Bibliometric Analysis of Global Research on Technology Information in Antimicrobial Stewardship using Scopus Database

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Abstract. Antibiotic resistance is a global public health threat impacted by the inappropriate use of antibiotics. Most countries carry out strategies to address the antimicrobial resistance increase, either by individuals, government agencies/agencies, or between health institutions with "Antimicrobial Stewardship Program". Since the late 1980s, technological tools have changed the way humans interact in their environment Technological tools have altered the way humans engage with their environment since the late 1980s. Information technology is widely used in the health sector. The primary purpose of this study is to define publication trends focused on information technology use in antimicrobial stewardship for the last 10 years. The method used is bibliometric analysis using VOS viewer software version 1.6.18 and R-Studio. The study was conducted in October 2022 by searching through the Scopus database in 2013-2022. The Scopus database is used because it is considered ideal for bibliometric analysis. The result showed that 48 published documents from 2013 to 2022 conducted studies on the use of information technology in antimicrobial stewardship according to inclusion criteria (focus on developing or using applications and studies conducted in health-care settings). The results show that during the year from 2013 to 2022 the number of publications has increased regarding the theme of information technology use in antimicrobial stewardship. The United States is the country that contributes the most research related to the use of information technology in antimicrobial stewardship. The presented bibliometric analysis provides relevant information about the themes of the main use of information technology in antimicrobial stewardship. All these results are discussed in the manuscript and conclusions are made. This study is useful in the health sector, namely the development of information technology in antimicrobial stewardship.

Keywords: Bibliometric Analysis, Technology Information, Antimicrobial Stewardship.

1   Introduction

Antibiotic resistance is an international public health menace impacted by the misuse of antibiotics in the rising number and types of resistant bacteria. In the case of resistant microorganisms, particularly those that are resistant to multiple drugs, the effectiveness of antibiotics is diminished, and infection becomes uncontrollable [1]. The overuse of antibiotics is a global problem that leads to increased morbidity, death, and health-care expenses. As a result, effective antibiotic use is critical and should be part of any pharmaceutical treatment strategy [2].

The WHO (World Health Organization) supported the GAP (Global Action Plan) on AMR in 2015, and one of the primary strategic goals that should be included in national action plans for addressing AMR was the optimization of antibiotic use [3]. AMR was identified as one of the top 10 global health threats by the WHO in 2019 [4]

According to the definition of antimicrobial stewardship, it is "a strategy adopted by health-care systems or organizations to promote and monitor the responsible use of antimicrobials to retain their efficacy" (AMS) [5]. The AMS concept was initially presented by the IDSA (Infectious Diseases Society of America) in 2007. Initially, it is characterized as the use of controlled interpositions to enhance antimicrobial usage by selecting the appropriate medications, doses, administration routes, as well as therapy duration without influencing patient outcomes [6].

Technology in health care is growing rapidly. Innovation and information technology have been implemented in all areas of healthcare delivery the deployment of robotics to deliver non-invasive surgical interventions to electronic medical records as well as prescription systems. With the existence of smartphones as well as their omnipresent use by healthcare professionals, various novel technology platforms are being used in healthcare [7]. The primary purpose of this study is to define publication trends focused on information technology use in antimicrobial stewardship for the last 10 years.

2   Materials and Method

2.1   Study Design

A bibliometric analysis was carried out to examine data on the application of information technology as a tool for controlling the use of antibiotics. Focused data by year of publication, country, author, citation, index keywords, and journal. This study performed data collection and search using the Scopus database. The organized search strategy was employed, which involved searching for relevant terms in the title, abstract, and keywords in the articles. Furthermore, the "document type" was restricted only to articles. Therefore, the obtaining search was as follows: [TITLE-ABS-KEY ("antimicrobial stewardship" OR "antibiotic stewardship" AND TITLE-ABS-KEY ("technology information" OR "mobile phone" OR "smart phone" OR android OR application. The VOS viewer 1.6.10 software was employed for data visualization as well as analysis [8].

2.2   Research Strategy

Identification: in this step, the process involves selecting a term and utilizing the Boolean operators "AND" and "OR". The search query is as follows: [TITLE-ABS-KEY ("antimicrobial stewardship" OR "antibiotic stewardship" AND TITLE-ABS-KEY ("technology information" OR "mobile phone" OR "smart phone" OR android OR application.

