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## Protocol for Developing a Database of Zoonotic Disease Research in India (DoZooRI)

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# Protocol for Developing a Database of Zoonotic Disease Research in India (DoZooRI)

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## Abstract

**Introduction:** Zoonotic and emerging infectious diseases represent a public health threat that has been acknowledged only recently although they have been on the rise for the past several decades. On an average, every year since the second world war, one pathogen has emerged or re-emerged on a global scale. Developing countries like India bear a significant burden of zoonotic and emerging infectious diseases. We propose that the creation of a database of published, peer-

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3 reviewed research will open up avenues for evidence-based policymaking for targeted prevention  
4 and control of zoonoses.  
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7 **Methods and Analysis:** A large scale systematic mapping of the published peer-reviewed  
8 research conducted in India will be conducted. All published research will be included in the  
9 database, without any prejudice for quality screening, to broaden the scope of included studies.  
10 Structured search strategies will be developed for priority zoonotic diseases (leptospirosis,  
11 rabies, anthrax, brucellosis, cysticercosis, salmonellosis, bovine tuberculosis, Japanese  
12 encephalitis, and rickettsial infections), and multiple databases will be searched for studies  
13 conducted in India. The database will be managed and hosted on a cloud-based platform called  
14 Rayyan. Individual studies will be tagged based on key pre-identified parameters (disease, study  
15 design, study type, location, randomization status and interventions, as applicable)  
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19 **Ethics and Dissemination:** The database will incorporate already-published studies, obviating  
20 the need for special ethical clearances. The database will be made available online, and in  
21 collaboration with multisectoral teams, domains of enquiries will be identified, and subsequent  
22 research questions raised. The database will be queried for these and resulting evidence will be  
23 analysed and published in peer-reviewed journals.  
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33 **Keywords:** zoonoses, database, one health, emerging infections  
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## 39 STRENGTHS AND LIMITATIONS

- 40 • The strength of this approach is that in the absence of rigorous surveillance programs and  
41 methods to track zoonotic diseases, this approach provides an alternate method to  
42 develop a continuously updated database to query zoonotic diseases and their  
43 determinants.  
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- 45 • The main limitation of the approach is that it is largely dependent on published data,  
46 which may be of heterogenous quality, and could also result in duplicate entries.  
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## 55 INTRODUCTION

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3 Zoonoses, diseases that are naturally transmitted between humans and other vertebrate animals  
4 have been recognised since the beginning of history, but their public health importance has  
5 gained increased visibility in the last few decades [1]. A global analyses of emerging infectious  
6 disease (EID) between 1940 to 2004 identified that 60.3% of them were zoonosis and they were  
7 increasing rapidly over time [2]. A substantial portion of the global burden of endemic zoonosis  
8 is from India and it is predicted to be one of the several 'EID hotspots' [3,4]. India is  
9 experiencing rapid urbanisation, industrialisation, increased incomes, changing food preferences  
10 raising demand for animal source proteins, leading to a larger section of the workforce being in  
11 close contact with livestock, including poultry, making a wider section of the population  
12 extremely susceptible to zoonotic diseases. Owing to the public health importance of zoonotic  
13 diseases in India a National Standing Committee on Zoonoses was formed in 2007 [5,6]. Lately a  
14 Centre for Zoonoses Research has been proposed to be set up to harness inter-sectoral  
15 collaborative research in line with the One Health approach which is required to tackle zoonotic  
16 diseases [7]. However not much is known about the status of zoonotic disease research and  
17 several key aspects related to it including several aspects of clinical presentation, diagnoses,  
18 management and epidemiology in the Indian context [8]. There is also a need to synthesise  
19 evidence about zoonoses in India to guide further research, set research and public health  
20 priorities and streamline disease control efforts in an evidence informed manner [9,10]. This  
21 paper reports the protocol for development of a Database of Zoonotic Disease Research in India  
22 (DoZooRI) which intends to address these gaps.  
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#### 40 **Rationale for Development of Database of Zoonotic Diseases Research in India:**

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44 We envision DoZooRI as a multidisciplinary research database which would embed all zoonoses  
45 related research in India. DoZooRI will be made accessible to clinicians, veterinarians,  
46 researchers, public health professionals, programme managers and policy makers on request.  
47 Citations within the research database would be tagged on several carefully chosen key  
48 parameters that would enable rapid retrieval of relevant research from a wide variety of sources  
49 to those who seek evidence. This would provide critical evidence support for clinical or public  
50 health practice, evidence syntheses or plan future research in line with research gaps. This is  
51 essential in the context of India, where access to electronic databases as well as trained health  
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3 information specialists with capability to develop search strategies is severely limited [11].  
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5 DoZooRI will also address concerns about wasteful research waste, owing to new research not  
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7 being based on pre-existing research and without their need being vindicated by existing  
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9 systematic reviews demonstrating critical knowledge gaps [12,13]. Mapping zoonotic disease  
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11 research and conduct of further evidence syntheses through the DoZooRI will facilitate better  
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13 understanding of knowledge gaps which is critical for disease control efforts, policy making,  
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15 public health planning and inform public health and research priorities. Further, the database will  
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17 enable us to undertake analyses to identify research capacity across institutions in India.

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19 DoZooRI is being developed as a strategic tool to support various activities of India Research  
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21 Initiative on Peri-Urban Human-Animal-Environment Interface, which is housed at the Public  
22  
23 Health Foundation of India, and aims to conduct and support multidisciplinary research, build  
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25 workforce capacity across sectors, and conduct evidence syntheses and policy advocacy.

