



Global Research Trend of Carbapenem Resistant-*Enterobacteriaceae* in Animals: A Bibliometric Analysis

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ABSTRACT

Carbapenem-resistant *Enterobacteriaceae* (CRE) pose a growing public health concern, especially with many reports of CRE in animals. However, the trends of CRE studies in animals are less explored. This study aims to provide a bibliometric analysis of global research on CRE in animals, identifying research trends, key contributors, theme trend, and future directions in the field. A systematic search of Scopus was conducted on January 25, 2025, using keywords related to CRE and animals. A total of 1,803 studies were retrieved, with 695 meeting the inclusion criteria for analysis. Bibliometric analysis was performed using R Studio's Bibliometrix package to examine publication trends, authorship networks, keyword co-occurrence, citation analysis, and research trend. The volume of publications on CRE in animals increased annually, especially since 2013, with a rate of 15.48%. China and the United States were the lead contributors, while less publications were found in African countries, indicating a research gap. The most common research themes included *Escherichia coli*, *Klebsiella pneumoniae*, antimicrobial resistance, whole genome sequencing and carbapenemase genes. International collaborations were limited, with most studies conducted by single-nation teams. Highly cited publications focused on epidemiology, molecular characterization, and drug resistance mechanisms. Arising attention was observed for the virulence factors and One Health topics. Future studies should be directed towards genomic surveillance, risk assessment of human's infection, and the implementation of the One Health approach to address the risks associated with CRE in animals.

Key words: Animal studies, Antimicrobial resistance, Bibliometric analysis, Carbapenem-resistant *Enterobacteriaceae*,

INTRODUCTION

Carbapenem-resistant *Enterobacteriaceae* (CRE) represent a significant public health challenge due to their high levels of antibiotic resistance and the associated morbidity and mortality (Tesfa et al. 2022). The emergence of CRE is largely attributed to the overuse and misuse of antibiotics, particularly carbapenems, which are often considered last-resort treatments for multidrug-resistant infections (Tepeli et al. 2023). Due to the importance, the World Health Organization (WHO) has classified CRE, especially the *Klebsiella pneumoniae* species, as a critical priority pathogen, highlighting the urgent need for effective strategies to combat this growing threat (World Health Organization 2024).

Recent research has highlighted the prevalence of CRE

in various regions, with alarming rates reported in clinical isolates, environment, animal populations and its product, such as milk (Nuraini et al. 2025; Tuhamize and Bazira 2024). This cross-species transmission is a critical concern as it complicates efforts to control the spread of CRE. The development of new therapeutic strategies is critical to mitigating the impact of CRE which often involves animal models in the process (Zhong et al. 2021). Considering the importance of animal roles in the CRE studies, a comprehensive understanding on the trend of CRE studies in animals is necessary.

This study conducts a bibliometric analysis of CRE in animals using relevant publications. Bibliometric analyses have emerged as valuable tools for understanding the trends and research focus, including CRE topics.

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Recent bibliometric analyses on CRE have identified key research trends and highlighted emerging hotspots over the past year. (Sweileh et al. 2016; Zhong et al. 2021). Additionally, a recent comprehensive bibliometric analysis highlighted the increasing number of research on CRE, underscoring the need for effective diagnostic methods and surveillance systems to monitor the spread of these pathogens (Gürbüz and Gencer 2024). The analysis also pointed out that the presence of CRE in food systems poses serious public health risks, as antibiotic resistance can spread rapidly through agricultural practices and food processing (Gürbüz and Gencer 2024). However, the previous bibliometric studies do not specify the trend of studies in animals which causes less understanding on the trend of CRE studies in animals. A comprehensive understanding of CRE studies in animals is valuable to identify the development of the publication production, lead contributors, research trends, research gap and future direction for academicians.

MATERIALS AND METHODS

Data collection

The data were retrieved from Scopus database on 25 January 2025. A thorough search was conducted using a combination of relevant keywords as follow: (TITLE-ABS-KEY ("carbapenem resistant" OR carbapenemase) AND TITLE-ABS-KEY (animal OR pet OR dog OR cat OR livestock OR cattle OR cow OR beef OR meat OR milk OR chicken OR pig OR fish) AND TITLE-ABS-KEY (*Enterobacteriaceae* OR *Klebsiella* OR *Escherichia* OR *Salmonella*)). Totally, 1,803 articles were retrieved from the searching result. The retrieved studies were transferred to Rayyan online software (<https://www.rayyan.ai/>) for duplication and inclusion screening. To specify the study of CRE in animals, the studies that were not include animals and no *Enterobacteriaceae* species were excluded. Additionally, we also excluded review, erratum, book chapter, and annual/regional report from for the quantitative analysis. As a result, 695 studies were used for analysis (Fig. 1).