This strategy was created to

1. Determine the number of published items where the title, abstract, or keywords were included in the terms (N = 426).
2. Screening: As many as 25 documents were eliminated by the timeframe. Subsequently, 106 more documents were removed from the dataset as a result of the keywords contained in the titles or abstracts.
3. Eligibility: During this step, the abstract or entire text of the remaining 271 documents was examined to establish the study's primary subject. During this step, 223 documents were removed from the last sample because they did not pertain to technology information, did not use a clinical setting, and did not focus on the patient,
4. Included: During this last step, a total of 48 documents were selected for both qualitative and quantitative analysis.

2.3   Analysis Technics and Statistical Analysis

Both qualitative and quantitative analysis techniques were utilized, which concentrated on calculating the number of papers connected to institutions, countries, and authors as well as counting citations (Fig. 1).
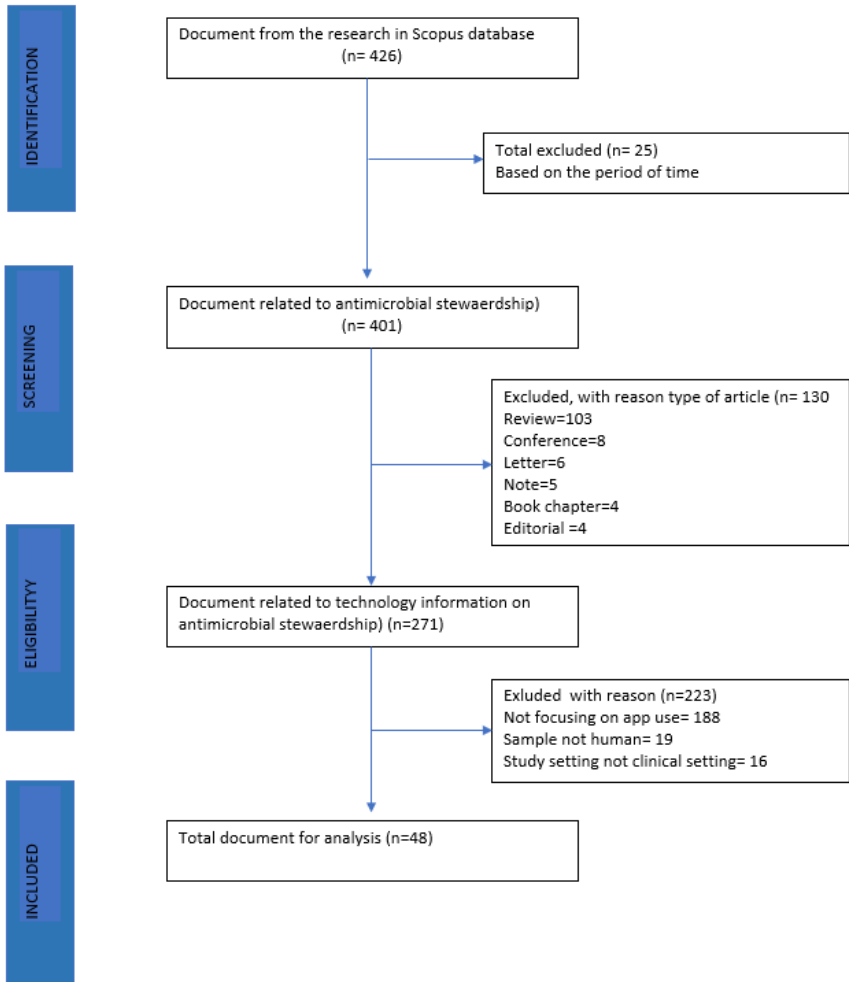
Fig. 1. Flow diagram on the selection of articles for qualitative and quantitative analysis

3   Result and Discussion

A total of 48 journal documents were retrieved. Types of retrieved documents are original research articles. This growth demonstrates the enthusiasm of academicians and researchers in the area of technology information on antimicrobial stewardship. Appropriate antimicrobial prescribing is very important to patients because it can increase the success of therapy as well as to avert the antimicrobial resistance (AMR) spread with a larger scale. Antimicrobial stewardship programs have been devised and executed by governments and healthcare organizations to promote the appropriate prescribing of antibiotics [9].