### 26 27 28 **Implications and Possible Collaborations**

29  
30 The creation of a database of zoonotic disease research in India presents an innovative approach  
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32 to systematic evidence synthesis. It should encourage researchers to collaborate, help to identify  
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34 and dissolve the compartments which have restricted research efforts to sectoral silos, and  
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36 encourage truly transdisciplinary collaborations to flourish [14–16]. Using the database,  
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38 researchers can map zoonotic diseases research; describe the characteristics of interventional  
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40 research on zoonotic diseases in India; describe the epidemiology of zoonotic diseases, including  
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42 differences by location, geographic terrain, or other determinants; identify the research-policy  
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44 disconnect and inform on realignment of research priorities in zoonotic disease prevention and  
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46 control in India; understand institutional capacity to conduct zoonotic research in India; and  
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48 address any other issues based on the extended tagging system. The database could potentially be  
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50 developed into a dynamic repository of the body of work being done in India with respect to  
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52 zoonotic diseases. Further, if collaborations with techno-medical entrepreneurs can be leveraged,  
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54 this can be developed into a platform which is updated in real time and allows auto-tagging of  
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56 published research for the purpose of evidence syntheses.  
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3 The database is going to provide a step towards closing the evidence-policy gap in zoonotic  
4 disease prevention and control programmes by providing the policy makers, programme  
5 managers or any other stakeholders access to a searchable, tagged database of existing evidence.  
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7 This opens avenues for data mining and conducting multiple rapid reviews or systematic reviews  
8 to assess the state of the published evidence. The process will bring together the tenets of open  
9 science and evidence based policymaking to strengthen the clinical, veterinarian and public  
10 health response to zoonotic disease prevention and control.  
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### 20 **Objective**

21 To develop a database of zoonotic diseases research in India which is appropriately tagged to  
22 facilitate the further conduct of evidence syntheses and landscaping of zoonotic disease research  
23 in India.  
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### 28 **METHODS AND ANALYSES**

29 A large scale systematic mapping of important zoonotic disease research in India will be  
30 conducted. Systematic mapping covers a broad body of literature without a narrowly defined  
31 research question as is done in a systematic review and is ideal for the research objective[17–21].  
32 No quality assessment is done unlike a systematic review but all research on zoonotic diseases is  
33 described based on pre-set characteristics as well as other characteristics identified iteratively as  
34 the mapping progresses. The database can however serve as a tool for conducting systematic  
35 reviews and rapid reviews on focussed research questions on zoonotic disease in India.  
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### 44 **Criteria for inclusion of studies in the database**

#### 45 *Definition of zoonotic diseases for the database*

46 We will include research on the following nine priority zoonotic diseases from India, as defined  
47 by the study authors [22]:  
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- 51 1. Leptospirosis
- 52 2. Rabies
- 53 3. Anthrax
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4. Brucellosis
5. Cysticercosis
6. Salmonellosis
7. Bovine tuberculosis
8. Japanese Encephalitis
9. Rickettsia Infections

We will not include research which has been conducted on participants of Indian origin living abroad or on those who have travelled from India to foreign countries.

Multi-centric studies containing Indian participants or samples and systematic reviews including at least one study which meets the population criteria will be included in the database. For studies conducted before 1947 and where it is not possible to differentiate it with results from post-1947 boundaries by reading the full text of the articles, the boundaries of undivided British India will be considered.

#### *Study Design*

We will include research using any kind of study design except commentaries, editorials, news item, historical articles, meeting notes and narrative reviews. This includes, but is not limited to animal studies, observational studies, experimental studies, case reports or case series, outbreak investigation, systematic reviews, practice guidelines and qualitative research.

#### *Time limits*

We will include research articles irrespective of their year of publication.

#### *Language Restriction*

We will include only articles published in English in the database. Exclusion of non-English studies introduces a very small risk of publication bias since English is the dominant language for health research in India.

#### *Publication Status*



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3 We will include all articles irrespective of publication status **Search strategy for electronic**  
4 **databases**  
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9 Since the database intends to identify all zoonotic disease research in India, a sensitive search  
10 strategy was designed in PubMed using relevant free text key words and MeSH heading  
11 (Appendix 1). The search strategy was designed iteratively with the intention to achieve maximal  
12 sensitivity. This implies that we added additional free-text key words and MeSH headings when  
13 the search did not yield enough results. Additional free-text key words were developed by adding  
14 synonyms or alternative terms. We then adapted the search strategy for use in other electronic  
15 databases, namely CINAHL (EBSCO Host) (Appendix 2) and Global Health (EBSCO Host)  
16 (Appendix 3). Future versions of DoZooRI might include studies for more electronic databases  
17 and additional sources for grey literature. We envision that DoZooRI collaborators who conduct  
18 evidence syntheses by using the database, will add grey literature citations within the database  
19 through expert contact, reference checking of articles from the database, searching clinical trial  
20 registries and register of observational studies and registers for systematic reviews.  
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### 31 **Screening of articles**

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35 We will screen all citations retrieved independently by at least two researchers based on titles  
36 and abstracts (if available) and mark them as retrieve (eligible or unclear eligibility) or do not  
37 retrieve (not eligible). For all citations marked retrieve full texts will be acquired and final  
38 decision on eligibility will be taken independently by two researchers. In case of any  
39 discrepancies that are not resolved through discussion between the two reviewers (SB and PC),  
40 consensus will be achieved by consultation with a third expert researcher (MK). Reasons for  
41 exclusion at full-text phase will be documented.  
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### 49 **Data management**

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53 We will manage data and host the database in a cloud based platform called Rayyan  
54 (<http://rayyan.qcri.org/>). The platform allows simultaneous screening as well as tagging of  
55 citations in a blind fashion by multiple researchers. Rayyan also allows multiple tagging of each  
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3 citation. We chose Rayyan over other options because of its two-fold advantage – it is free to use  
4 and it has an inbuilt artificial platform where it provides prediction for includes and excludes  
5 based on the choices marked by researchers manually through a colour coded five-star system  
6 through text mining of the records. An independent evaluation of Rayyan found that after  
7 screening of three-quarters of included citations 98% of articles included were correctly  
8 predicted [23]. This would be an essential tool to rapidly allow the DoZooRI administrators to  
9 screen and mark includes and excludes when new studies are added as and when the database is  
10 updated from time to time. Rayyan also detects duplicates automatically.  
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### 19 **Database tagging**