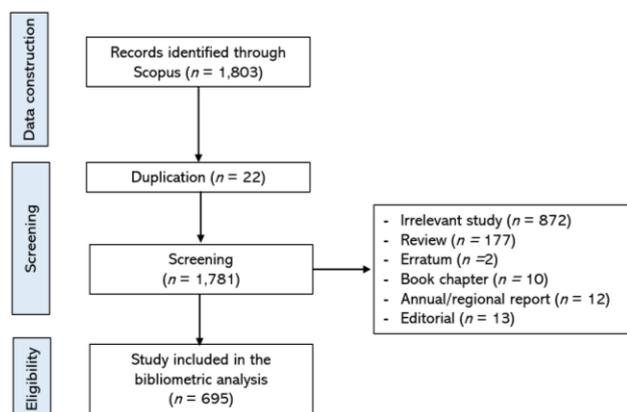


Fig. 1: Flowchart of articles screening process for bibliometric analysis.

Data extraction

From all studies, the data such as authorship, title, publication year, the journal name, abstract, keywords, and

citation count were systematically retrieved. All of this data were directly downloaded from Scopus in the comma-separated values (csv) format.

Bibliometric analysis

Bibliometric analysis is conducted to assess the academic literature quantitatively and evaluate the influence of the study, identify trends, and the evaluate the connections. This method utilizes some indicators such as the citation analysis, the network between co-author, and the trend in the published works (Jangid et al. 2023). In the current study, the analysis was divided into several sections: 1) Publication trends and growth analysis to analyse the trend of publication annually and determine the evolution of CRE in animal study. The rate of development was measured and the significances were determined in this analysis (Donthu et al. 2021). Additionally, the global distribution of the published articles was also analysed. 2) Bibliometric analysis of co-authorship and collaboration to identify the productive authors and collaboration between authors (Donthu et al. 2021). In current study, this analysis was performed to gain insight on the leading authors in the study of CRE in animal and the networks between them. Furthermore, the institutional analysis was performed to determine the leading institution in the topic of CRE in animals. 3) Bibliometric analysis of keyword co-occurrence to highlight the current and future connection of the topics in the study area (Emich et al. 2020), in this case in the study of CRE in animals. 4) Bibliometric analysis of citation to assess the connection between the relevant studies by recognising the most influential studies in the research subject (Wang et al. 2022), which was study of CRE in animals. The analysis of citation was necessary to gain a comprehensive understanding in the significance and pattern of the knowledge dissemination among the academicians and the community (Elango and Ho 2017). 5) Thematic mapping to determine the theme terms and trend topic. They were visualised by the thematic mapping to display the clusters of the co-occurrence network based on Callon's centrality and ranking of the density system (Callon et al. 1991). In the graph, clusters are visualised as bubbles with dimensions that are proportional to the words' frequency in each cluster. The X-axis representing the centrality of the cluster that indicates the interaction degree with other clusters which show the significance of a thematic area. Meanwhile, the Y-axis portrays the density that determine the cluster's internal cohesion and the growth of the thematic content (Parlina et al. 2020). The projection of the cluster to the upper right over time is an indication of an arising trend, while the projection to the lower left shows a reduction in trends (Alkhamash 2023). To analyse the data, the Bibliometric package (Aria and Cuccurullo 2017) in R studio (v.4.3.0) were used.

RESULTS

Totally, 1,803 articles of CRE in animal were retrieved from Scopus spanning from 2009 to 2025. The studies of CRE in animals mainly consist of experimental studies that used animals in developing the solution for treatment CRE or the epidemiological studies which observe the

prevalence or the occurrence of CRE from animal samples. From the retrieved articles, studies from clinical human samples, or studies of carbapenem-resistant non-*Enterobacteriaceae* such as the *Pseudomonas*, *Acinetobacter*, and others were excluded to enhance the specificity of the analysis. From the screening, 695 articles were included for the analysis (Table 1).

Table 1: Overview of included articles

Description	Results
<i>Main information</i>	
Timespan	2009:2025
Sources	208
Documents	695
Annual Growth Rate %	15.48
Document Average Age	4.55
Average citations per doc	20.82
References	26,504
<i>Document contents</i>	
Keywords Plus (ID)	4,401
Author's Keywords (DE)	1,290
<i>Authors</i>	
Authors	3,942
Authors of single-authored docs	8
<i>Authors collaboration</i>	
Single-authored docs	8
Co-Authors per Doc	8.11
International co-authorships %	32.66
<i>Document types</i>	
Article	655
Conference paper	3
Letter	30
Note	7

Annual production trend

Based on the annual publication since 2009 until January 2025, there was 15.48% growth rate for the articles of CRE in animals. The result showed that the studies started to increase in 2013, while prior to that, only 8 articles were produced (Fig. 2). Since 2013, the production of articles of CRE studies in animals was increased slowly with less than 10 articles growth per year until 2018. A notable increasing publication of CRE in animals was seen in 2019 with an addition of 17 articles from 2018, and the highest production was found in 2021 with a total of 110 studies published.

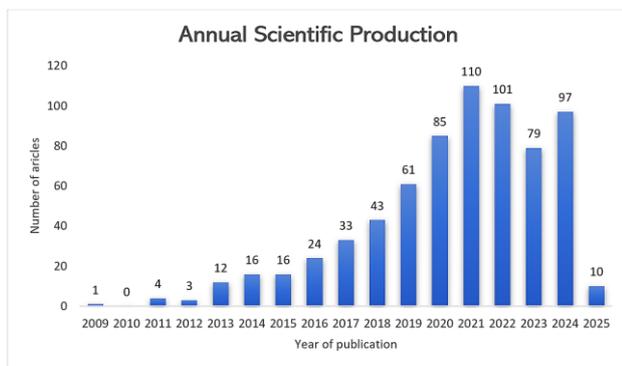


Fig. 2: Graph of annual scientific articles of carbapenem resistant-*Enterobacteriaceae* in animals span from 2009 to January 2025.

