


REVIEW ARTICLE

Global trends of dalbavancin: A bibliometric analysis

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Abstract

What is known and objective?: Dalbavancin is used against gram-positive pathogens such as *Staphylococcus aureus* in acute bacterial skin and skin-structure infections.

Methods: Our main goal was to identify the key articles sustaining the current knowledge of this drug's therapeutic possibilities through a bibliometric analysis of the available literature.

Results and discussion: On 15 March 2021, we searched the Web of Science electronically for documents that contain within its title the term “dalbavancin.” We found a total of 675 documents that average 20.23 citations/publication with a density of 682.60 citations per/year, yielding an h-index of 58. After ranking them by the number of times cited, we extracted the top 100 most-cited records (T100). Number of citations/publication ranged from 13 to 231, publication years were 2002–2019, with the top-cited article published in 2014. All T100 publications were written in English. JMI Laboratories was the institution with the most articles in the T100 (22 documents), and the United States was the top country (75 documents). Five authors participated in at least five of the T100, led by Jones RN with 20 articles. Positions #1, #2, #5, and #9 were clinical trials for acute bacterial skin and skin structure infections (ABSSSI), the on-label indication for dalbavancin. Only one article in the top 10 (T10) was an off-label indication that was published in 2005 with 186 citations, and occupied the third position among the T100. Using the VOSviewer© programme, we observed that the most used keywords were: dalbavancin, lipoglycopeptide, gram-positive, osteomyelitis, vancomycin, and MRSA.

What is new and conclusions?: Our study identifies the most significant research on dalbavancin, including the highest impact publications, and highlights the recent trend of dalbavancin in new therapies. The T10 articles include the most important dalbavancin clinical trials, along with other studies and reviews that support the growing role of this antibiotic in clinical use. Emphasis has been on the favourable pharmacokinetic profile that allows administration once-weekly, with minimal risk of severe adverse events.

KEYWORDS

bibliometric analysis, dalbavancin, top-cited articles, VOS viewer

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1 | WHAT IS KNOWN AND OBJECTIVE?

Dalbavancin is a second-generation lipoglycopeptide antibiotic with a teicoplanin-like structure. It was approved by The US Food and Drug Administration¹ (FDA) in May 2014, and by the European Medicines Agency (EMA) in February 2015.² It is indicated for the treatment of adult patients with acute bacterial skin and skin structure infections (ABSSSI), including those caused by methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci except for strains exhibiting vanA resistance.³ Dalbavancin has established similar efficacy and safety with non-inferiority studies compared to other regimens (vancomycin/linezolid), and several clinical trials established its efficacy and safety.⁴ Dalbavancin's most unique property is its weekly dosing, resulting from its long half-life (9–12 days). This promotes increased adherence and fewer hospitalizations. Dalbavancin decreases the hospitalization length of stay and facilitates outpatient parenteral antimicrobial treatment.

A bibliometric review can evaluate scientific literature with results of interest to both researchers and clinicians. Nowadays, leading scientific databases like Web of Science, Elsevier's Scopus, and Google Scholar provide information on the number of times that a document has been cited.^{5–9} Subsequent statistical bibliometric analysis helps to identify outstanding scientific research, and allows identification of countries, organizations, or authors with the most prominent contributions in a specific field.^{10,11} A well-established bibliometric approach is a review and ranking of the top 100-cited articles. This endeavour identified relevant work in several health fields, including dentistry,^{5–7,12,13} medicine,^{14–18} neurology,^{19,20} and antibiotics.^{21–23}

The main goal of this study was to identify the key articles that influence the current knowledge of dalbavancin's antimicrobial therapeutic possibilities. A bibliometric study was conducted to highlight the notable advancements made on this topic. Using the *Institute for Scientific Information database*, we identified and analysed the top 100 (T100) documents containing dalbavancin in its title or topic. Further information on authorship, journal, country, and keywords is also discussed.

2 | METHODS

Two investigators (N.M.M. and J.J.) independently performed electronic searches via the Web of Science (WOS; Clarivate Analytics, USA). One search was for articles with the term “dalbavancin” in the topic, and another search with the term “dalbavancin” in the title. Indexes used were SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, and IC. No limitation was imposed on the period of publication, language, authors, funding entities, subject matter of the work, or access cost of the articles. Next, the document type was refined by selecting articles, clinical trials, and letters. We sorted these results according to the number of citations and ranked the top 100 (T100) citations in descending order. We extracted the following data elements: authors/editors, article title, journal title, countries where the articles were published, author

institutions, publication year, number of citations, citation density (citations/year), ISSN/ISBN, and the data obtained. Data elements were exported to an Excel spreadsheet (Microsoft, Redmond, Washington, USA).

The “Visualization of Similarities (VOSviewerApp) viewer software” [version 1.6.15 © 2009–2020 Nees Jan van Eck and Ludo Waltman] automatic term identification algorithm was used to graphically illustrate the bibliometric parameters with mapping networks like a word cloud. These maps facilitate visualization of the critical and most important bibliometric elements such as authors and keywords. The more important the item, the larger its label. Terms are organized in clusters, and the distance between two items reflects the relation between the items (a smaller distance indicates a stronger relationship).^{24–27} A cluster is a set of items linked together, and those without links are non-overlapping. There are two standard weight attributes, referred to as the link attribute and the total link strength attribute. For a given item, the “link” indicates the number of connections of an item with other items, and “total link strength attributes” represents the total number of connections of an item with other items.

3 | RESULTS AND DISCUSSION

On 15 March 2021, a total of 675 documents were retrieved from the WOS database by searching with the term “dalbavancin.” These documents included a total of 13,652 citations dating as far back as 2001, yielding an average of 20.23 citations/publication, a density of 682.60 citations/year, and an h-index value of 58. The types of publications were articles (584; 61.86%), reviews (242; 25.63%), meeting abstracts (38; 4.02%), letters (31; 3.29%), editorial materials (28; 2.97%), and clinical trials (21; 2.23%). Since our main objective was to ascertain the most relevant articles, clinical trials, and letters, we refined the search and obtained 584 documents. These publications maintained an h-index of 58, with a total of 13,499 citations to 7658 different papers. Next, we sorted the 584 documents by the total number of citations received to date and selected the T100. Subsequent review of the titles and the abstracts revealed that a high number of these articles lacked dalbavancin as the main focus of the study, with dalbavancin only being mentioned in a minor issue comment (data not shown). For this reason, we decided to change our query to “dalbavancin” in the title. This second query retrieved 306 documents with an h-index of 36, including 4959 total citations with an average of 16.21 citations/publication, and a density of 247.95 citations/year. These included articles (243; 66.76%), reviews (46; 12.64%), letters (26; 7.14%), clinical trials (18; 4.95%), meeting abstracts (17; 4.67%), and editorials (14; 3.84%). Again, we narrowed the second search to articles, clinical trials, and letters, reducing the results to 264 documents. These documents had an h-index of 36, which was the result of having been cited a total of 4943 times in 1555 different papers.