AMS is crucial for both general practice and hospitals; however, the incidence of antimicrobial-resistant microorganisms is greatest in hospitals [10]. The emergence of smartphones has made it possible to access applications (apps) without non-mobile desktop needs while also allowing for integration with clinical decision support systems.

3.1   Publication Output

According to Fig. 2, the number of published articles has increased from 3 in 2013 to 7 in 2022. This increase indicates the enthusiasm of academicians and researchers in the area of technology information related to antimicrobial stewardship. The growing trends also suggest that this trend will continue to climb in the upcoming years. The articles are observed in 2022.
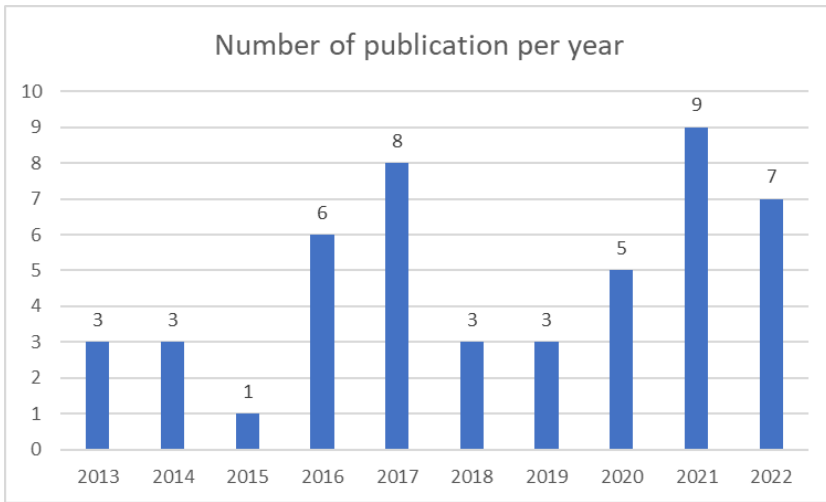
Fig. 2.   Publication trend during past 10 years

Fig. 3 indicates that 35 countries are actively involved in research on information technology related to antimicrobial stewardship. The top three countries, with 12, 12, and 5 publications each over the past decade, are the UK, the US, and Canada. These results show the same results as previous studies where most of the research focusing on information technology in the administration of antibiotics is mostly carried out in developed countries compared to developing countries [11]. This study provides a roadmap for other researchers, especially in less developed and low-income countries, to conduct similar research
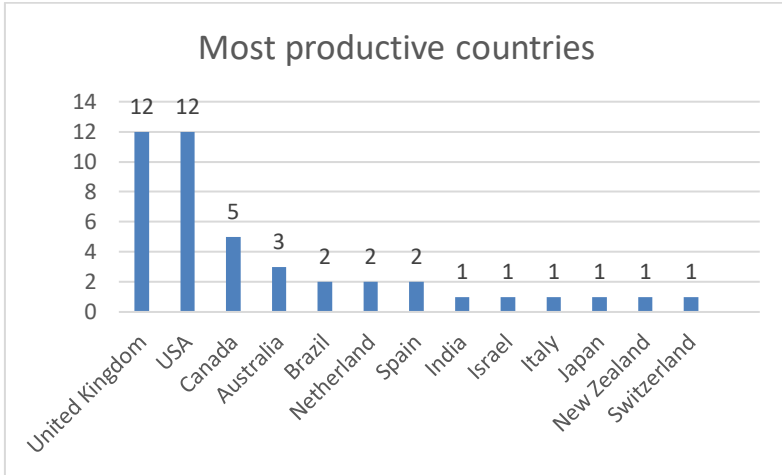
Fig. 3. Leading countries