Publication analysis based on geographical distribution

An analysis on the publication distribution was conducted to assess the dispersion of research contribution

in the insight of CRE in animals. According to the geographical distribution, a total 76 countries had been contributed to the CRE in animal studies with the top productive countries as follow: China (1,328), The United State of America (590), France (317), Germany (304), India (239) and Brazil (238) (Table 2; Fig. 3). Among 76 countries, 26 countries reported less than 10 studies within the 2009 to 2025. This result showed a diversity in research focus on CRE in animal studies. It is important to note that some countries have not reported any studies of CRE in animals, particularly in Africa.

Table 2: Top 15 countries publishing the most articles in the field of CRE in animal studies

Rank	Country	Articles	Articles %	Total citation	Average article citations
1	China	145	20.9	2908	20.10
2	United State	84	12.1	2639	31.40
3	France	39	5.6	2157	55.30
4	Germany	36	5.2	727	20.20
5	India	29	4.2	507	31.70
6	Brazil	26	3.7	377	25.10
7	Japan	23	3.3	368	16.00
8	Italy	21	3	361	40.10
9	United Kingdom	17	2.4	360	21.20
10	Switzerland	16	2.3	272	45.30
11	Egypt	15	2.2	250	8.60
12	Spain	15	2.2	250	11.90
13	Netherlands	13	1.9	247	9.50
14	Australia	12	1.7	206	13.70
15	Pakistan	12	1.7	167	33.40

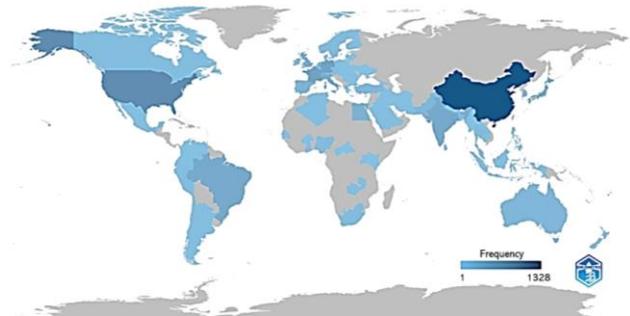


Fig. 3: Geographical distribution of the studies about carbapenem resistant-*Enterobacteriaceae* in animals.

To analyse the collaboration initiative among the authors, analysis of single-country publication (SCP) and multiple-countries publication (MCP) were conducted (Fig. 4). As a result, China, as the top 1 productive country showed that the majority of the studies were conducted under collaboration of local authors with a SCP of 80.7%. The studies from USA and Germany showed a MCP higher than 30%. Among the leading countries, France showed the highest MCP with a rate of 55.6%, while India showed the lowest MCP at 6.9%. The results indicate that France has more extensive international collaboration network compared to the other countries. The visualisation of countries networks can be seen in Fig. 5.

Bibliometric analysis of co-authorship

The co-authorship analysis provides an insight of collaborative dynamics between the authors in the related field of CRE in animals. A total of 3,942 authors have

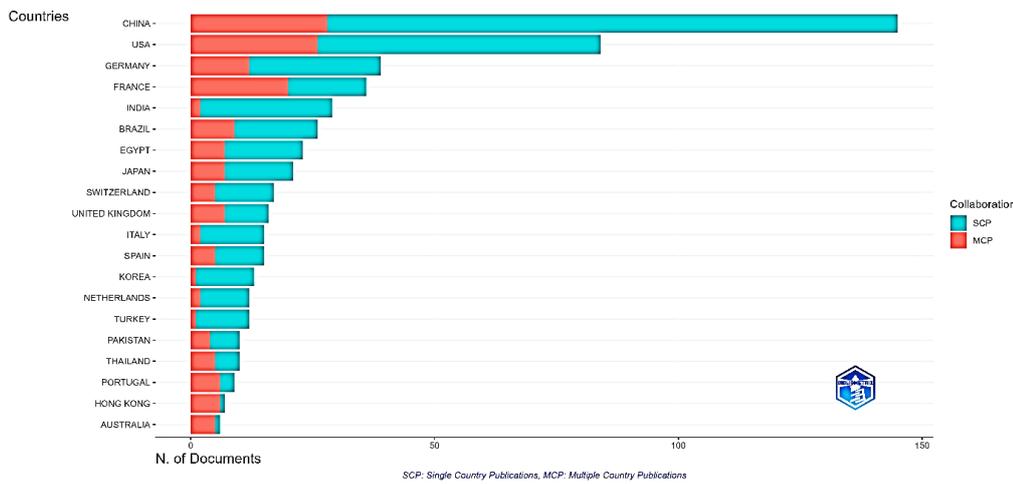


Fig. 4: Graph of corresponding author countries for CRE in animal studies based on the single-country publication (SCP) and multiple-countries publication (MCP).