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22 We will develop a tagging system iteratively for several key parameters which would enable  
23 users to rapidly identify and retrieve articles to answer research, policy or clinical questions of  
24 their interest. Tagging will be done independently by at least two researchers (SB and PC) and  
25 discrepancies will be solved through consensus decision within the research team. We have  
26 predetermined tags for the following key parameters:  
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- 31 • Name(s) of zoonotic disease – from amongst the nine priority zoonotic disease
- 32 • Study Design – classification as per standard terminologies (example: case report or case-  
33 series, case-control, cohort, cross-sectional, retrospective study, ecologic study, clinical  
34 trial, systematic review, qualitative research, in-vitro studies)
- 35 • Special study type tags- example, GENE for genetic or genomic studies, EPIDEM for a  
36 study on any aspect of epidemiology, OUTBREAK for a study on any aspect of disease  
37 outbreak, DIAG for a study on diagnostic modality for a zoonotic disease, ECONOM on  
38 health economics related studies.
- 39 • For epidemiological studies- Name of state(s) from India where the study was conducted
- 40 • For clinical trials- randomisation status, name of intervention.
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### 50 **ETHICS AND DISSEMINATION**

We prepared DoZooRI from already conducted research publications and did not involve any animal or human subjects. As such there are no ethical issues involved in the creation of the database or its subsequent use for evidence syntheses.

Findings from any research done by using DoZooRI will be published in peer-reviewed journals. The results of any such research on the database will also be shared with key stakeholders, including health professionals, researchers and policy makers in the form of policy briefs.

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## Foot notes

- **Contributors** MK and PC conceptualized the article; SB and ASC were responsible for developing the initial methods; PC and SB refined the methodology and pilot tested it using a limited exercise; PC and SB drew up the first draft of the manuscript. PC and SB contributed equally to the manuscript. All the authors contributed in the development and drafting of the manuscript, including reviews and intellectual inputs in the process. All the authors have reviewed and approved the final version of the manuscript, which has been submitted to the journal.

**Competing interests** The authors declare that they have no conflicts of interest.

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## Appendix 1: Search Strategy for PubMed

### Anthrax

#	Searches	
#1	"Anthrax"[Mesh] OR "Anthrax Vaccines"[Mesh] OR anthrax OR (bacillus anthracis)	
#2	India[Mesh] OR India	
#3	#1 AND #2	

### Brucellosis

#	Searches	

#1	brucell* OR (Malta Fever) OR (undulant fever) or brucellosis[mesh]	
#2	India[Mesh] OR India	
#3	#1 AND #2	

## Bovine TB

#	Searches	
#1	(((bovine or zoono*) AND (tuberculosis OR "tuberculosis"[MeSH]) ) OR "mycobacterium bovis")	
#2	India[Mesh] OR India	
#3	#1 AND #2	

## Rabies

#	Searches	
#1	Rabies [MeSH] OR Rabies Vaccines [Mesh] OR rabies OR rabid	
#2	India[Mesh] OR India	
#3	#1 AND #2	

## Cysticercosis

#	Searches	
#1	cysticercosis[MeSH] OR cysticerc* OR neurocysticer* OR taeni* OR tapeworm	
#2	India[Mesh] OR India	
#3	#1 AND #2	

## Leptospirosis

#	Searches	
#1	Leptospirosis[Mesh] OR Leptospira[Mesh] OR leptospir* OR (weil* disease) OR infectious icterus OR canicola OR mud fever OR field fever OR (rat catcher* adj yellow*) OR pretibial fever OR grippotyphosa or icteroh* OR (spirochaet* jaundice) OR (spirochete* jaundice)	
#2	India[Mesh] OR India	
#3	#1 AND #2	

### Salmonellosis

#	Searches	
#1	"Salmonella Infections"[Mesh] OR "Salmonella Food Poisoning"[Mesh] OR "Salmonella Vaccines"[Mesh] OR "Salmonella typhi"[Mesh] OR typhoid OR "typhoid fever" OR "enteric fever" OR "Salmonella typhi" OR "Salmonella enterica" OR paratyphoid OR paratyphi	
#2	India[Mesh] OR India	
#3	#1 AND #2	

### Japanese Encephalitis

#	Searches	
#1	"Encephalitis, Japanese"[Mesh] OR " Japanese encephalitis" OR JBE	
#2	India[Mesh] OR India	
#3	#1 AND #2	

### Rickettsia Infections

#	Searches	

#1	"Rickettsia Infections"[Mesh] OR "Typhus, Epidemic Louse-Borne"[Mesh] OR "Typhus, Epidemic Louse-Borne"[Mesh] OR "Rocky Mountain Spotted Fever"[Mesh] OR "Boutonneuse Fever"[Mesh] OR typhus OR "rickettsial pox" OR "trench fever" OR "Q fever" OR "rocky mountain spotted fever"	
#2	India[Mesh] OR India	
#3	#1 AND #2	

## Appendix 2: Search Strategy for CINAHL

### Leptosiprosis

#	Searches	
#1	(MM "Leptospirosis") OR leptospir* OR (weil* disease) OR infectious icterus OR canicola OR mud fever OR field fever OR (rat catcher* adj yellow*) OR pretibial fever OR grippotyphosa or icteroh* OR (spirochaet* jaundice) OR (spirochete* jaundice)	
#2	(MH "India") OR India	
#3	#1 AND #2	

### Rabies

#	Searches	
#1	(MM "Rabies Vaccine") OR (MM "Rabies") OR rabies OR rabid	
#2	(MH "India") OR India	
#3	#1 AND #2	

### Anthrax

#	Searches	



#1	(MM "Anthrax+") OR (MM "Anthrax Vaccines") OR anthrax OR (bacillus anthracis)	
#2	(MH "India") OR India	
#3	#1 AND #2	

### Brucellosis

#	Searches	
#1	(MM "Brucellosis") OR brucell* OR (Malta Fever) OR (undulant fever)	
#2	(MH "India") OR India	
#3	#1 AND #2	

### Cysticercosis

#	Searches	
#1	(MM "Cysticercosis") OR cysticerc* OR neurocysticer* OR taeni* OR tapeworm	
#2	(MH "India") OR India	
#3	#1 AND #2	