3.2 Most Productive Journals

Fig. 4 illustrates the top 10 journals that have published articles regarding technology information on antimicrobial stewardship. The Journal of Antimicrobial Chemotherapy is the leading journal in this area with 4 publications, followed by Applied Clinical Informatics and PLOS One with 3 articles, respectively.
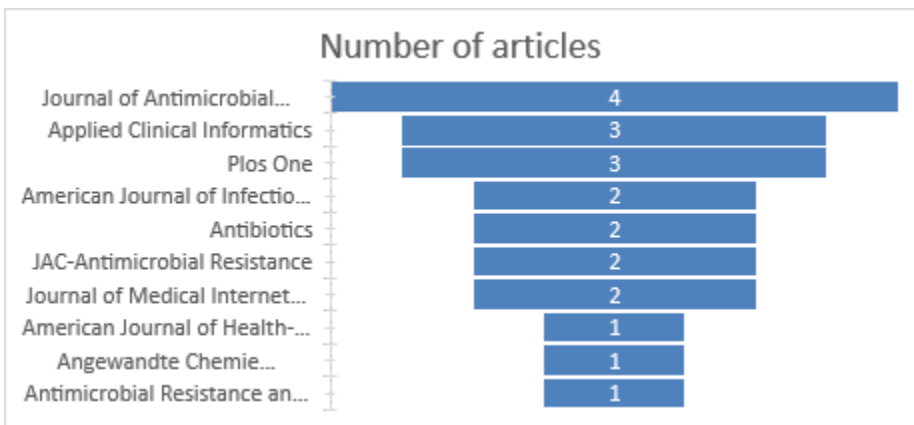

Fig. 4. Number of articles

3.3 Top Institution

By utilizing the Scopus database, this study determined the top 3 institutions vigorously engaged in research regarding technology information on antimicrobial stewardship.

These institutions were Denver Health Medical Center, Massachusetts General Hospital, and University of Toronto with 4 publications, respectively. Additionally, Imperial College London, Universidad Cardenal Herrera-CEU, University College London, University of Camerino, and University of Twente had 3 publications, respectively. The remaining institutions on the top 10 list are shown in Table 1.

Table 1. Top ten institution

Rank	Institution	Frequency
1st	Denver Health Medical Center	4
2nd	Massachusetts General Hospital	4
3rd	University of Toronto	4
4th	Imperial College London	3
5th	Universidad Cardenal Herrera-Ceu	3
6th	University College London	3
7th	University of Camerino	3
8th	University of Twente	3
9th	Brigham And Women's Hospital	2
10th	California Institute of Technology	2

3.4   Bibliometric Analysis

This study conducted a bibliometric analysis as well as performed a co-occurrence keyword analysis to define the primary research areas regarding information technology on antibiotic stewardship. The bibliometric analysis involves reviewing all existing literature on a particular topic as well as mapping out clusters of related published literature thematically. A co-occurrence keyword analysis is conducted with the use of VOSviewer software to determine core research areas as well as emerging topics related to information technology on antibiotic stewardship. This will function as a roadmap for future researchers interested in performing research in the identical area.

Co-authorship (authors)

To conduct an author co-authorship analysis, the data from Scopus was inputted into VOS viewer software. The minimum number of documents set by the author is to aggressively obtain a greater pool of authors. However, only 21 out of 300 authors were found to be strongly interconnected, as depicted in Fig. 5, and these authors were divided into 2 clusters.
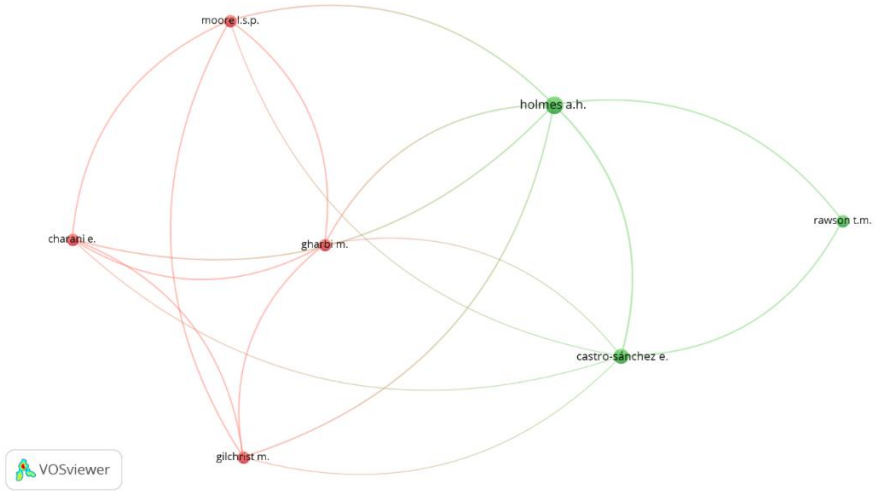
Fig. 5. Co-authorship analysis of authors on network visualisation mode