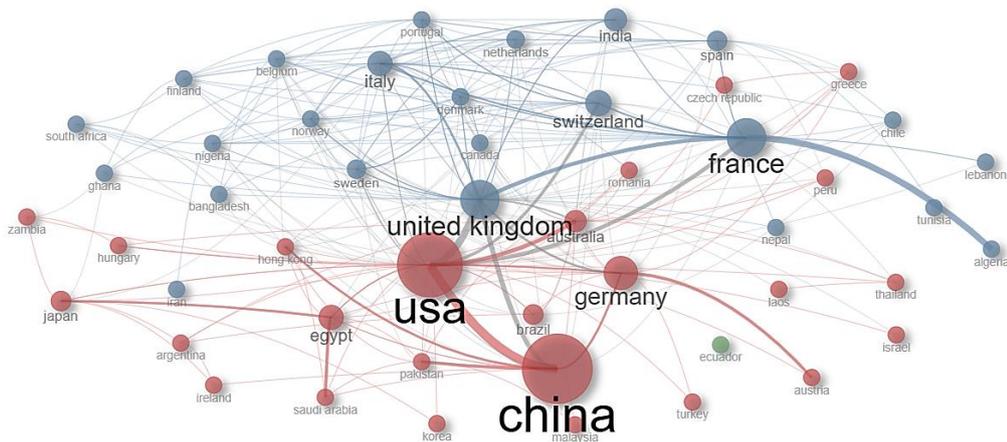


Fig. 5: Network visualisation of collaborative research network between countries. Different colours representing different cluster, the size of node representing the number of studies, and the line thickness indicate the intensity of the connection.

contributed in the dissemination of study related to CRE in animal. Almost all authors wrote the study in collaboration with other authors, and only 8 studies were published under single author. Among all authors, Wang et al. (2017) were the top authors based on the number of articles (Table 3). All of these authors had published at least 15 articles related to CRE in animals. The top 10 author’s publication pattern was seen started in 2011 with Bulik and Nicolau noticeable in this year, indicating early involvement in the study of CRE in animals. Meanwhile, the top 2 authors, Wang et al. (2017) started the involvement in 2015 with increasing number of published articles along the year (Fig. 6).

Table 3: Most productive authors in the CRE in animal studies with more than 10 studies

Authors	Articles	Articles Fractionalized
Wang Y	25	2.47
Li J	19	1.75
Wang J	16	1.54
Zhang Y	15	1.35
Endimiani A	14	1.98
Liu X	14	1.73
Nicolau D P	14	3.98
Li Y	13	1.56
Liu Y	13	1.43
Nordmann P	13	2.23
Perreten V	13	1.68
Fischer J	12	1.71
Guerra B	12	1.75
Schwarz S	12	1.36
Haenni M	11	1.40

Based on the result of collaborative network analysis of the top 50 authors, there were seven clusters seen with two of most notable clusters related to the collaboration of Wang Y from China Agricultural University (Fig. 7). The affiliation of Wang Y was among the top institution that had published more than 140 articles in the topic of CRE in animals along with the South China Agricultural University (Fig. 8). In terms of leading institution, five out of ten were located in China, one in Swiss (University of Bern), one in India (ICAR-Indian Veterinary Research Institute), one in Egypt (Cairo University), one in Thailand (Chulalongkorn University), and one in USA (Center for Anti-Infective Research and Development).

Bibliometric analysis of citation

The analysis revealed the top 10 most cited documents in the topic of CRE in animal studies were led by a document of Wang et al. (2017), which is also the lead author in the topic (Table 4). This paper reported the prevalence of NDM-1 and mcr-1 from poultry, dogs, and sewage in the poultry production setting (Wang et al. 2017). However, based on the total citation per year, the document of (Song et al. 2020) had the highest citation index with 51.00 total citation per year since 2020. This study focused on the utilisation of antibiotic adjuvant to enhance the efficacy of antibiotics against the multidrug resistant pathogen, including the carbapenem-resistant *E. coli*, that was tested using animal models (Song et al. 2020). The result indicates that in the last five years, the treatment development for CRE infection gains high amount of attention.

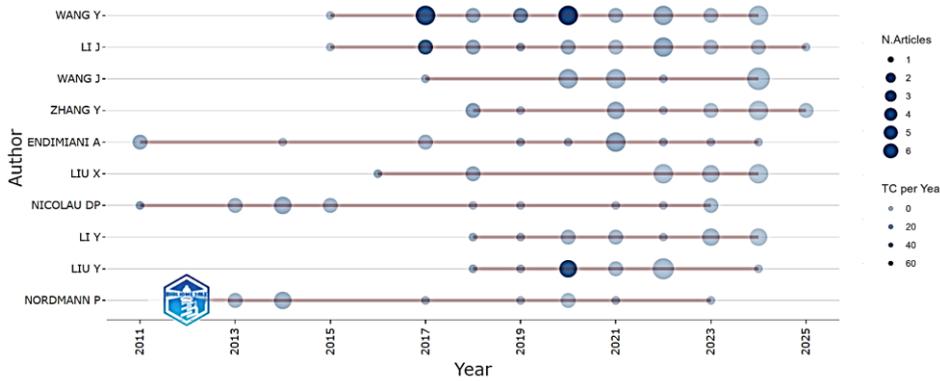


Fig. 6: Annual publication of the top 10 authors in the topic of CRE in animal studies.