### Salmonellosis

#	Searches	
#1	(MM "Salmonella") OR (MM "Salmonella Vaccines+") OR (MM "Salmonella Infections+") OR (MM "Paratyphoid Fever") OR typhoid OR "typhoid fever" OR "enteric fever" OR "Salmonella typhi" OR "Salmonella enterica" OR paratyphoid OR paratyphi	
#2	(MH "India") OR India	
#3	#1 AND #2	

### Bovine TB

#	Searches	
#1	((bovine or zoono*) AND (tuberculosis OR MH "tuberculosis")) OR	

	"mycobacterium bovis")	
#2	(MH "India") OR India	
#3	#1 AND #2	

### Japanese Encephalitis

#	Searches	
#1	(MM "Encephalitis Viruses, Japanese+") OR (MM "Japanese Encephalitis Vaccines") OR " Japanese encephalitis" OR JBE	
#2	(MH "India") OR India	
#3	#1 AND #2	

### Rickettsial Infections

#	Searches	
#1	(MM "Rickettsial Infections+") OR (MM "Rocky Mountain Spotted Fever") OR (MM "Typhus") OR typhus OR "rickettsial pox" OR "trench fever" OR "Q fever" OR "rocky mountain spotted fever"	
#2	(MH "India") OR India	
#3	#1 AND #2	

## Appendix 3: Search Strategy for Global Health

### Leptospirosis

#	Searches	
#1	(DE "leptospirosis" OR DE "Leptospira" ) OR leptospir* OR (weil* disease) OR infectious icterus OR canicola OR mud fever OR field fever OR (rat catcher* adj	

	yellow*) OR pretibial fever OR grippotyphosa or icteroh* OR (spirochaet* jaundice) OR (spirochete* jaundice)	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

### Rabies

#	Searches	
#1	DE "rabies" OR rabies OR rabid	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	

#3	#1 AND #2	
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## Anthrax

#	Searches	
#1	DE "anthrax" OR DE "cutaneous anthrax" OR DE "inhalational anthrax" OR anthrax OR "anthrax bacillus"	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

## Brucellosis

#	Searches	
#1	DE "brucellosis" OR DE "Brucella" OR brucell* OR (Malta Fever) OR (undulant fever)	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE	

	"Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

## Cysticercosis

#	Searches	
#1	DE "cysticercosis" OR DE "neurocysticercosis" OR cysticerc* OR neurocysticer* OR taeni* OR tapeworm	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

## Salmonellosis

#	Searches	
#1	DE "typhoid" OR DE "salmonellosis" OR DE "enteric fevers" OR DE "paratyphoid" OR typhoid OR "enteric fever" OR paratyphityphoid OR	

	paratyphoid	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

## Bovine TB

#	Searches	
#1	(( (bovine or zoono*) AND (tuberculosis OR DE "tuberculosis") ) OR "mycobacterium bovis")	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	

#3	#1 AND #2	
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## Japanese Encephalitis

#	Searches	
#1	DE "Japanese encephalitis" OR " Japanese encephalitis" OR JBE	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

## Rickettsial Infections

#	Searches	
#1	DE "rickettsial diseases" OR DE "ehrlichioses" OR DE "neorickettsioses" OR DE "African tick bite fever" OR DE "Q fever" OR DE "spotted fever" OR DE "anaplasmoses" OR DE "typhus fevers" OR DE "Q fever" OR DE "spotted fever" OR DE "Mediterranean spotted fever" OR DE "Rocky Mountain spotted fever" OR DE "typhus fevers" OR DE "louse-borne typhus" OR DE "murine typhus" OR DE "scrub typhus" OR typhus OR "rickettsial pox" OR "trench fever" OR "Q fever" OR "rocky mountain spotted fever"	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR	

	DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	



# BMJ Open

## Protocol for Developing a Database of Zoonotic Disease Research in India (DoZooRI)

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# Protocol for Developing a Database of Zoonotic Disease Research in India (DoZooRI)

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## Abstract

**Introduction:** Zoonotic and emerging infectious diseases represent a public health threat that has been acknowledged only recently although they have been on the rise for the past several decades. On an average, every year since the second world war, one pathogen has emerged or re-emerged on a global scale. Developing countries such as India bear a significant burden of

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3 27 zoonotic and emerging infectious diseases. We propose that the creation of a database of  
4  
5 28 published, peer-reviewed research will open up avenues for evidence-based policymaking for  
6  
7 29 targeted prevention and control of zoonoses.

8  
9 30 **Methods and Analysis:** A large scale systematic mapping of the published peer-reviewed  
10  
11 31 research conducted in India will be conducted. All published research will be included in the  
12  
13 32 database, without any prejudice for quality screening, to broaden the scope of included studies.  
14  
15 33 Structured search strategies will be developed for priority zoonotic diseases (leptospirosis,  
16  
17 34 rabies, anthrax, brucellosis, cysticercosis, salmonellosis, bovine tuberculosis, Japanese  
18  
19 35 encephalitis, and rickettsial infections), and multiple databases will be searched for studies  
20  
21 36 conducted in India. The database will be managed and hosted on a cloud-based platform called  
22  
23 37 Rayyan. Individual studies will be tagged based on key pre-identified parameters (disease, study  
24  
25 38 design, study type, location, randomization status and interventions, host involvement, and others  
26  
27 39 as applicable)

28  
29 40 **Ethics and Dissemination:** The database will incorporate already-published studies, obviating  
30  
31 41 the need for special ethical clearances. The database will be made available online, and in  
32  
33 42 collaboration with multisectoral teams, domains of enquiries will be identified, and subsequent  
34  
35 43 research questions raised. The database will be queried for these and resulting evidence will be  
36  
37 44 analysed and published in peer-reviewed journals.