The 264 documents were sorted by the number of times cited to select the T100 (Table 1). The T100 publications together received

**TABLE 1** The Top 100 most cited articles with the term “dalbavancin” in the title

Top 100 position (#)	Article title	Journal	Year	Times cited	Citations/year
1	Once-Weekly Dalbavancin versus Daily Conventional Therapy for Skin Infection	<i>New England Journal of Medicine</i>	2014	231	28.88
2	Randomized, double-blind comparison of once-weekly dalbavancin versus twice-daily linezolid therapy for the treatment of complicated skin and skin structure infections.	<i>Clinical Infectious Diseases</i>	2005	220	12.94
3	Efficacy and safety of weekly dalbavancin therapy for catheter-related bloodstream infection caused by gram-positive pathogens	<i>Clinical Infectious Diseases</i>	2005	186	10.94
4	New Lipoglycopeptides a Comparative Review of Dalbavancin, Oritavancin and Telavancin	<i>Drugs</i>	2010	178	14.83
5	Once-weekly dalbavancin versus standard-of-care antimicrobial regimens for treatment of skin and soft-tissue infections	<i>Clinical Infectious Diseases</i>	2003	164	8.63
6	Tolerability, pharmacokinetics, and serum bactericidal activity of intravenous dalbavancin in healthy volunteers	<i>Antimicrobial Agents and Chemotherapy</i>	2004	128	7.11
7	Worldwide assessment of dalbavancin activity and spectrum against over 6000 clinical isolates	<i>Diagnostic Microbiology and Infectious Disease</i>	2004	111	6.17
8	Origin, structure, and activity in vitro and in vivo of dalbavancin	<i>Journal of Antimicrobial Chemotherapy</i>	2005	110	6.47
9	A Randomized Clinical Trial of Single-Dose Versus Weekly Dalbavancin for Treatment of Acute Bacterial Skin and Skin Structure Infection	<i>Clinical Infectious Diseases</i>	2016	95	15.83
10	In vitro activities of dalbavancin and nine comparator agents against anaerobic gram-positive species and corynebacteria	<i>Antimicrobial Agents and Chemotherapy</i>	2003	80	4.21
11	A Comparative Review of the Lipoglycopeptides: Oritavancin, Dalbavancin, and Telavancin	<i>Pharmacotherapy</i>	2010	75	6.25
12	In vivo pharmacodynamic activity of the glycopeptide dalbavancin	<i>Antimicrobial Agents and Chemotherapy</i>	2007	72	4.8
13	Extended-Duration Dosing and Distribution of Dalbavancin into Bone and Articular Tissue	<i>Antimicrobial Agents and Chemotherapy</i>	2015	71	10.14
14	Human pharmacokinetics and rationale for once-weekly dosing of dalbavancin, a semi-synthetic glycopeptide	<i>Journal of Antimicrobial Chemotherapy</i>	2005	68	4
15	Update of dalbavancin spectrum and potency in the USA: report from the SENTRY Antimicrobial Surveillance Program (2011)	<i>Diagnostic Microbiology and Infectious Disease</i>	2013	67	7.44
16	Antistaphylococcal activity of dalbavancin, an experimental glycopeptide	<i>Antimicrobial Agents and Chemotherapy</i>	2005	67	3.94
17	Dalbavancin: A novel once-weekly lipoglycopeptide antibiotic	<i>Clinical Infectious Diseases</i>	2008	65	4.64
18	Dalbavancin: a novel antimicrobial	<i>International Journal of Clinical Practice</i>	2007	65	4.33
19	Dalbavancin activity against selected populations of antimicrobial-resistant Gram-positive pathogens	<i>Diagnostic Microbiology and Infectious Disease</i>	2005	62	3.65
20	Population pharmacokinetic analysis of dalbavancin, a novel lipoglycopeptide	<i>Journal of Clinical Pharmacology</i>	2005	61	3.59
21	Activities of Dalbavancin against a Worldwide Collection of 81,673 Gram-Positive Bacterial Isolates	<i>Antimicrobial Agents and Chemotherapy</i>	2009	58	4.46
22	Efficacy of dalbavancin against methicillin-resistant <i>Staphylococcus aureus</i> in the rat granuloma pouch infection model	<i>Antimicrobial Agents and Chemotherapy</i>	2004	53	2.94
23	Bactericidal activity and resistance development profiling of dalbavancin	<i>Antimicrobial Agents and Chemotherapy</i>	2007	52	3.47

(Continues)

TABLE 1 (Continued)

