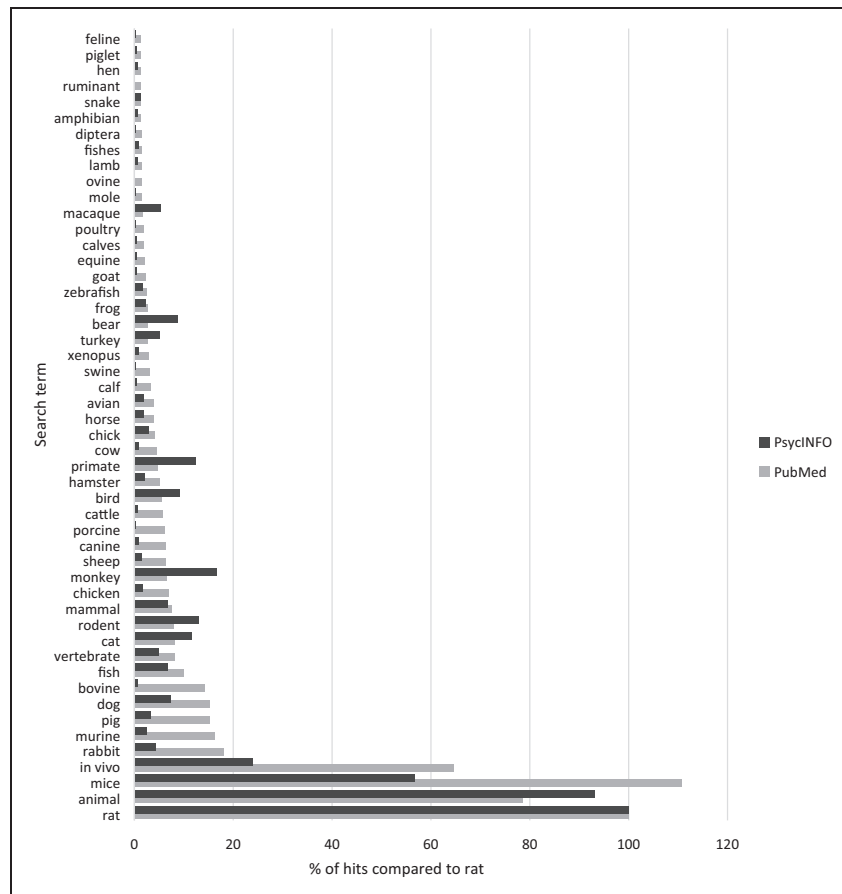


Figure 1. The number of hits retrieved for each search term as percentage compared with the search term “rat” in PubMed (light grey) and PsycINFO (black). For example, a percentage of 50 indicates that the term retrieves half the number of hits compared with “rat”. Rat was chosen as it is the animal that gives the most hits in PsycINFO.

PubMed to 47.8% for WoS. The results are presented in Table 4. The new references were randomly sampled and screened by one reviewer to see whether the new filters retrieved relevant references about binge eating in animal studies. The new filters retrieved relevant references; these additional references were mainly (systematic) reviews. It is common in systematic reviews to screen the reference lists of relevant reviews to find additional references; the increased retrieval of relevant reviews can thus benefit future systematic reviews.

How to use the filters

The filters can be found in the Supplementary material and at <https://osf.io/q6uxs/> online.

Using the filters starts with copying and pasting them into the search box of the selected database. For most databases, certain options must be selected to ensure correct working. These are provided with the search strings in the respective supplement.

Discussion and conclusions

In conclusion, the updated and new search filters have higher retrieval of animal studies compared with the databases’ own filters and the previous SYRCLE filters. In general, the previous SYRCLE filters focus more on retrieving all relevant references than on avoiding retrieving non-relevant references, and the databases’ own filters are mainly based on index terms. Using our updated and newly developed filters reduces the chance of missing potentially relevant papers when performing a systematic review in the field of animal sciences.