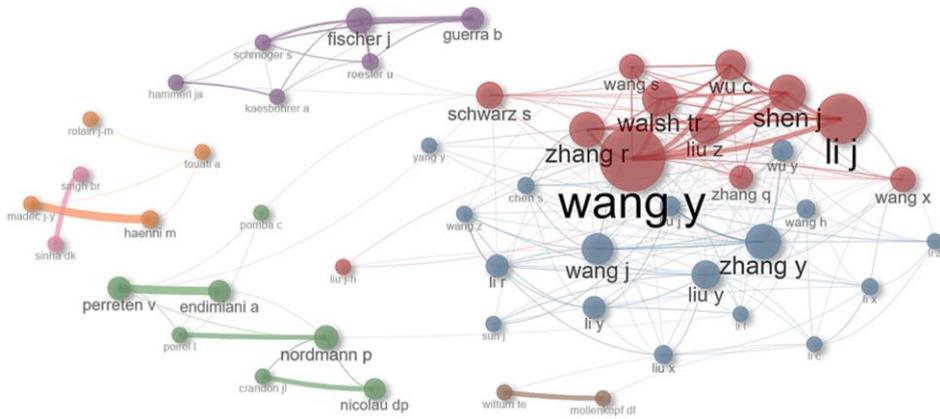


Fig. 7: Network visualisation of collaborative research network between authors. Different colours representing different cluster, the size of node representing the number of studies, and the line thickness indicate the intensity of the connection.

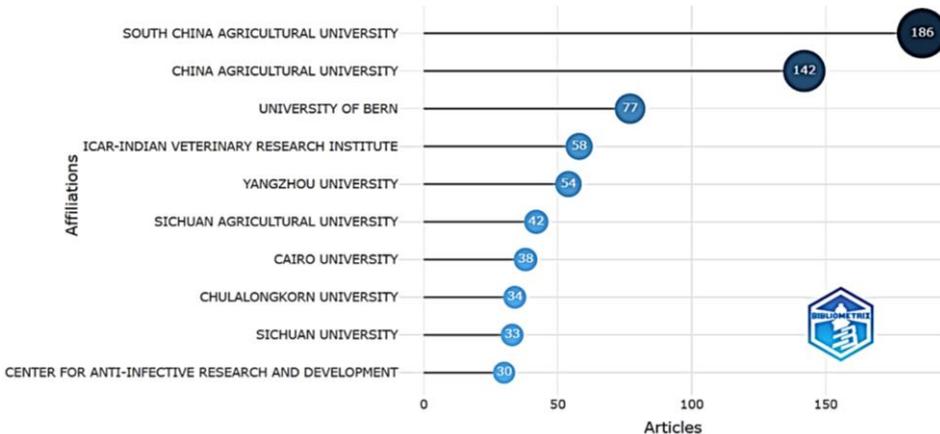


Fig. 8: The top 10 most productive institution in publishing articles related to the CRE in animals.

Table 4: The most cited author in the topics of CRE in animal studies

Author (Publishing year)	Total Citations	Total citation per year	Normalized total citation
Wang et al. (2017)	358	39.78	5.74
Song et al. (2020)	306	51.00	13.02
Pomba et al. (2017)	286	31.78	4.58
Falgenhauer et al. (2016)	244	24.40	3.81
Marshall et al. (2017)	234	26.00	3.75
Woodford et al. (2014)	204	17.00	3.52
Yao et al. (2016)	200	20.00	3.12
Du et al. (2016)	188	18.80	2.93
Bulik and Nicolau (2011)	183	12.20	2.15
Guerra et al. (2014)	156	13.00	2.69

Based on the country total citation analysis, the top cited countries were China, the United States and Germany (Table 2). However, Germany had the highest average article citations which indicates more impact studies were published in this country. According to the publisher, Antimicrobial Agents and Chemotherapy and Journal of Antimicrobial Chemotherapy were the top leads

with 53 published articles, more than 2,000 total citation and *h*-index higher than 20 (Table 5).

Bibliometric analysis of keyword co-occurrence

The keywords analysis has a potential to discover the comprehensive of the main themes, the study trend, and also the intellectual framework in a specific study focus.