Top 100 position (#)	Article title	Journal	Year	Times cited	Citations/year
24	Activities of dalbavancin in vitro and in a rabbit model of experimental endocarditis due to <i>Staphylococcus aureus</i> with or without reduced susceptibility to vancomycin and teicoplanin	<i>Antimicrobial Agents and Chemotherapy</i>	2004	52	2.89
26	Dalbavancin in the treatment of different gram-positive infections: a real-life experience	<i>International Journal of Antimicrobial Agents</i>	2018	50	12.5
25	Dalbavancin as Primary and Sequential Treatment for Gram-Positive Infective Endocarditis: 2-Year Experience at the General Hospital of Vienna	<i>Clinical Infectious Diseases</i>	2018	50	12.5
27	Antimicrobial activity of dalbavancin tested against Gram-positive clinical isolates from Latin American medical centres	<i>Clinical Microbiology and Infection</i>	2005	47	2.76
28	Pharmacokinetics of dalbavancin in plasma and skin blister fluid	<i>Journal of Antimicrobial Chemotherapy</i>	2007	46	3.07
29	Pharmacokinetics and excretion of dalbavancin in the rat	<i>Journal of Antimicrobial Chemotherapy</i>	2005	46	2.71
30	In vitro antistaphylococcal activity of dalbavancin, a novel glycopeptide	<i>Journal of Antimicrobial Chemotherapy</i>	2005	46	2.71
31	Pharmacokinetics of Dalbavancin in Patients with Renal or Hepatic Impairment	<i>Journal of Clinical Pharmacology</i>	2009	45	3.46
32	Dalbavancin compared with vancomycin for prevention of <i>Staphylococcus aureus</i> colonization of devices in vivo	<i>Journal of Infection</i>	2005	44	2.59
33	In vitro activities of dalbavancin and 12 other agents against 329 aerobic and anaerobic gram-positive isolates recovered from diabetic foot infections	<i>Antimicrobial Agents and Chemotherapy</i>	2006	43	2.69
34	Spectrum and potency of dalbavancin tested against 3322 Gram-positive cocci isolated in the United States Surveillance Program (2004)	<i>Diagnostic Microbiology and Infectious Disease</i>	2006	43	2.69
35	Dalbavancin for the Treatment of Osteomyelitis in Adult Patients: A Randomized Clinical Trial of Efficacy and Safety	<i>Open Forum Infectious Diseases</i>	2019	38	12.67
36	Effect of dalbavancin on the normal intestinal microflora	<i>Journal of Antimicrobial Chemotherapy</i>	2006	37	2.31
37	Dalbavancin: A Novel Lipoglycopeptide Antibiotic with Extended Activity Against Gram-Positive Infections	<i>Infectious Diseases and Therapy</i>	2015	36	5.14
38	Factors influencing broth microdilution antimicrobial susceptibility test results for dalbavancin, a new glycopeptide agent	<i>Journal of Clinical Microbiology</i>	2007	34	2.27
40	Dalbavancin and telavancin: novel lipoglycopeptides for the treatment of Gram-positive infections	<i>Expert Review of Anti-Infective Therapy</i>	2008	33	2.36
39	Pharmacokinetic-pharmacodynamic modelling of dalbavancin, a novel glycopeptide antibiotic	<i>Journal of Clinical Pharmacology</i>	2008	33	2.36
41	Comparative in vitro activities of dalbavancin and seven comparator agents against 41 <i>Staphylococcus</i> species cultured from osteomyelitis infections and 18 VISA and hVISA strains	<i>Diagnostic Microbiology and Infectious Disease</i>	2014	32	4
42	Pharmacodynamics of dalbavancin studied in an in vitro pharmacokinetic system	<i>Journal of Antimicrobial Chemotherapy</i>	2006	32	2
43	Antimicrobial spectrum and potency of dalbavancin tested against clinical isolates from Europe and north America (2003): Initial results from an international surveillance protocol	<i>Journal of Chemotherapy</i>	2005	32	1.88
44	Emergence of dalbavancin non-susceptible, vancomycin-intermediate <i>Staphylococcus aureus</i> (VISA) after treatment of MRSA central line-associated bloodstream infection with a dalbavancin- and vancomycin-containing regimen	<i>Clinical Microbiology and Infection</i>	2018	31	7.75



TABLE 1 (Continued)

Top 100 position (#)	Article title	Journal	Year	Times cited	Citations/year
45	Activity of dalbavancin, alone and in combination with rifampicin, against methicillin-resistant <i>Staphylococcus aureus</i> in a foreign-body infection model	<i>International Journal of Antimicrobial Agents</i>	2013	31	3.44
46	Review of dalbavancin, a novel semisynthetic lipoglycopeptide	<i>Expert Opinion on Investigational Drugs</i>	2007	31	2.07
47	Dalbavancin (Biosearch Italia/Versicor).	<i>Current Opinion in Investigational Drugs</i>	2002	31	1.55
48	In Vitro Activity of Dalbavancin against Drug-Resistant <i>Staphylococcus aureus</i> Isolates from a Global Surveillance Program	<i>Antimicrobial Agents and Chemotherapy</i>	2015	30	4.29
49	Dalbavancin: A new option for the treatment of gram-positive infections	<i>Annals of Pharmacotherapy</i>	2006	29	1.81
50	Dalbavancin and Oritavancin: An Innovative Approach to the Treatment of Gram-Positive Infections	<i>Pharmacotherapy</i>	2015	28	4
51	In vitro activity of dalbavancin and telavancin against staphylococci and streptococci isolated from patients in Canadian hospitals: results of the CANWARD 2007–2009 study	<i>Diagnostic Microbiology and Infectious Disease</i>	2011	28	2.55
52	Antibiotics for Gram-Positive Bacterial Infections: Vancomycin, Teicoplanin, Quinupristin/Dalfopristin, Oxazolidinones, Daptomycin, Dalbavancin, and Telavancin	<i>Infectious Disease Clinics of North America</i>	2009	28	2.15
53	Dalbavancin reduces biofilms of methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) and methicillin-resistant <i>Staphylococcus epidermidis</i> (MRSE)	<i>European Journal of Clinical Microbiology & Infectious Diseases</i>	2017	27	5.4
54	Phosphate-controlled regulator for the biosynthesis of the dalbavancin precursor A40926	<i>Journal of Bacteriology</i>	2007	27	1.8
55	Safety of Dalbavancin in the Treatment of Skin and Skin Structure Infections: A Pooled Analysis of Randomized, Comparative Studies	<i>Drug Safety</i>	2016	26	4.33
56	Dalbavancin for the treatment of acute bacterial skin and skin structure infections	<i>Expert Opinion on Pharmacotherapy</i>	2015	26	3.71
57	Dalbavancin: A novel lipoglycopeptide antibacterial	<i>Pharmacotherapy</i>	2006	26	1.63
58	Initial quality control evaluations for susceptibility testing of dalbavancin (BI397), an Investigational glycopeptide with potent gram-positive activity	<i>Journal of Clinical Microbiology</i>	2003	26	1.37
59	Dalbavancin Use in Vulnerable Patients Receiving Outpatient Parenteral Antibiotic Therapy for Invasive Gram-Positive Infections	<i>Infectious Diseases and Therapy</i>	2019	25	8.33
60	Pharmacokinetics, Safety and Tolerability of Single Dose Dalbavancin in Children 12–17 Years of Age	<i>Paediatric Infectious Disease Journal</i>	2015	25	3.57
61	Dalbavancin: A Review in Acute Bacterial Skin and Skin Structure Infections	<i>Drugs</i>	2015	25	3.57
62	Dalbavancin: A new lipoglycopeptide antibiotic	<i>American Journal of Health-System Pharmacy</i>	2008	25	1.79
63	Activity of dalbavancin tested against <i>Staphylococcus</i> spp. and beta-hemolytic <i>Streptococcus</i> spp. isolated from 52 geographically diverse medical centers in the United States	<i>Journal of Clinical Microbiology</i>	2007	25	1.67
64	Understanding and manipulating glycopeptide pathways: the example of the Dalbavancin precursor A40926	<i>Journal of Industrial Microbiology & Biotechnology</i>	2006	25	1.56
65	In vitro activity of dalbavancin against biofilms of staphylococci isolated from prosthetic joint infections	<i>Diagnostic Microbiology and Infectious Disease</i>	2016	24	4
66	Activity of dalbavancin against staphylococci and streptococci, assessed by BSAC and NCCLS agar dilution methods	<i>Journal of Antimicrobial Chemotherapy</i>	2004	24	1.33

(Continues)

TABLE 1 (Continued)