The new Psycnet PsycInfo filter does not contain as many terms as the other filters because psycnet.apa.org could not execute the whole query completely. Based on our comparison between PubMed and PsycINFO we do not expect to miss many relevant articles in PsycINFO.

Due to the issues with executing the whole query, we cannot rule out the risk of missing potentially relevant

Table 4. Comparison of relative retrieval between the new animal filter and the previous SYRACLE filters on their own and in combination with a search strategy for binge eating.

PubMed Search	Embase.com			Web of Science			APA PsycINFO via PsycNet		
	Hits	%	Search	Hits	%	Search	Hits	%	Search
New animal filter	7,238,869	100.84	New animal filter	8,503,795	108.09	New animal filter	8,717,479	191.70	New filter
SYRACLE PubMed	7,178,636	100	SYRACLE Embase (:ti,ab)	7,867,196	100	Rehn filter	4,547,464	100	Rehn filter (adapted from Ovid to Apa. psycinfo.net)
Animals [MeSH Terms: noexp]	6,704,929	93.40	SYRACLE Embase (:ti,ab,kw)	7,880,568	100.17				
Binge eating	20,072		Binge eating	25,389		Binge eating	13,058		Binge eating
Binge eating + new animal filter	3686	100.52	Binge eating + new animal filter	6523	102.02	Binge eating + new animal filter	2615	147.08	Binge eating + new animal filter
Binge eating + SYRACLE PubMed	3667	100	Binge eating + SYRACLE Embase (:ti,ab)	6394	100	Binge eating + Rehn filter	1778	100	Binge eating + adapted Rehn filter
Binge eating + animals [MeSH Terms: noexp]	3131	85.38	Binge eating + SYRACLE Embase (:ti,ab, kw)	6398	100.06				

papers with the new psycnet.apa.org filter. Fortunately, multiple databases are often searched in systematic reviews, and we strongly advise that this continues when searching on psycnet.apa.org.

When using the filters, it is important to note that only laboratory animals as defined in the EU directive 2010/63 are included. In other words, all non-human vertebrates and cephalopods are included in our filters, but other commonly used animals such as *Drosophila* or *Caenorhabditis elegans* are not. If authors are interested in these species, these terms should be added when using the filters. The current filters are thus not recommended for use in systematic reviews on, for example, more ecological or agricultural topics, or for fields where laboratory studies comprise substantial work in animal species that are not part of the EU directive.

We would discourage using this animal filter as an exclusionary filter, that is, adding the animal filter using a “NOT” Boolean operator to your search to remove animal studies. There is a risk that relevant articles will be excluded, for example, if an article about humans mentions previous pre-clinical studies or jargon matches the name of an animal (CAT-scan, for example).

It is also unlikely that the search filters have a 100% sensitivity (i.e. find all references on laboratory animals that are in the database). References can be missed for several reasons: authors not mentioning species name in the title, abstract, or keywords, misspellings and the use of (uncommon) synonyms. It is impossible to create a search filter which accommodates for all these factors; a larger filter increases the chance that a database cannot successfully execute the search.

Ideally, we would have performed a more extensive validity test where we would test the filters on an exhaustive set of references to see whether any animal studies are missed. However, for a proper validity test, all references from the databases, also the ones not retrieved by our filters, would need to be screened to see what the filters missed. This was not viable within our resources.

In summary, the laboratory animal filters presented in this paper will ease the search and screening process for systematic reviews of animal studies and will also benefit finding all potentially relevant papers.

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Data availability

The data for the comparison of the different filters and comparing ranking of terms between PubMed and PsycINFO is

available on <https://osf.io/q6uxs/>. The data for the term frequency analysis in PubMed is available upon reasonable request.