Table 5: The most relevant and cited journals in the topics of CRE in animal studies

Source	Articles	Total citation	<i>h</i> -index
Antimicrobial Agents and Chemotherapy	53	2011	25
Journal of Antimicrobial Chemotherapy	53	2271	24
Frontiers in Microbiology	44	964	18
Microbial Drug Resistance	18	428	15
Antibiotics	44	403	12
International Journal of Antimicrobial Agents	18	388	9
PLOS One	14	427	9
Veterinary Microbiology	12	411	9
Journal of Global Antimicrobial Resistance	22	295	8
International Journal of Food Microbiology	10	144	7

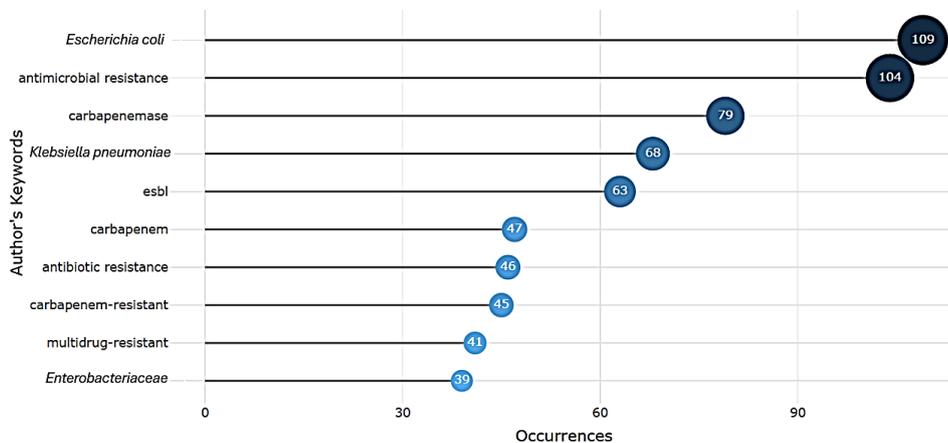


Fig. 9: Top 10 most frequently used keywords in the topics of CRE in animals.



Fig. 10: The most frequently used keywords in the topic of CRE in animals.

Based on the analysis of author keywords, a total of 1,290 keywords were determined. The most appeared keyword was ‘*Escherichia coli*’ with number of appearances 109 times, indicating the most commonly studied species (Fig. 9, 10). Additionally, keywords ‘antimicrobial resistance’ was also widely used by authors with 104 appearances. This finding is similar to the keyword’s trends, indicating that authors most likely used same words in the title and keywords to presenting their studies.

Theme terms and trend topic analysis

The thematic maps based on the author keywords were divided into four themes: the motor theme in the top right, the niche themes in the top left, the emerging or declining themes in the bottom left and basic themes in the bottom right (Fig. 11). The motor themes in the top right mean that the themes in this quadrant have a high centrality with a low density which indicated the well-developed themes. This quadrant had one cluster located in between motor and niche themes that consists of: ‘meropenem’, ‘carbapenem-

resistant Enterobacterales’, and ‘pneumonia’, and another cluster located in between motor and basic themes with themes: ‘One Health’, ‘livestock’, and ‘whole genome sequencing’. The second quadrant, the niche themes, showed the themes that had high density with low centrality as indication of less relevant themes. This niche theme was divided into four clusters: 1) ‘virulence genes’; 2) ‘drug resistance’, ‘virulence factor’, and ‘β-lactamase’; 3) ‘carbapenem-resistant *Enterobacteriaceae*’; and 4) ‘meropenem’, ‘carbapenem-resistant Enterobacterales’, and ‘pneumonia’. The cluster 4 in this quadrant can be regarded as higher relevance and more developed than the others as it was also located in the motor themes. The quadrant on the bottom left suggested the emerging or declining themes as the themes have low centrality and low density, indicating they are less developed and marginal. The analysis showed one cluster in this quadrant that consisted of: ‘carbapenem-resistant *Klebsiella pneumoniae*’ and ‘carbapenemase genes’. The fourth quadrant, the basic themes, had a high centrality with low

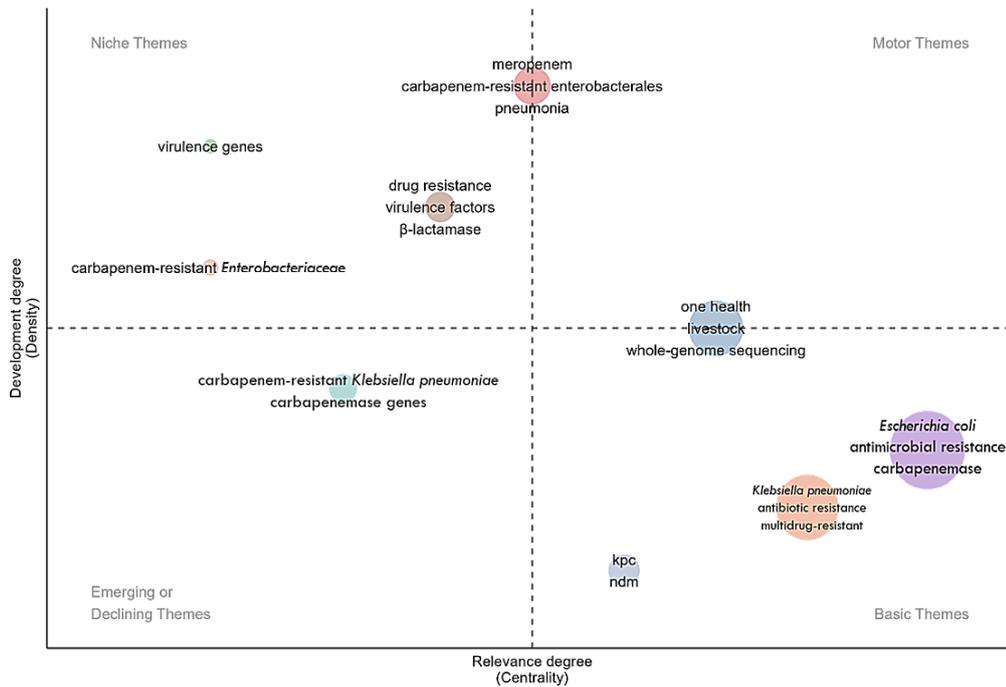


Fig. 11: Thematic mapping of CRE in animals.