Top 100 position (#)	Article title	Journal	Year	Times cited	Citations/year
67	Evaluation of dalbavancin in combination with nine antimicrobial agents to detect enhanced or antagonistic interactions	<i>International Journal of Antimicrobial Agents</i>	2006	23	1.44
68	Validation of commercial dry-form broth microdilution panels and test reproducibility for susceptibility testing of dalbavancin, a new very long-acting glycopeptide	<i>International Journal of Antimicrobial Agents</i>	2004	23	1.28
69	Multicenter clinical experience of real life Dalbavancin use in gram-positive infections	<i>International Journal of Infectious Diseases</i>	2019	22	7.33
70	Adis drug profile—Dalbavancin	<i>Drugs</i>	2008	22	1.57
71	Distribution of radioactivity in bone and related structures following administration of [C-14] dalbavancin to New Zealand white rabbits	<i>Antimicrobial Agents and Chemotherapy</i>	2007	22	1.47
72	Comparison of dalbavancin MIC values determined by Etest (AB BIODISK) and reference dilution methods using gram-positive organisms	<i>Journal of Clinical Microbiology</i>	2006	22	1.38
73	Dalbavancin as Secondary Therapy for Serious <i>Staphylococcus aureus</i> Infections in a Vulnerable Patient Population	<i>Open Forum Infectious Diseases</i>	2019	21	7
74	Clinical efficacy of dalbavancin for the treatment of acute bacterial skin and skin structure infections (ABSSSI)	<i>Therapeutics and Clinical Risk Management</i>	2016	21	3.5
75	Surrogate analysis of vancomycin to predict susceptible categorization of dalbavancin	<i>Diagnostic Microbiology and Infectious Disease</i>	2015	21	3
76	Surveillance of dalbavancin potency and spectrum in the United States (2012)	<i>Diagnostic Microbiology and Infectious Disease</i>	2013	21	2.33
77	Safety and Efficacy of Prolonged Use of Dalbavancin in Bone and Joint Infections	<i>Antimicrobial Agents and Chemotherapy</i>	2019	20	6.67
78	A thorough QT study with dalbavancin: A novel lipoglycopeptide antibiotic for the treatment of acute bacterial skin and skin-structure infections	<i>International Journal of Antimicrobial Agents</i>	2015	20	2.86
79	A Carrier Protein Strategy Yields the Structure of Dalbavancin	<i>Journal of The American Chemical Society</i>	2012	20	2
80	Evaluation of Dalbavancin as Chiral Selector for HPLC and Comparison with Teicoplanin-Based Chiral Stationary Phases	<i>Chirality</i>	2010	20	1.67
81	Efficacy of dalbavancin in the treatment of MRSA rat sternal osteomyelitis with mediastinitis	<i>Journal of Antimicrobial Chemotherapy</i>	2016	19	3.17
82	In vitro activities of ceftobiprole, dalbavancin, daptomycin, linezolid, and tigecycline against methicillin-resistant <i>Staphylococcus aureus</i> blood isolates: stratified analysis by vancomycin MIC	<i>Diagnostic Microbiology and Infectious Disease</i>	2012	19	1.9
83	Multicenter evaluation of the in vitro activity of dalbavancin tested against staphylococci and streptococci in 5 European countries: results from the DECIDE Surveillance Program (2007)	<i>Diagnostic Microbiology and Infectious Disease</i>	2009	19	1.46
84	On- and off-label utilization of dalbavancin and oritavancin for Gram-positive infections	<i>Journal of Antimicrobial Chemotherapy</i>	2019	18	6
85	Antipneumococcal activity of dalbavancin compared to other agents	<i>Antimicrobial Agents and Chemotherapy</i>	2005	18	1.06
86	Update on dalbavancin activity tested against Gram-positive clinical isolates responsible for documented skin and skin-structure infections in US and European hospitals (2011–2013)	<i>Journal of Antimicrobial Chemotherapy</i>	2016	17	2.83
87	Dalbavancin in-vitro activity obtained against Gram-positive clinical isolates causing bone and joint infections in United States and European hospitals (2011–2016)	<i>International Journal of Antimicrobial Agents</i>	2018	16	4



TABLE 1 (Continued)

Top 100 position (#)	Article title	Journal	Year	Times cited	Citations/year
88	<i>Streptococcus suis</i> serotype 9 strain GZ0565 contains a type VII secretion system putative substrate EsxA that contributes to bacterial virulence and a vanZ-like gene that confers resistance to teicoplanin and dalbavancin in <i>Streptococcus agalactiae</i>	<i>Veterinary Microbiology</i>	2017	16	3.2
89	Anti-cooperative ligand binding and dimerisation in the glycopeptide antibiotic dalbavancin	<i>Organic & Biomolecular Chemistry</i>	2014	16	2
90	Selection of a surrogate agent (Vancomycin or Teicoplanin) for initial susceptibility testing of dalbavancin: Results from an international antimicrobial surveillance programme	<i>Journal of Clinical Microbiology</i>	2006	16	1
91	Dalbavancin: an investigational glycopeptide.	<i>Expert Review of Anti-Infective Therapy</i>	2004	16	0.89
92	Unsuccessful treatment of methicillin-resistant <i>Staphylococcus aureus</i> endocarditis with dalbavancin	<i>Journal of Clinical Pharmacy and Therapeutics</i>	2018	15	3.75
93	Dalbavancin for the treatment of acute bacterial skin and skin structure infections.	<i>Le Infezioni In Medicina</i>	2015	15	2.14
94	Monte Carlo simulation analysis of ceftobiprole, dalbavancin, daptomycin, tigecycline, linezolid and vancomycin pharmacodynamics against intensive care unit-isolated methicillin-resistant <i>Staphylococcus aureus</i>	<i>Clinical and Experimental Pharmacology and Physiology</i>	2014	15	1.88
95	Comprehensive update of dalbavancin activity when tested against uncommonly isolated streptococci, <i>Corynebacterium</i> spp., <i>Listeria monocytogenes</i> , and <i>Micrococcus</i> spp. (1357 strains)	<i>Diagnostic Microbiology and Infectious Disease</i>	2013	15	1.67
96	Activity of Dalbavancin against <i>Bacillus anthracis</i> In Vitro and in a Mouse Inhalation Anthrax Model	<i>Antimicrobial Agents and Chemotherapy</i>	2010	15	1.25
97	Dalbavancin in the treatment of complicated skin and soft-tissue infections: a review.	<i>Therapeutics and Clinical Risk Management</i>	2008	14	1
98	Dalbavancin for the management of gram-positive osteomyelitis: Effectiveness and potential utility	<i>Diagnostic Microbiology and Infectious Disease</i>	2019	13	4.33
99	Emergence of a dalbavancin induced glycopeptide/lipoglycopeptide non-susceptible <i>Staphylococcus aureus</i> during treatment of a cardiac device-related endocarditis	<i>Emerging Microbes & Infections</i>	2018	13	3.25
100	Activity of dalbavancin and comparator agents against Gram-positive cocci from clinical infections in the United States and Europe 2015–2016	<i>Journal of Antimicrobial Chemotherapy</i>	2018	13	3.25