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39 45  
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41 46 **Keywords:** zoonoses, database, one health, emerging infections, evidence synthesis, protocol  
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## 49 **STRENGTHS AND LIMITATIONS**

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- The strength of this approach is that in the absence of rigorous surveillance programs and methods to track zoonotic diseases, this approach provides an alternate method to develop a continuously updated database to query zoonotic diseases and their determinants.
  - The main limitation of the approach is that it is largely dependent on published data, which may be of heterogeneous quality, and could also result in duplicate entries. However, we envisage that the issue of publication bias might be resolved to a large extent in future iterations of the database as collaborators would contribute by adding

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2  
3 58 more citations from the literature to make it a more comprehensive repository of zoonotic  
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5 59 disease research in India.  
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## 10 62 **INTRODUCTION**

11 63 Zoonoses, diseases and infections that are naturally transmitted between humans and other  
12 64 vertebrate animals have been recognised since the beginning of history, but their public health  
13 65 importance has gained increased visibility in the last few decades [1]. A global analyses of  
14 66 emerging infectious disease (EID) between 1940 to 2004 identified that 60.3% of them were  
15 67 zoonosis and they were increasing rapidly over time [2]. A substantial portion of the global  
16 68 burden of endemic zoonosis is from India and it is predicted to be one of the several 'EID  
17 69 hotspots' [3,4]. India is experiencing rapid urbanisation, industrialisation, increased incomes,  
18 70 changing food preferences raising demand for animal source proteins, leading to a larger section  
19 71 of the workforce being in close contact with livestock, including poultry, making a wider section  
20 72 of the population extremely susceptible to zoonotic diseases. Owing to the public health  
21 73 importance of zoonotic diseases in India a National Standing Committee on Zoonoses was  
22 74 formed in 2007 [5,6]. Lately a Centre for Zoonoses Research has been proposed to be set up to  
23 75 harness inter-sectoral collaborative research in line with the One Health approach which is  
24 76 required to tackle zoonotic diseases [7]. However not much is known about the status of zoonotic  
25 77 disease research and several key aspects related to it including several aspects of clinical  
26 78 presentation, diagnoses, management and epidemiology in the Indian context [8]. There is also a  
27 79 need to synthesise evidence about zoonoses in India to guide further research, set research and  
28 80 public health priorities, and streamline disease control efforts in an evidence informed manner  
29 81 [9,10]. Further, given the resource restrictions and multiple competing priorities that need to be  
30 82 addressed by policymakers and funders alike, the synthesised evidence could help in making  
31 83 evidence informed decisions to guide resource allocation. This paper reports the protocol for  
32 84 development of a Database of Zoonotic Disease Research in India (DoZooRI) which intends to  
33 85 address these gaps.  
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## 55 87 **Rationale for Development of Database of Zoonotic Diseases Research in India:**

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3 89 We envision DoZooRI as a multidisciplinary research database which would embed all zoonoses  
4 related research in India. DoZooRI will be made accessible to clinicians, veterinarians,  
5 90 researchers, public health professionals, programme managers and policy makers on request.  
6  
7 91 Citations within the research database would be tagged on several carefully chosen key  
8  
9 92 parameters that would enable rapid retrieval of relevant research from a wide variety of sources  
10  
11 93 to those who seek evidence. This would provide critical support for clinical or public health  
12  
13 94 practice, including, but not limited to the fields of human, veterinary and environmental health,  
14  
15 95 by facilitating evidence syntheses or planning of future research in line with research gaps. The  
16  
17 96 multidisciplinary nature of the database in fact provides and impetus for this purpose. This is  
18  
19 97 essential in the context of India, where access to electronic databases as well as trained health  
20  
21 98 information specialists with capability to develop search strategies is severely limited [11].  
22  
23 100 DoZooRI will also address concerns about wasteful research, owing to new research not being  
24  
25 101 based on pre-existing evidence and without their need being vindicated by existing systematic  
26  
27 102 reviews demonstrating critical knowledge gaps [12,13]. Mapping zoonotic disease research and  
28  
29 103 conduct of further evidence syntheses through the DoZooRI will facilitate better understanding  
30  
31 104 of knowledge gaps which is critical for disease control efforts, policy making, public health  
32  
33 105 planning and inform public health and research priorities. Further, the database will enable us to  
34  
35 106 undertake analyses to identify research capacity across institutions in India.

36  
37 108 DoZooRI is being developed as a strategic tool to support various activities of India Research  
38  
39 109 Initiative on Peri-Urban Human-Animal-Environment Interface, which is housed at the Public  
40  
41 110 Health Foundation of India, and aims to conduct and support multidisciplinary research, build  
42  
43 111 workforce capacity across sectors, and conduct evidence syntheses and policy advocacy.

### 44 112

### 46 113 **Implications and Possible Collaborations**

47 114 The creation of a database of zoonotic disease research in India presents an innovative approach  
48  
49 115 to systematic evidence synthesis. It should encourage researchers to collaborate, help to identify  
50  
51 116 and dissolve the compartments which have restricted research efforts to sectoral silos, and  
52  
53 117 encourage truly transdisciplinary collaborations to flourish [14–16]. Using the database,  
54  
55 118 researchers can map zoonotic diseases research; describe the characteristics of interventional  
56  
57 119 research on zoonotic diseases in India; describe the epidemiology of zoonotic diseases, including

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2  
3 120 differences by location, geographic terrain, or other determinants; identify the research-policy  
4  
5 121 disconnect and inform on realignment of research priorities in zoonotic disease prevention and  
6  
7 122 control in India; understand institutional capacity to conduct zoonotic research in India; and  
8  
9 123 address any other issues based on the extended tagging system. The database could potentially be  
10  
11 124 developed into a dynamic repository of the body of work being done in India with respect to  
12  
13 125 zoonotic diseases. Further, if collaborations with techno-medical entrepreneurs can be leveraged,  
14  
15 126 this can be developed into a platform which is updated in real time and allows auto-tagging of  
16  
17 127 published research for the purpose of evidence syntheses. Additionally, this protocol for the  
18  
19 128 development of the database should be of interest to professionals involved with human, animal  
20  
21 129 and environmental health alike. This manuscript outlines the development of a database that  
22  
23 130 proposes curating the first of its kind of evidence-base for zoonotic diseases in India. This is  
24  
25 131 likely to be interest to Indian and international scholars alike given the global health security  
26  
27 132 threat posed by zoonotic and emerging diseases.  
28  
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31 134