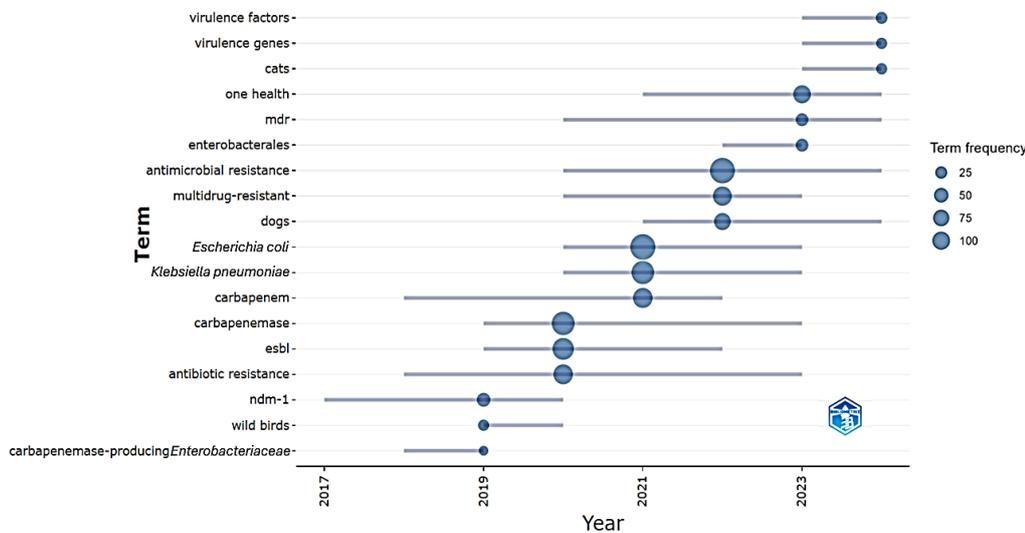


Fig. 12: Graphical illustration for the trend topics along the years for CRE in animal studies.

density which indicates the transdisciplinary research topics. The result shows four clusters: 1) ‘KPC’, ‘NDM’; 2) ‘*Escherichia coli*’, ‘antimicrobial resistance’, ‘carbapenemase’; 3) ‘*Klebsiella pneumoniae*’, ‘antibiotic resistance’ and ‘multidrug-resistant’. Another cluster that consists of ‘One Health’, ‘livestock’, and ‘whole-genome sequencing’ located in between basic and motor themes indicating that these transdisciplinary topics were currently the trends.

Furthermore, based on the most appearing keywords over years, several topic lists were showed more dominant than others (Fig. 12). Since 2020, the most frequently used terms were ‘*Escherichia coli*’ and ‘antimicrobial resistance’ indicating that the study of CRE in animals mainly focusing in these topics. Other topics such as ‘*Klebsiella pneumoniae*’, ‘carbapenem’, ‘carbapenemase’, ‘ESBL’, and ‘antibiotic resistance’ also appeared as common topics in the studies CRE in animals. A noteworthy number of studies had incorporated term ‘One Health’ since 2021, indicating that this topic has gain more attention in the last years.

DISCUSSION

The current study provides a bibliometric analysis of publication in the study of CRE in animals globally. This study specifically selects the studies that involve animals in the research in purpose of epidemiological studies and animal experimentation. Some studies have reported the rate of CRE in animals (Köck et al. 2018; Tuhamize and Bazira, 2024) and its products (Nuraini et al. 2025), which indicating the CRE has been circulating outside the hospital setting and poses a public health threat. Following the increasing threat of CRE, the current and future research trends are directed towards drugs development and early detection using genomic based method (Zhong et al. 2021). For these purposes, animal models play a big role in the trial. Therefore, the current bibliometric study could provide a comprehensive understanding in the studies of CRE in animals and provide a predictive in the future trends.

Based on the results, there is an increasing trend of CRE in animals over the years. Animals had been involved

in the CRE studies since 2009 based on Scopus database with a notable increasing number in 2018 that resulting 15.48% growth rate per year. This increasing trend indicates the popularity of CRE study that may be related to the inclusion of CRE members in the critically important list of WHO since 2017 (World Health Organization 2017, 2024). Similar increasing trend is also seen in global studies of CRE since 2010-2020 (Zhong et al. 2021). However, comparing the overall studies of CRE, the number of studies of CRE in animals is less than half of the overall number of studies of CRE in 2010-2020 (695 vs 2,303, respectively) (Zhong et al. 2021).