4397 citations, which represents 88.95% of the total citations to all 264 publications. The most cited article (#1), published in 2014, received a total of 231 citations, with a density of 28.88 citations/year. In contrast, the T100 lowest cited article (#100) was published in 2018, received 13 citations, with a density of 3.25 citations/year. Of the T100, eight documents exceeded 100 citations. In addition, the top 10 papers (T10) summed 1503 citations, which represents 30.41% of the cumulative T100 citations. Publication dates ranged from 2002 to 2019 (Figure 1). The oldest T100 document is from 2002 (#47) and the most recent works are from 2019 (#35, #59, #69, #73, #77, #84, and #98). The most productive year for T100 documents was 2015 (10 documents), followed by 2018 and 2019 (seven documents each; Figure 1). The most recent document was published in August 2019 with 18 citations and is placed at the #84 spot of the T100. The #1 cited article (T1) is the 68th oldest document among the 264 publications.

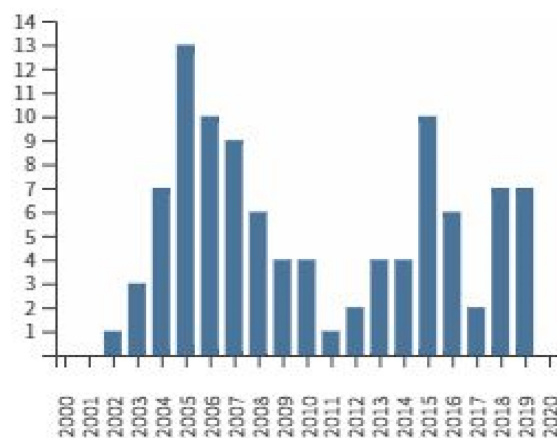
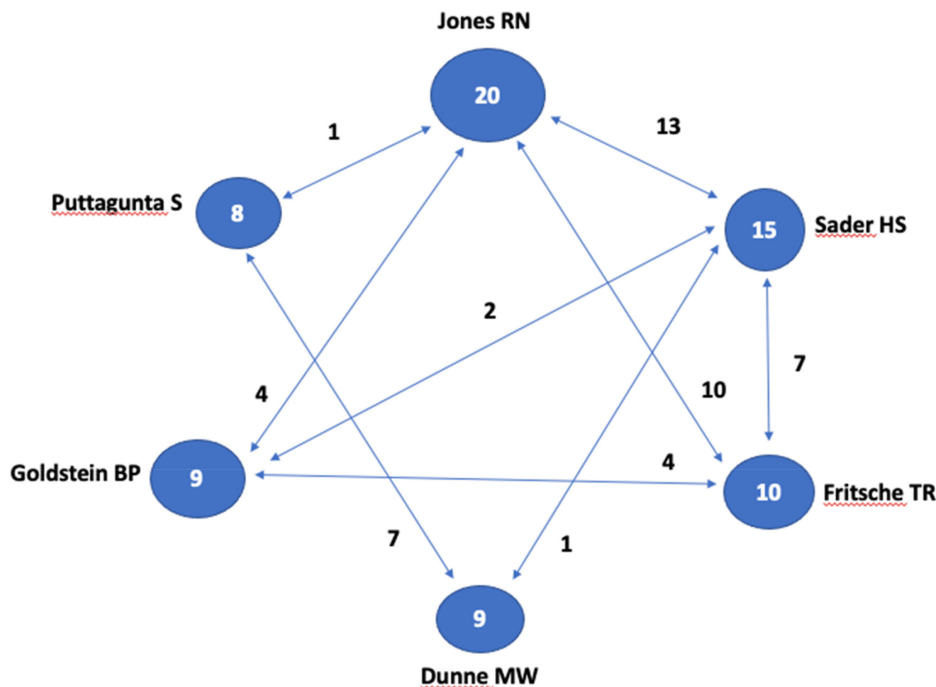


FIGURE 1 Number of T100 articles published over the years

(A)



(B)

Author	Top100-Record	Times Cited	Citations/ Record	Citation Density	Year of First Publication
Jones RN	20	712	35.60	39.56	2003
Sader HS	15	572	38.13	31.78	2004
Fritsche TR	10	391	39.10	21.72	2004
Dunne MW	9	551	61.22	68.88	2014
Goldstein BP	9	518	57.56	28.78	2003
Puttagunta S	8	535	66.88	66.88	2014

FIGURE 2 (A) The most productive authors, all authoring on eight or more of the T100 documents. Numbers inside the circles indicate the number of articles published. Connecting arrows and numbers affixed indicate co-authorship and number of papers together, respectively. (B) Authors publishing eight or more of the T100 dalbavancin-related papers are arranged by the number of T100 articles published

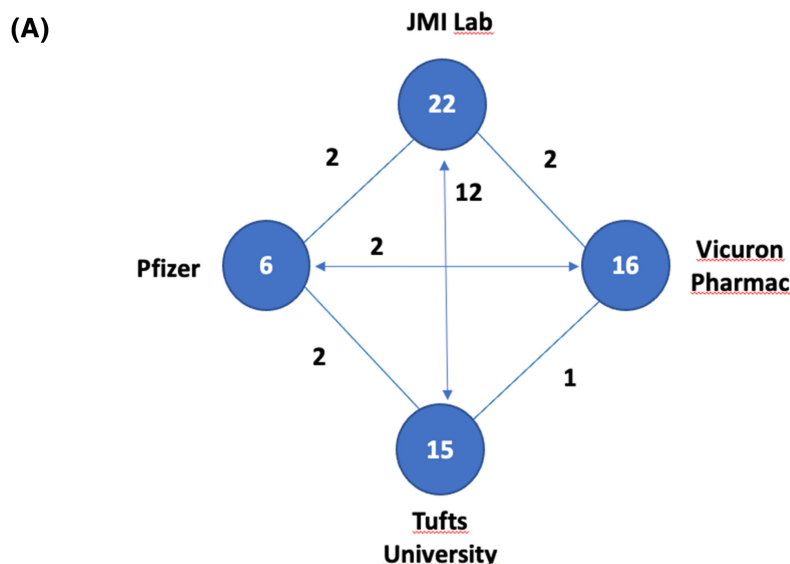
If we consider the density of citations (number of citations/year), the average of the T100 is 4.32 citations/year (Table 1). Article #1 maintains its lead with a density of 28.88 citation/year, more than double the density obtained by article #2 with 12.94 citations/year (fourth place in the density ranking). Interestingly, article #9 by total citations has a density of 15.83 citations/year, putting it in second place for citation density. With 0.89 citations/year, the publication with the lowest citation density was #91 (published in 2004).