30 135 The database is going to provide a step towards closing the evidence-policy gap in zoonotic  
31  
32 136 disease prevention and control programmes by providing the policy makers, programme  
33  
34 137 managers or any other stakeholders access to a searchable, tagged database of existing evidence.  
35  
36 138 This opens avenues for data mining and conducting multiple rapid reviews or systematic reviews  
37  
38 139 to assess the state of the published evidence. The process will bring together the tenets of open  
39  
40 140 science and evidence based policymaking to strengthen the clinical, veterinarian and public  
41  
42 141 health response to zoonotic disease prevention and control.  
43  
44 142  
45 143

#### 46 144 **Objective**

47 145 To develop a database of publications resulting from research conducted on a set of priority  
48  
49 146 zoonotic diseases in India and tag them in a manner so as to facilitate further conduct of evidence  
50  
51 147 syntheses and landscaping of zoonotic disease research in India.  
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53 148

#### 55 149 **METHODS AND ANALYSES**

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2  
3 150 A large scale systematic mapping of important zoonotic disease research in India will be  
4  
5 151 conducted. Systematic mapping covers a broad body of literature without a narrowly defined  
6  
7 152 research question as is done in a systematic review and is ideal for the research objective[17–21].  
8  
9 153 No quality assessment is done unlike a systematic review but all research on zoonotic diseases is  
10  
11 154 described based on pre-set characteristics as well as other characteristics identified iteratively as  
12  
13 155 the mapping progresses. The database can however serve as a tool for conducting systematic  
14  
15 156 reviews and rapid reviews on focussed research questions on zoonotic disease in India.  
16

### 17 157

### 18 158 **Criteria for inclusion of studies in the database**

#### 19 159

#### 20 160 *Definition of zoonotic diseases for the database*

21 161 We will include research on the following nine priority zoonotic diseases from India, as defined  
22  
23 162 by the study authors [22]:

- 24 163 1. Leptospirosis
- 25 164 2. Rabies
- 26 165 3. Anthrax
- 27 166 4. Brucellosis
- 28 167 5. Cysticercosis
- 29 168 6. Salmonellosis
- 30 169 7. Bovine tuberculosis
- 31 170 8. Japanese Encephalitis
- 32 171 9. Rickettsia Infections

33 172

34 173 We will not include research which has been conducted on participants of Indian origin living  
35 174 abroad or on those who have travelled from India to foreign countries.  
36 175

37 176 Multi-centric studies containing Indian participants or samples and systematic reviews including  
38 177 at least one study which meets the population criteria will be included in the database. For  
39 178 studies conducted before 1947 and where it is not possible to differentiate it with results from  
40 179 post-1947 boundaries by reading the full text of the articles, the boundaries of undivided British  
41 180 India will be considered.  
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3 181  
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5 182 *Study Design*  
6  
7 183 We will include research using any kind of study design except commentaries, editorials, news  
8  
9 184 item, historical articles, meeting notes and narrative reviews. This includes, but is not limited to  
10  
11 185 animal studies, observational studies, experimental studies, case reports or case series, outbreak  
12  
13 186 investigation, systematic reviews, practice guidelines and qualitative research.  
14

15 187  
16 188 *Time limits*  
17  
18 189 We will include research articles irrespective of their year of publication.  
19

20 190  
21 191 *Language Restriction*  
22  
23 192 We will include only articles published in English in the database. Exclusion of non-English  
24  
25 193 studies introduces a very small risk of publication bias since English is the dominant language  
26  
27 194 for health research in India.  
28

29 195  
30 196 *Publication Status*  
31  
32 197 We will include all articles irrespective of publication status **Search strategy for electronic**  
33  
34 198 **databases**  
35

36 199  
37 200 Since the database intends to identify all zoonotic disease research in India, a sensitive search  
38  
39 201 strategy was designed in PubMed using relevant free text key words and MeSH heading  
40  
41 202 (Appendix 1). The search strategy was designed iteratively with the intention to achieve maximal  
42  
43 203 sensitivity. This implies that we added additional free-text key words and MeSH headings when  
44  
45 204 the search did not yield enough results. Additional free-text key words were developed by adding  
46  
47 205 synonyms or alternative terms. We then adapted the search strategy for use in other electronic  
48  
49 206 databases, namely CINAHL (EBSCO Host) (Appendix 2) and Global Health (EBSCO Host)  
50  
51 207 (Appendix 3). Future versions of DoZooRI might include studies for more electronic databases  
52  
53 208 and additional sources for grey literature. We envision that DoZooRI collaborators who conduct  
54  
55 209 evidence syntheses by using the database, will add grey literature citations within the database  
56  
57 210 through expert contact, reference checking of articles from the database, searching clinical trial  
58  
59 211 registries and register of observational studies and registers for systematic reviews.  
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5 213 **Screening of articles**6  
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9 215 We will screen all citations retrieved independently by at least two researchers based on titles  
10 216 and abstracts (if available) and mark them as retrieve (eligible or unclear eligibility) or do not  
11 217 retrieve (not eligible). For all citations marked retrieve full texts will be acquired and final  
12 218 decision on eligibility will be taken independently by two researchers. In case of any  
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14 219 discrepancies that are not resolved through discussion between the two reviewers (SB and PC),  
15 220 consensus will be achieved by consultation with a third expert researcher (MK). Reasons for  
16 221 exclusion at full-text phase will be documented.

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23 223 **Data management**24  
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26 225 We will manage data and host the database in a cloud based platform called Rayyan  
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28 226 (<http://rayyan.qcri.org/>). The platform allows simultaneous screening as well as tagging of  
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30 227 citations in a blind fashion by multiple researchers. Rayyan also allows multiple tagging of each  
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32 228 citation. We chose Rayyan over other options because of its two-fold advantage – it is free to use  
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34 229 and it has an inbuilt artificial platform where it provides prediction for includes and excludes  
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36 230 based on the choices marked by researchers manually through a colour coded five-star system  
37  
38 231 through text mining of the records. An independent evaluation of Rayyan found that after  
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40 232 screening of three-quarters of included citations 98% of articles included were correctly  
41  
42 233 predicted [23]. This would be an essential tool to rapidly allow the DoZooRI administrators to  
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44 234 screen and mark includes and excludes when new studies are added as and when the database is  
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46 235 updated from time to time. Rayyan also detects duplicates automatically.

