CAS INSIGHTS™

THE FUTURE OF ANTIMICROBIAL DISCOVERY

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Overview

The WHO has declared antimicrobial resistance as one of the top ten primary health concerns. Analysis of the CAS Content Collection™ provided an overview of the current state of global research efforts in this field.

Background: Bacterial pathogens such as *Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, *Enterobacter sp.*, and *Escherichia coli* (collectively known as ESKAPEE) are among many known to be multi-drug resistant. Mining the CAS Content Collection for publications from 2012 onwards uncovered trends in antimicrobial publications, research focus, and funding.

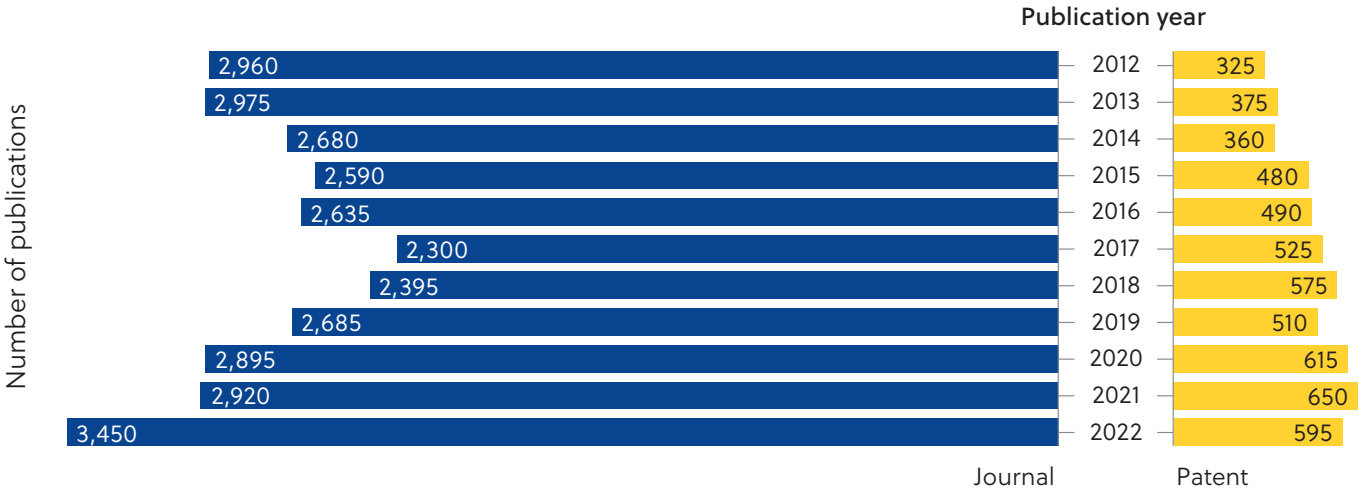
Market potential: Six out of eighteen antimicrobial-resistant bacterial threats listed by the Centers for Disease Control and Prevention incurred a collective cost of $4.6 billion in 2020. These include: Vancomycin-resistant *Enterococcus* (VRE), Carbapenem-resistant *Acinetobacter baumannii* (CRAB), Methicillin-resistant *Staphylococcus aureus* (MRSA), Carbapenem-resistant Enterobacterales (CRE), Multidrug-resistant *Pseudomonas aeruginosa* (MDR-PA), and Extended-spectrum beta-lactamases (ESBL) producing Enterobacterales.

Key challenges: Genetic mutations, biofilm formation, low candidate drug success rates, and lesser return on investment due to resistance acquisition outpacing the development of antimicrobials are common obstacles in antimicrobial research.

Key benefits: Steady investment over the past ten years has led to the discovery of new potential antimicrobials. Artificial intelligence (AI) is in its infancy but shows promise for streamlining the process from discovery to market.

Overview of research insights

Over 35,000 scientific publications relating to antimicrobial research, with a particular focus on antibacterials, were identified within the CAS Content Collection. Patent publications represented one-fifth of the journal publications, suggesting academic research in the past decade has yet to result in commercialization.

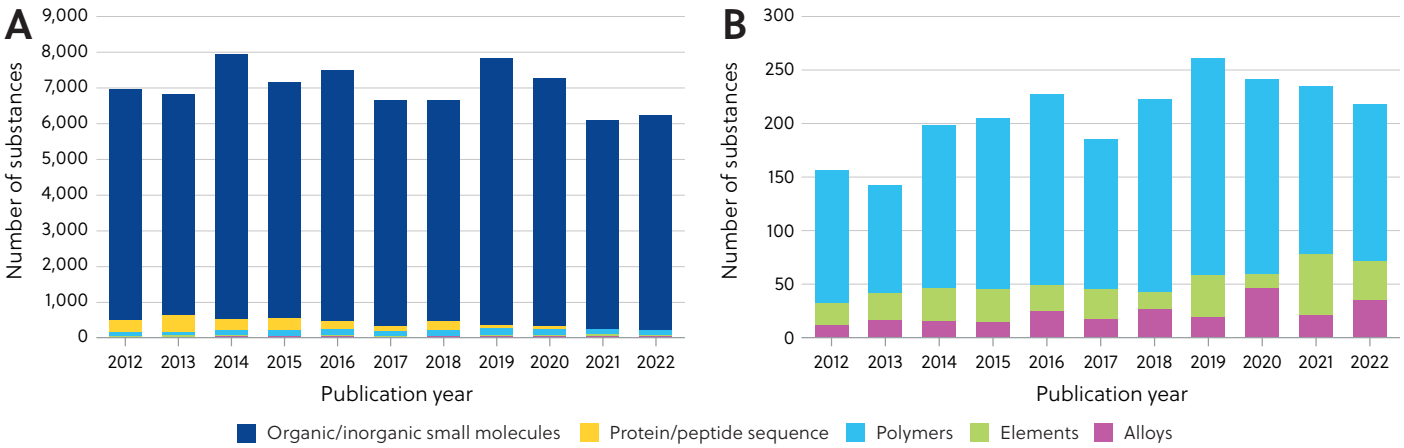


Number of journal and patent publications per year in the field of antimicrobial research (shown as blue and yellow bars, respectively) over the last decade (2012–2022).