The T100 publications had a total of 382 contributing authors, regardless of their authorship position or relevance in each of the publications, with affiliations to 225 different institutions from 23 different countries. In Figure 2A, we present the most productive authors within the T100 and their co-authorships. Jones RN (JMI Laboratories, North Liberty, IA, USA) leads this ranking with 20 articles, totaling 712 citations with a density of 35.60 citations/article and 39.56 citations/year. In second position is Sader HS with 15 articles, Fritsche TR occupies the third position with 10 articles, and Dunne

authored on nine articles (Figure 2B). Of note, these latter three authors collaborated on at least seven of the T100 articles.

There are four institutions that contributed to five or more of the T100 publications (Figure 3). JMI Laboratories was the most productive institution with 22 publications, and collaborated on 12 publications with Tufts University (Figure 3A). Vicuron Pharmaceuticals published 16 articles with 1266 citations, JMI Laboratories obtained 741 citations to its 22 publications (Figure 3B). Figure 4 illustrates the T100 geographical distribution of author origin. The United States of America published 75 articles with a total of 3543 citations (80.57%) and a density of 186.47 citations/article, the next closest country being Italy with 503 citations. There was a low number of international collaborations among the T100 (Figure 4).

The T100 articles were published in a total of 39 different journals. *Antimicrobial Agents and Chemotherapy* is the most productive journal with 15 papers, followed by *Diagnostic Microbiology and Infectious Disease* with 13 papers, and *Journal Antimicrobial Chemotherapy*



(B)

Institution	T100 Record	Times Cited	Citations/Record	Citation Density	Year of First Publication
JMI Laboratories	22	741	33.68	41.17	2003
Vicuron Pharmaceuticals	16	1,266	79.13	70.33	2003
Tufts University	15	740	49.33	41.11	2004
Pfizer	6	165	27.50	11.00	2006

FIGURE 3 The four most productive institutions within the T100. (A) Relationships between the institutions with more than five articles in the T100. Numbers inside the circles indicate the number of articles published by each institution. Connecting arrows and numbers indicate co-authorship between institutions and number of papers collaboratively co-authored, respectively. (B) Dalbavancin-related institutions publishing more than five of the T100 papers.

with 11 papers (Table 2). *Clinical Infectious Diseases* with six papers amassed 780 citations, with an average of 130.00 citations/publication. The T10s include publications in *Clinical Infectious Diseases* for #2, #3, #5, and #9.

We used Vosviewer© to map author keywords of the T100 articles. After selecting “Co-occurrence” as the type of analysis, the algorithm detected 137 author keywords. With a minimum number of occurrences of “two,” 10 words met the threshold (Figure 5A). Next, we grouped items by cluster, denoting that these top 10 author keywords yielded five clusters (Figure 5B). In the last set of studies, we analysed these keywords along a timeline (Figure 5C). For example, in 2007, “resistance” was the most relevant keyword, while “osteomyelitis” was the top one in 2018. The keywords “staphylococci” and “*Staphylococcus aureus*” remained top keywords in 2007 and 2013, respectively. This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

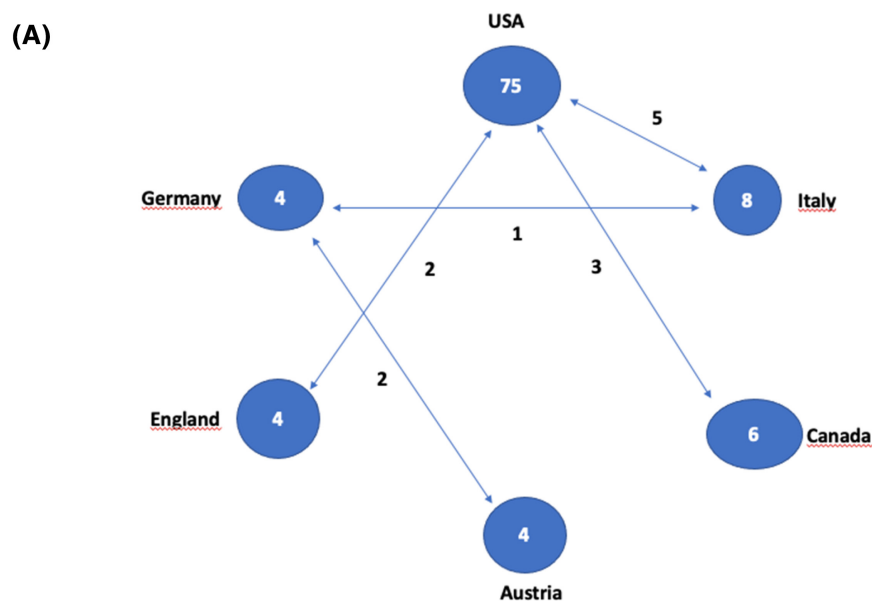
This bibliometric analysis of the available dalbavancin literature focused on the analysis of the bibliometric characteristics of the top 100 most cited documents in the WOS database. Understanding literature interactions may facilitate learning about this antibiotic, of

which we have previously shown its efficacy and safety in a systematic review meta-analysis.²⁸

We performed two different search strategies to recognize and shed light on the dalbavancin literature. Our initial WOS database search for dalbavancin as a topic term had good recall but lacked precision. It retrieved a large number of records that only peripherally mentioned dalbavancin or its results did not include dalbavancin. Frequently, the term dalbavancin was included among a list with other antibiotics as an example of antibiotics. In the second search for documents that included dalbavancin in their titles, the results were much more relevant and hence we used it for our bibliometric study.

Consistent with the fact that dalbavancin is a relatively new semi-synthetic glycopeptide antimicrobial, the oldest T100 article is from 2002. A maximum of 10 articles in one calendar year were noted in 2015, just 1 year after its approval by the United States Food & Drug Administration (FDA) (2014).

Jones and Sader are the top two authors with the most articles in the T100 (20 and 15, respectively). It is noteworthy that these two authors co-authored 13 articles, possibly because they work in the same institution (JMI laboratory). This institution retains the highest number of articles (22), including 12 articles in collaboration



(B)

Country	T100 Record	Times Cited	Citations/Record	Citation Density	Year of First Publication
USA	75	3,543	47.24	186.47	2003
Italy	8	503	62.88	27.94	2004
Canada	6	310	51.67	20.67	2006
Austria	4	112	28.00	28.00	2017
England	4	313	78.25	18.41	2004
Germany	4	121	30.25	9.31	2007

FIGURE 4 (A) Country of author origin of the T100 dalbavancin publications and their interactions. Numbers inside the circles indicate articles published by each country. Connecting arrows and numbers indicate co-authorship and number of papers co-authored, respectively. (B) Dalbavancin-related countries publishing four or more articles of the T100 papers.