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48 23649  
50 237 **Database tagging**51  
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53 239 We will develop a tagging system iteratively for several key parameters which would enable  
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55 240 users to rapidly identify and retrieve articles to answer research, policy or clinical questions of  
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57 241 their interest. Tagging will be done independently by at least two researchers (SB and PC) and

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3 242 discrepancies will be solved through consensus decision within the research team. We have  
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5 243 predetermined tags for the following key parameters:  
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7 244
- Name(s) of zoonotic disease – from amongst the nine priority zoonotic disease
  - Study Design – classification as per standard terminologies (example: case report or case-series, case-control, cohort, cross-sectional, retrospective study, ecologic study, clinical trial, systematic review, qualitative research, in-vitro studies)
  - Special study type tags- example, GENE for genetic or genomic studies, EPIDEM for a study on any aspect of epidemiology, OUTBREAK for a study on any aspect of disease outbreak, DIAG for a study on diagnostic modality for a zoonotic disease, ECONOM on health economics related studies.
  - For epidemiological studies- Name of state(s) from India where the study was conducted
  - For clinical trials- randomisation status, name of intervention.
  - Based on host involved: human, cattle, wild animals, multi-host, invertebrate vectors, etc.
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## 28 256 **ETHICS AND DISSEMINATION**

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31 258 We prepared DoZooRI from already conducted research publications and did not involve any  
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33 259 animal or human subjects. As such there are no ethical issues involved in the creation of the  
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35 260 database or its subsequent use for evidence syntheses.  
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39 262 Findings from any research done by using DoZooRI will be published in peer-reviewed journals.  
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41 263 The results of any such research on the database will also be shared with key stakeholders,  
42  
43 264 including health professionals, researchers and policy makers in the form of policy briefs.  
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## Foot notes

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55 331• Contributors MK and PC conceptualized the article; SB and ASC were responsible for developing the initial methods;  
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57 332 PC and SB refined the methodology and pilot tested it using a limited exercise; PC and SB drew up the first draft of  
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4 333 the manuscript. PC and SB contributed equally to the manuscript. All the authors contributed in the development and  
5 334 drafting of the manuscript, including reviews and intellectual inputs in the process. All the authors have reviewed and  
6  
7 335 approved the final version of the manuscript, which has been submitted to the journal.

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For peer review only

## 1 Appendix 1: Search Strategy for PubMed

### 2 Anthrax

#	Searches	
#1	"Anthrax"[Mesh] OR "Anthrax Vaccines"[Mesh] OR anthrax OR (bacillus anthracis)	
#2	India[Mesh] OR India	
#3	#1 AND #2	

### 4 Brucellosis

#	Searches	
#1	brucell* OR (Malta Fever) OR (undulant fever) or brucellosis[mesh]	
#2	India[Mesh] OR India	
#3	#1 AND #2	

### 7 Bovine TB

#	Searches	
#1	((bovine or zoono*) AND (tuberculosis OR "tuberculosis"[MeSH]) ) OR "mycobacterium bovis")	
#2	India[Mesh] OR India	
#3	#1 AND #2	

### 11 Rabies

#	Searches	
#1	Rabies [MeSH] OR Rabies Vaccines [Mesh] OR rabies OR rabid	
#2	India[Mesh] OR India	
#3	#1 AND #2	

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## Cysticercosis

#	Searches	
#1	cysticercosis[MeSH] OR cysticerc* OR neurocysticer* OR taeni* OR tapeworm	
#2	India[Mesh] OR India	
#3	#1 AND #2	

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## Leptospirosis

#	Searches	
#1	Leptospirosis[Mesh] OR Leptospira[Mesh] OR leptospir* OR (weil* disease) OR infectious icterus OR canicola OR mud fever OR field fever OR (rat catcher* adj yellow*) OR pretibial fever OR grippotyphosa or icteroh* OR (spirochaet* jaundice) OR (spirochete* jaundice)	
#2	India[Mesh] OR India	
#3	#1 AND #2	

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## Salmonellosis

#	Searches	
#1	"Salmonella Infections"[Mesh] OR "Salmonella Food Poisoning"[Mesh] OR "Salmonella Vaccines"[Mesh] OR "Salmonella typhi"[Mesh] OR typhoid OR "typhoid fever" OR "enteric fever" OR "Salmonella typhi" OR "Salmonella enterica" OR paratyphoid OR paratyphi	
#2	India[Mesh] OR India	
#3	#1 AND #2	

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## 26 Japanese Encephalitis

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#	Searches	
#1	"Encephalitis, Japanese"[Mesh] OR " Japanese encephalitis" OR JBE	
#2	India[Mesh] OR India	
#3	#1 AND #2	

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## 29 Rickettsia Infections

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#	Searches	
#1	"Rickettsia Infections"[Mesh] OR "Typhus, Epidemic Louse-Borne"[Mesh] OR "Typhus, Epidemic Louse-Borne"[Mesh] OR "Rocky Mountain Spotted Fever"[Mesh] OR "Boutonneuse Fever"[Mesh] OR typhus OR "rickettsial pox" OR "trench fever" OR "Q fever" OR "rocky mountain spotted fever"	
#2	India[Mesh] OR India	
#3	#1 AND #2	

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## 33 Appendix 2: Search Strategy for CINAHL

## 34 Leptosiprosis

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#	Searches	
#1	(MM "Leptospirosis") OR leptospir* OR (weil* disease) OR infectious icterus OR canicola OR mud fever OR field fever OR (rat catcher* adj yellow*) OR pretibial fever OR grippotyphosa or icteroh* OR (spirochaet* jaundice) OR (spirochete* jaundice)	
#2	(MH "India") OR India	
#3	#1 AND #2	