Declaration of conflicting interests

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Science des animaux de laboratoire et filtre de recherche Psyclnfo pour différentes bases de données portant sur la documentation; PubMed, Embase, Web

Résumé

Les études systématiques représentent des outils importants dans le domaine de la recherche animale, mais le nombre toujours croissant d'études rend difficile l'identification de l'ensemble des publications pertinentes. Les filtres de recherche permettent d'identifier autant de documents portant sur la recherche animale que possible. Dans cet article, nous proposons des versions mises à jour et élargies des filtres de recherche animale SYRCLE pour PubMed et Embase. Nous fournissons le filtre Embase pour Embase.com et via Ovid. Nous proposons par ailleurs de nouveaux filtres de recherche animale pour Web of Science (WoS) et APA PsyclnFO via psycnet.apa.org et via Ovid. Par rapport aux versions précédentes, les nouveaux filtres ont identifié entre 0,5% et 47,1% (19 références pour PubMed, 837 pour WoS) plus de références dans le cadre d'un exemple concret. L'ensemble des filtres ont identifié des références supplémentaires, comprenant plusieurs études pertinentes. Un échantillon aléatoire de WoS a identifié au moins une étude primaire potentiellement pertinente. Ces filtres de recherche animale facilitent l'identification d'autant d'études animales que possible, tout en minimisant le nombre d'études non liées à la recherche animale.

Labortiere in Web of Science und PsycInfo: Suchfilter für unterschiedliche Literaturdatenbanken; PubMed, Embase, Web

Abstract

Systematische Überprüfungen sind wichtige Instrumente in Tierstudien. Dennoch macht die stetig zunehmende Zahl dieser Studien das Auffinden aller relevanten Veröffentlichungen zu einer Herausforderung. Suchfilter helfen dabei, so viele Tierstudien wie möglich zu finden. In dieser Abhandlung stellen wir aktualisierte und erweiterte Versionen der SYCRE-Tierfilter für PubMed und Embase sowie einen Embase-Filter sowohl für Embase.com als auch für Ovid bereit. Darüber hinaus bieten wir neue Suchfilter für Web of Science (WoS) und APA PsycInfo über psycnet.apa.org und Ovid an. Im Vergleich zu früheren Versionen konnten mit den neuen Filtern in einem Praxisbeispiel 0,5% bis 47,1% mehr Referenzen abgerufen werden (19 Referenzen für PubMed, 837 für WoS). Alle Filter fanden zusätzliche Referenzen, die mehrere relevante Überarbeitungen umfassen. In einem zufälligen Beispiel wurde in WoS mindestens eine potenziell relevante Primärstudie gefunden. Diese Suchfilter für Labortiere ermöglichen es, so viele Tierstudien wie möglich zu identifizieren und gleichzeitig die Zahl der Nicht-Tierstudien in den Suchergebnissen auf ein Mindestmaß zu reduzieren.

Filtros de búsqueda para animales de laboratorio en distintas bases de datos bibliográficas: PubMed, Embase, Web of Science y PsycINFO

Resumen

Si bien las revisiones sistemáticas son herramientas importantes en investigación animal, la cantidad cada vez mayor de estudios dificulta la identificación de todas las publicaciones relevantes. Los filtros de búsqueda ayudan a localizar el mayor número posible de estudios en animales. En este artículo, ofrecemos versiones actualizadas y ampliadas de los filtros para estudios en animales de SYRCLE en PubMed y Embase. Incluimos el filtro de Embase tanto para la búsqueda en Embase.com como a través de Ovid. Además, proporcionamos nuevos filtros de búsqueda para estudios en animales de Web of Science (WoS) y APA PsycINFO a través de psycnet.apa.org y Ovid. En comparación con las versiones anteriores, estos nuevos filtros identificaron entre un 0,5% y un 47,1% (19 referencias en PubMed y 837 en WoS) más de referencias con un ejemplo real. Todos los filtros detectaron referencias adicionales, incluidas diversas revisiones relevantes. Una muestra aleatoria en WoS halló al menos un estudio primario potencialmente relevante. Estos filtros de búsqueda para estudios en animales facilitan la identificación del mayor número posible de ellos, al tiempo que reducen los resultados de estudios no efectuados en animales.