TABLE 2 Dalbavancin-related journals publishing five or more of the T100 articles arranged by number of T100 articles published (T100 record)

Journal	T100 record	Times cited	Citations/record	Citation density	Year of first publication	Impact factor 2019
<i>Antimicrobial Agents and Chemotherapy</i>	15	781	52.07	41.11	2003	4.921
<i>Diagnostic Microbiology and Infectious Disease</i>	13	475	36.54	26.39	2004	2.540
<i>Journal Antimicrobial Chemotherapy</i>	12	476	39.67	28.00	2004	5.439
<i>Clinical Infectious Diseases</i>	6	780	130.00	43.33	2003	8.313
<i>International Journal of Antimicrobial Agents</i>	6	163	27.17	9.59	2004	4.621
<i>Journal of Clinical Microbiology</i>	5	123	24.60	6.83	2003	5.897

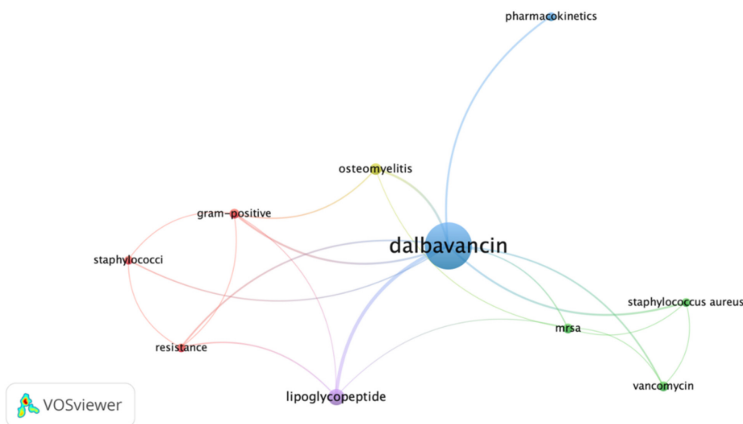
with Tufts University, the third institution in the T100. Interestingly, Fritsche TR (third most productive author with articles in the T100) was employed there. There are three different institutions from the United States (Figure 3), the country with the most contributions to the T100, a characteristic also seen in other bibliometric studies.^{19,20}

In addition, our bibliometric study affirms the hypothesis that high impact factor journals publish articles that result in high

citation records. For example, our top article (T1) was published in the *New England Journal of Medicine* (NEJM, impact factor [IF] ≈ 74.67). However, the NEJM failed to be the journal with the most T100 articles. In fact, they published only this #1 article. In contrast, among the top 10 articles, the top journal was *Clinical Infectious Diseases* (IF ≈ 8.31 , rank 3/92 in infectious diseases Q1), including four publications in the T10 and six publications in the T100.



(A)



(B)

Keyword	Links	Total Link Strength	Occurrences	Avg. Pub. Year
Cluster 1				
Gram-positive	5	9	5	2012.80
Resistance	4	7	4	2007.75
Staphylococci	3	4	4	2007.75
Cluster 2				
MRSA	5	6	5	2012.60
<i>Staphylococcus aureus</i>	3	6	5	2013.75
Vancomycin	3	5	5	2009.40
Cluster 3				
Dalbavancin	9	37	44	2012.07
Pharmacokinetics	1	4	4	2010.00
Cluster 4				
Osteomyelitis	3	8	6	2018.00
Cluster 5				
Lipoglycopeptide	4	14	10	2010.90

(C)

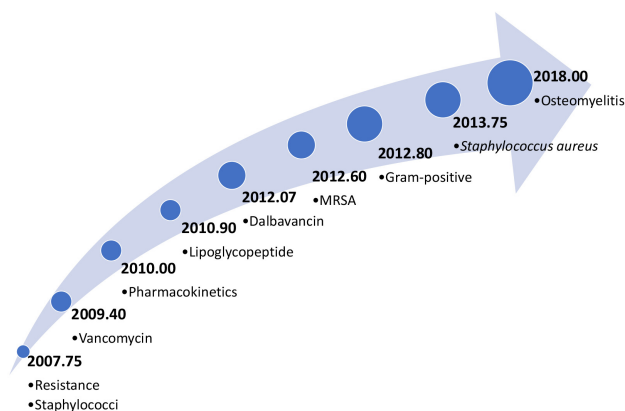


FIGURE 5 (A) The 10 most important author keywords. Word size indicates the weight of an item: the bigger the word, the more frequent it is, inferring importance. The distance indicates the relatedness of the words: the closer two words are located to each other, the stronger their relationship. (B) Top 10 author keywords of the T100 articles grouped into clusters. A cluster is a set of items included in a map. Clusters are non-overlapping in VOSviewer. An item can belong to only one cluster. (C) Chronological representation of the keywords included in T100 articles. Numbers represent the average publication year.

4 | WHAT IS NEW AND CONCLUSION?

Our study delves deeper into the evolution of the authors' keywords used in these T100 over time. Keyword development might facilitate our understanding of how the authors adjusted their research over

time. In the earliest T100 articles (year 2007.75), authors frequently used “resistance” as a keyword, while the most recent articles (2018.00) used “osteomyelitis” Relatively early results reflect an initial interest in dalbavancin in cases of microbial resistance and its pharmacokinetic profile, with subsequent later extension to expanded clinical

uses. Relatively recent dalbavancin investigations focus on the development of clinical trials and real-world studies for off-label indications. These findings are in line with a previous bibliometric analysis performed on antibiotics.²⁹

As with any bibliometric study, ours presents some limitations such as valuable results restricted to a particular point in time, and the use of only one database (Web of Science). These weaknesses can be assumed as they are also present in other systematic and bibliographic reviews as a known methodologic limitation. Additional biases within each article, such as funding from or employment with a dalbavancin-associated institution/company, may be difficult to fully appreciate in a bibliometric review. Our work is also limited by searching for “dalbavancin” in the title, which may exclude some research studies administering dalbavancin but without drug's name explicitly mentioned in the title.

Our bibliometric analysis addresses the most cited papers, regardless of positive or negative results, and reveals the most influential papers in the field. Such an analysis shows the evolution of dalbavancin in both the research realm and its clinical applications. On-label use of dalbavancin in ABSSSI studies shows no loss of efficacy or safety compromise. Investigators began looking into other clinical applications due to its pharmacokinetic advantage of once-weekly administrations. We noted a change in author keyword trends initially having to do with “resistance” and winning the battle against antibiotic-resistant bacteria, to more recent studies aimed at applying dalbavancin to off-label indications such as bone or orthoprosthesis infections. Dalbavancin's pharmacokinetic properties also avoid unnecessary hospitalization, focusing on the possibility of effective outpatient care treatments to reduce hospital length of stay.