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## 38 Rabies

#	Searches	
#1	(MM "Rabies Vaccine") OR (MM "Rabies") OR rabies OR rabid	
#2	(MH "India") OR India	
#3	#1 AND #2	

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## 41 Anthrax

#	Searches	
#1	(MM "Anthrax+") OR (MM "Anthrax Vaccines") OR anthrax OR (bacillus anthracis)	
#2	(MH "India") OR India	
#3	#1 AND #2	

42

## 43 Brucellosis

#	Searches	
#1	(MM "Brucellosis") OR brucell* OR (Malta Fever) OR (undulant fever)	
#2	(MH "India") OR India	
#3	#1 AND #2	

44

## 45 Cysticercosis

#	Searches	
#1	(MM "Cysticercosis") OR cysticerc* OR neurocysticer* OR taeni* OR tapeworm	
#2	(MH "India") OR India	
#3	#1 AND #2	

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## 48 Salmonellosis

#	Searches	
#1	(MM "Salmonella") OR (MM "Salmonella Vaccines+") OR (MM "Salmonella	

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	Infections+") OR (MM "Paratyphoid Fever") OR typhoid OR "typhoid fever" OR "enteric fever" OR "Salmonella typhi" OR "Salmonella enterica" OR paratyphoid OR paratyphi	
#2	(MH "India") OR India	
#3	#1 AND #2	

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## 50 Bovine TB

#	Searches	
#1	(( (bovine or zoono*) AND (tuberculosis OR MH "tuberculosis") ) OR "mycobacterium bovis")	
#2	(MH "India") OR India	
#3	#1 AND #2	

51

## 52 Japanese Encephalitis

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#	Searches	
#1	(MM "Encephalitis Viruses, Japanese+") OR (MM "Japanese Encephalitis Vaccines") OR " Japanese encephalitis" OR JBE	
#2	(MH "India") OR India	
#3	#1 AND #2	

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## 55 Rickettsial Infections

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#	Searches	
#1	(MM "Rickettsial Infections+") OR (MM "Rocky Mountain Spotted Fever") OR (MM "Typhus") OR typhus OR "rickettsial pox" OR "trench fever" OR "Q fever" OR "rocky mountain spotted fever"	
#2	(MH "India") OR India	
#3	#1 AND #2	

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60 **Appendix 3: Search Strategy for Global Health**

61 Leptosiprosis

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#	Searches	
#1	(DE "leptospirosis" OR DE "Leptospira" ) OR leptospir* OR (weil* disease) OR infectious icterus OR canicola OR mud fever OR field fever OR (rat catcher* adj yellow*) OR pretibial fever OR grippotyphosa or icteroh* OR (spirochaet* jaundice) OR (spirochete* jaundice)	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

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64

65 Rabies

#	Searches	
#1	DE "rabies" OR rabies OR rabid	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE	

	"Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

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68 Anthrax

#	Searches	
#1	DE "anthrax" OR DE "cutaneous anthrax" OR DE "inhalational anthrax" OR anthrax OR "anthrax bacillus"	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

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70 Brucellosis

#	Searches	
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#1	DE "brucellosis" OR DE "Brucella" OR brucell* OR (Malta Fever) OR (undulant fever)	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

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72 Cysticercosis

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#	Searches	
#1	DE "cysticercosis" OR DE "neurocysticercosis" OR cysticerc* OR neurocysticer* OR taeni* OR tapeworm	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR	

	DE "West Bengal" OR India	
#3	#1 AND #2	

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## 75 Salmonellosis

#	Searches	
#1	DE "typhoid" OR DE "salmonellosis" OR DE "enteric fevers" OR DE "paratyphoid" OR typhoid OR "enteric fever" OR paratyphityphoid OR paratyphoid	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

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## 77 Bovine TB

#	Searches	
#1	(( (bovine or zoono*) AND (tuberculosis OR DE "tuberculosis") ) OR "mycobacterium bovis")	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE	

	"Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

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79 Japanese Encephalitis

80

#	Searches	
#1	DE "Japanese encephalitis" OR " Japanese encephalitis" OR JBE	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

81

82 Rickettsial Infections

83

#	Searches	
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#1	DE "rickettsial diseases" OR DE "ehrlichioses" OR DE "neorickettsioses" OR DE "African tick bite fever" OR DE "Q fever" OR DE "spotted fever" OR DE "anaplasmoses" OR DE "typhus fevers" OR DE "Q fever" OR DE "spotted fever" OR DE "Mediterranean spotted fever" OR DE "Rocky Mountain spotted fever" OR DE "typhus fevers" OR DE "louse-borne typhus" OR DE "murine typhus" OR DE "scrub typhus" OR typhus OR "rickettsial pox" OR "trench fever" OR "Q fever" OR "rocky mountain spotted fever"	
#2	DE "India" OR DE "Arunachal Pradesh" OR DE "Assam" OR DE "Bihar" OR DE "Chandigarh" OR DE "Chhattisgarh" OR DE "Dadra and Nagar Haveli" OR DE "Daman and Diu" OR DE "Delhi" OR DE "Goa" OR DE "Gujarat" OR DE "Haryana" OR DE "Himachal Pradesh" OR DE "Jammu and Kashmir" OR DE "Jharkhand" OR DE "Karnataka" OR DE "Kerala" OR DE "Lakshadweep" OR DE "Madhya Pradesh" OR DE "Maharashtra" OR DE "Manipur" OR DE "Meghalaya" OR DE "Mizoram" OR DE "Nagaland" OR DE "Orissa" OR DE "Puducherry" OR DE "Punjab (India)" OR DE "Rajasthan" OR DE "Sikkim" OR DE "Tamil Nadu" OR DE "Andaman and Nicobar Islands" OR DE "Andhra Pradesh" OR DE "Tripura" OR DE "Uttar Pradesh" OR DE "Uttarakhand" OR DE "West Bengal" OR India	
#3	#1 AND #2	

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85

86

87