Substances associated with antimicrobials

There are more than 193 thousand substances associated with journal publications in the antimicrobial field from 2012–2022. Investigation into substance classes reveals that organic/inorganic small molecules, protein/peptide sequences, polymers, elements, and alloys are the important classes. The number classified as organic/inorganic small molecules outnumber protein/peptide sequences 15-fold.

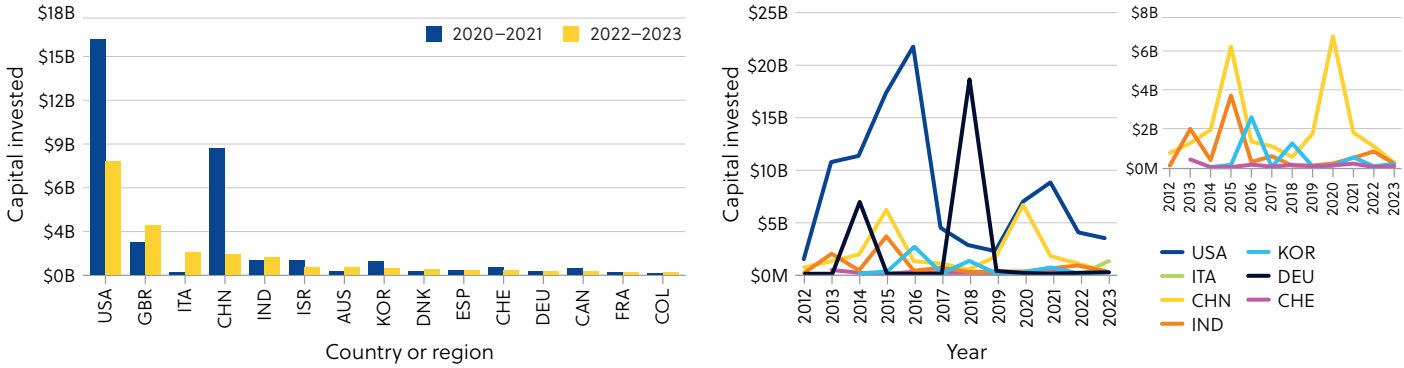
While still important, other classes such as polymers, elements, and alloys, account for a much smaller fraction of substances being used for antimicrobials. Overall, the growth in antimicrobial substances has been more or less stagnant. However, among the major classes, organic/inorganic small molecules show a marginal increase post-2020, indicating continued and sustained research endeavors.



(A) Growth in substances associated with antimicrobials over 2012–2022 from the CAS Content Collection. Only substances indexed with a therapeutic (THU) or pharmacological activity (PAC) role were included in the analysis. **(B)** A zoomed-in view with an emphasis on polymers, elements, and alloys to better reflect growth over the last decade.

Capital investment in antimicrobial resistance

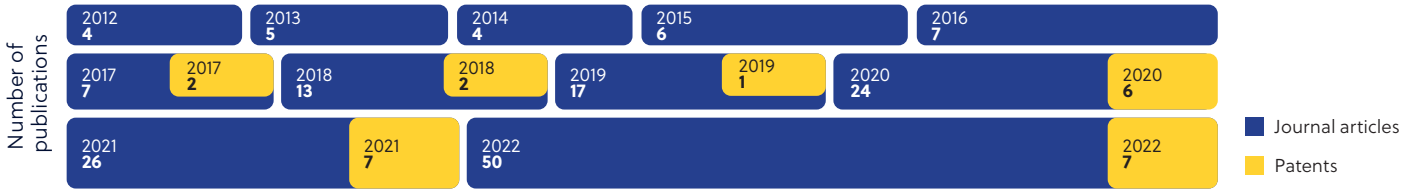
Pitchbook, an investment data platform, reveals an overall steady increase in invested capital over the last decade. The USA continues to lead in terms of capital invested in 2022–2023, followed closely by Europe and Asia. Among the leading countries or regions, the UK and India are the only two that show an increase in capital investments in 2022–2023 vs. 2020–2021. Overall, capital investment time trends indicate lower investments for most countries or regions, except for Italy, which could be an indicator of a rise in alternate antimicrobial therapies.



(A) Leading countries or regions in terms of capital investment in antibiotics between 2020-2023. Standard three-letter codes are used to represent countries or regions. **(B)** Growth in capital invested over time for several key countries or regions

AI in antimicrobials

Although still in its infancy, increased AI use in antimicrobial publications has been reported over the past ten years. Algorithms are being developed to identify viable hit molecules and accelerate the drug development timeline.



The number of journal and patent publications per year corresponding to AI use in antimicrobial research (shown as blue and yellow blocks, respectively) over the last decade (2012–2022).

Looking ahead

The biggest challenge in antimicrobials remains the continued development and persistence of antimicrobial resistance, and there is a dire need for novel agents. AI and machine learning-based approaches have the potential to reduce the timeline for the development of new antimicrobials significantly. However, their widespread use is still in its infancy and requires further research efforts.

Learn more at cas.org/insights

More comprehensive information and references can be found at cas.org/insights

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