A focus on the pharmacokinetic profile, which allows once-weekly administration with no serious adverse events, has played an important role in dalbavancin's evolution in research and clinical translation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data openly available in a public repository that issues datasets with DOIs.

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REFERENCES

1. FDA. Dalvance FDA Approval History. 2014. <https://www.drugs.com/history/dalvance.html>.
2. EMA. Xydalba, INN-dalbavancin hydrochloride. 2014. <http://www.ema.europa.eu>.
3. Roberts KD, Sulaiman RM, Rybak MJ. Dalbavancin and Oritavancin: an innovative approach to the treatment of gram-positive infections. *Pharmacotherapy*. 2015;35:935-948. doi:10.1002/phar.1641
4. Boucher HW, Wilcox M, Talbot GH, Puttagunta S, Das AF, Dunne MW. Once-weekly dalbavancin versus daily conventional therapy for skin infection. *N Engl J Med*. 2014;370:2169-2179. doi:10.1056/NEJMoa1310480
5. Feijoo JF, Limeres J, Fernandez-Varela M, Ramos I, Diz P. The 100 most cited articles in dentistry. *Clin Oral Investig*. 2014;18:699-706. doi:10.1007/s00784-013-1017-0
6. Fardi A, Kodonas K, Gogos C, Economides N. Top-cited articles in endodontic journals. *J Endod*. 2011;37:1183-1190. doi:10.1016/j.joen.2011.05.037
7. Corbella S, Francetti L, Taschieri S, Weinstein R, Del Fabbro M. Analysis of the 100 most-cited articles in periodontology. *J Investig Clin Dent*. 2017;8:e12222. doi:10.1111/jicd.12222
8. Kolahi J, Khazaei S. Altmetric: top 50 dental articles in 2014. *Br Dent J*. 2016;220:569-574. doi:10.1038/sj.bdj.2016.411
9. Richard Van Noorden BM, Nuzzo R. The top 100 papers. *Nature*. 2014;514:550-553.
10. Hirsch JE. An index to quantify an individual's scientific research output. *Proc Natl Acad Sci U S A*. 2005;102:16569-16572. doi:10.1073/pnas.0507655102
11. Ahmad P, Dummer PMH, Noorani TY, Asif JA. The top 50 most-cited articles published in the *International Endodontic Journal*. *Int Endod J*. 2019;52:803-818. doi:10.1111/iej.13083
12. Tarazona B, Lucas-Dominguez R, Paredes-Gallardo V, Alonso-Arroyo A, Vidal-Infer A. The 100 most-cited articles in orthodontics: a bibliometric study. *Angle Orthod*. 2018;88:785-796. doi:10.2319/012418-65.1
13. Wu Y, Tiwana H, Durrani M, et al. Hallmark of success: top 50 classics in oral and maxillofacial cone-beam computed tomography. *Pol J Radiol*. 2018;83:e11-e18. doi:10.5114/pjr.2018.74343
14. Shuaib W, Acevedo JN, Khan MS, Santiago LJ, Gaeta TJ. The top 100 cited articles published in emergency medicine journals. *Am J Emerg Med*. 2015;33:1066-1071. doi:10.1016/j.ajem.2015.04.047
15. Coats AJ. Top of the charts: download versus citations in the *International Journal of Cardiology*. *Int J Cardiol*. 2005;105:123-125. doi:10.1016/j.ijcard.2005.08.004
16. Tam WW, Wong EL, Wong FC, Hui DS. Citation classics: top 50 cited articles in ‘respiratory system’. *Respirology*. 2013;18:71-81. doi:10.1111/j.1440-1843.2012.02262.x
17. Baltussen A, Kindler CH. Citation classics in anesthetic journals. *Anesth Analg*. 2004;98:443-451. doi:10.1213/01.ane.0000096185.13474.0a
18. Ponce FA, Lozano AM. Highly cited works in neurosurgery. Part I: the 100 top-cited papers in neurosurgical journals. *J Neurosurg*. 2010;112:223-232. doi:10.3171/2009.12.JNS091599
19. Garcia-Fernandez FJ, Garcia-Fernandez AE, Ikuta I, et al. A bibliometric evaluation of the top 100 cited dimethyl fumarate articles. *Molecules*. 2021;26:1085. doi:10.3390/molecules26041085
20. Garcia-Fernandez FJ, Garcia-Fernandez AE, Nava E, et al. A bibliometric evaluation of the top 100 cited natalizumab articles. *J Neuroimmunol*. 2020;349:577379. doi:10.1016/j.jneuroim.2020.577379
21. Arshad AI, Ahmad P, Karobari MI, et al. Antibiotics: A Bibliometric Analysis of Top 100 Classics. *Antibiotics (Basel)*. 2020;9:219. doi:10.3390/antibiotics9050219
22. Sweileh WM, Moh'd Mansour A. Bibliometric analysis of global research output on antimicrobial resistance in the environment (2000-2019). *Glob Health Res Policy*. 2020;5:37. doi:10.1186/s41256-020-00165-0



23. Wang CY, Li BH, Ma LL, et al. The Top-100 highly cited original articles on drug therapy for ventilator-associated pneumonia. *Front Pharmacol*. 2019;10:108. doi:[10.3389/fphar.2019.00108](https://doi.org/10.3389/fphar.2019.00108)
24. van Eck NJ, Waltman L, van Raan AF, Klautz RJ, Peul WC. Citation analysis may severely underestimate the impact of clinical research as compared to basic research. *PLoS One*. 2013;8:e62395. doi:[10.1371/journal.pone.0062395](https://doi.org/10.1371/journal.pone.0062395)
25. van Eck NJWL, Noyons EC, Buter RK. Automatic term identification for bibliometric mapping. *Scientometrics*. 2010;82:15-596.
26. van Eck NJWL. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*. 2010;84:15-538.
27. van Eck NJWL. Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics*. 2017;111:17-1070.
28. Monteagudo-Martinez N, Solis-Garcia Del Pozo J, Nava E, Ikuta I, Galindo M, Jordan J. Acute bacterial skin and skin-structure infections, efficacy of Dalbavancin: a systematic review and meta-analysis. *Expert Rev Anti Infect Ther*. 2020;1-13. doi:[10.1080/14787210.2021.1828865](https://doi.org/10.1080/14787210.2021.1828865)
29. Azzopardi EA, Ferguson EL, Thomas DW. Colistin past and future: a bibliographic analysis. *J Crit Care*. 2013;28:e213. doi:[10.1016/j.jcrc.2012.04.008](https://doi.org/10.1016/j.jcrc.2012.04.008)

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