Scientific collaboration was widely recognized as a crucial component in enhancing the impact and quality of the research [12]. In order to investigate this further, this study conducted a co-authorship analysis focused on countries. During the process of performing a co-authorship country analysis, the lowest number of documents per country was determined at a minimum of 1. As a result, 19 countries fulfilled the boundaries thereby resulting in 4 clusters which were then reduced to. A bibliometric map representing the co-authoring of the country analysis is shown in Fig. 6
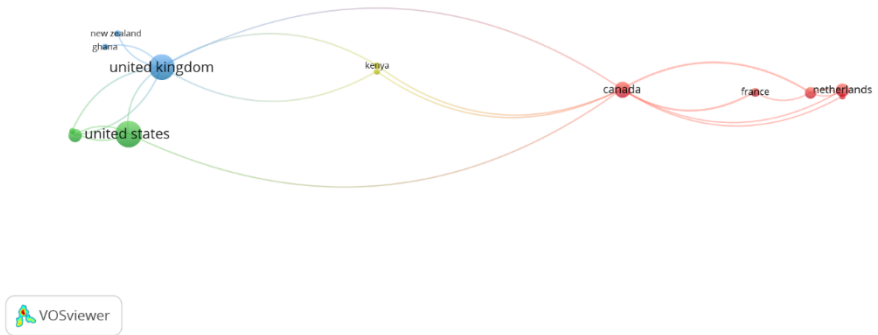
Fig. 6. Co-authorship analysis of countries on network visualisation mode

3.5   Co-occurrence of keywords analysis

By utilizing the VOSviewer software, this study has identified the most popular keywords.

According to the results, the most commonly employed keywords include antimicrobial stewardship, antibiotic stewardship, antibiotics, medical education, antibiogram, smartpghone, pharmacist, --ehealth-nurseas. Fig. 7 shows that based on the keywords (co-words), research on information technology in the administration of Scopus-indexed antibiotics in 2012 - 2022 forms 5 clusters. Cluster 1 consists of 5 keywords, antibiotics, antimicrobial resistance, antimicrpobial stewardship, infectious disease and medical education. Cluster 2 consists of 4 keywords, antibiotic stewardship, ehealth, nurse and task support. Cluster 3 consists of 2 keywords, clinical decision support and medical informatics Cluster 4 consists of 2 keywords pharmacist and prescribing. Cluster 5 consists of 2 keywords, antibiogram and smartphone
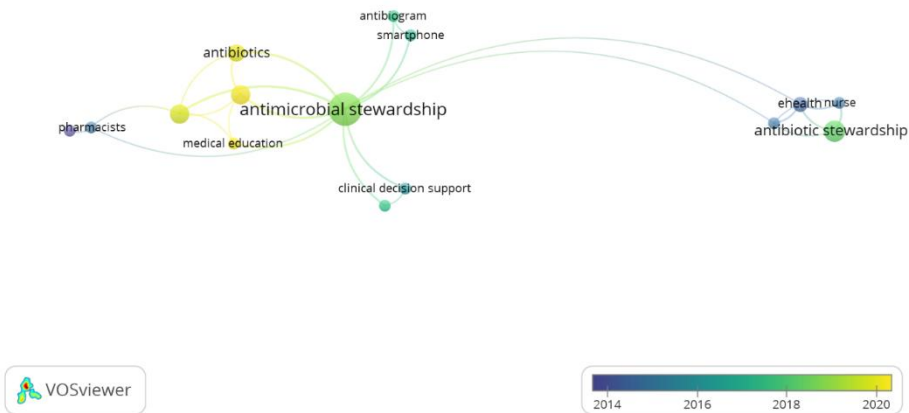

Fig. 7. Co -occurrence analysis of author keyword

4   Conclusion

The study shows that during the year from 2013 to 2022 the quantity of publications has increased concerning the theme of information technology use in antimicrobial stewardship. The United States is the country that contributes the most research related to the use of information technology in antimicrobial stewardship. From the results of the bibliometric study there has not been much research on the use of technology in antimicrobial stewardship, this will function as a roadmap for future researchers interested in performing research in the identical area.

scholarship, the hospital for giving research opportunities as well as the health professionals who participated in the study.

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