The monitoring of CRE in animals and animal experimentation for drugs development against CRE have been conducted in many countries, accounting 76 countries. The top two leading countries of the study field are China and USA, which also lead in the CRE studies in general (Gürbüz and Gencer 2024). Among 76 contributor countries, more than one-third published less than 10 studies, and it is noteworthy that 15 countries only have one article. Additionally, the top 10 institution in the CRE studies is located in China. This finding suggested that the CRE in animals has not been evenly explored based on geographical distribution, showing a possible gap on these topics and high potential of exploration by scientist, especially in the African countries.

Multination collaboration research should be considered in studying the CRE in animals. Analysis of countries collaborative network found that in the top 10 leading countries, most articles are published by authors from single nation, except for France, indicating less multination collaboration in the study topic. According to the collaborative network, there are seven clusters of networks, however the intensity of connection at most of the clusters is seen weak, indicating a low connection between authors. Collaboration between researcher and countries in health study has good impact by increasing the efficiency, optimizing the benefits, and promoting equity (Saenz et al. 2024). Thus, it is deemed necessary to increase research collaboration in the study of CRE in animals. Furthermore, international collaboration has increased the citation, indicating a wider exposure of study to the scientific community (Wang et al. 2024). In accordance to this statement, the study of Wang et al. (2017), which has the highest number of citation, has four countries listed in the authors' institution country which may play a role in the increase the exposure of the studies in international community.

Additionally, international collaboration studies have more chance to be published in the higher impact journal which also increase the citations (Wang et al. 2024). Among all journals, 'Antimicrobial Agents and Chemotherapy' and 'Journal of Antimicrobial Chemotherapy' have the highest citation and *h*-index among all journals in the topic of CRE in animals. High *h*-index indicates high number of publications with high number of citations (Kumar et al. 2022). As seen in both top journals that have *h*-index more than 20, it shows that each journal has published more than 20 papers that has more than 20 citation each. The higher impact journals are more reliable and often become the reference for other studies as they have more thorough peer review process, especially in the methodologies section (Severin et al. 2023).

Most of the studies of CRE in animals focus on *E. coli*, antimicrobial resistance, and *K. pneumoniae*, as indicated by the number of co-occurrence keywords and title in this topic. This pattern is also seen in the studies of CRE in general, where *E. coli* and *K. pneumoniae* are often reported in human, animal, and the environmental setting (Tuhamize and Bazira 2024). Considering the importance of CRE, especially the *E. coli* and *K. pneumoniae*, in human and animal health, the study of CRE in animals is started to shift to 'One Health' approach as seen in the thematic map and also in the trend topic analysis. The transdisciplinary studies of CRE in animals has related to the *E. coli*, *K. pneumoniae*, carbapenemase, antimicrobial resistance, livestock, KPC, NDM, and whole genome sequencing. This trend indicated that transdisciplinary studies by understanding the molecular structure is popular to study CRE in animals. Furthermore, it suggests that these topics may become the trend in the following years, considering the importance of the studies is highly related to the public health. Additionally, the studies of virulence factors are also seen increasing in the last year, indicating an effort to gain understanding in the disease severity potency of CRE from animals. In regards of animal species, the companion animals, such as cats and dogs, have gain more attention than the other type on animals, considering that the companion animals live closely to human and may become CRE reservoir. Additionally, livestock has been appeared in the transdisciplinary studies subjects that suggests more attention also been pointed to this food producing animals.

Some limitations exist in the current study. First, this study was conducted using only a single database, Scopus, so that some information from other databases may be missed. Scopus was selected because it contains more articles of CRE in animal studies compare to other databases. Additionally, it provides comprehensive data of authorship and the institution which increase the reliability of the databases for bibliometric analysis (Baas et al. 2020). Second, the analysis does not separate the study of epidemiology based and animal trial based, so that the results cannot differentiate the trend in epidemiological and animal trial. Moreover, bibliometric analysis prone to subjectivity during the data collection and analysis (Alkhamash 2023), thus, the interpretation of analysis in the current study may contain some subjectivity.

Conclusion

The results of our study provide a new paradigm on study development of CRE in animals. The publication has been increasing rapidly since 2013 with domination of China and USA with purpose of epidemiological reports and drug development studies. Based on geographical distribution, there is a need to increase studies of CRE in animals in many countries, especially in Africa regions as there are limited reports from this region. The trend of the epidemiological studies of CRE in animals is circulated in the transdisciplinary approach with molecular technique such as whole genome sequencing. Additionally, the trend One Health approach is also increasing with companion animals and livestock as the subject of the studies. The studies of CRE in animals in epidemiological and trial setting play a big role in the control and treatment effort of the pathogen. Therefore, more studies should be conducted

to enhance the understanding risk of disease transfer and to develop appropriate treatment for CRE infection.

DECLARATIONS

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Ethics Statement: This study analysed previously published articles related to the studies of CRE in animals. Thus, ethical approval is not necessary.

Author's Contribution: Dian Meididewi Nuraini: Conceptualization, Data Curation and Analysis, Writing – Original Draft. Morsid Andityas: Conceptualization, Data Analysis. Patchara Phuektes: Conceptualization, Supervision, Writing – Editing, Peerapol Sukon: Supervision, Writing – Review, Editing, Finalisation. All authors have read and approved the final version of the manuscript.

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