Bridging the fair share gap for antibacterial innovation: an observational analysis of antibacterial revenues in the G7 and EU27

Maple Goh,[a,b] Matt McEnany,[c] Rachel Freeman,[d] Max Newton,[e] Aaron S. Kesselheim,[a] and Kevin Outterson[b,*]

[a]Program on Regulation, Therapeutics and Law, Division of Pharmacoepidemiology and Pharmacoeconomics, Department of Medicine, Brigham and Women's Hospital/Harvard Medical School, 1620 Tremont, Suite 3030, Boston, MA, 02120, United States
[b]Boston University School of Law, 765 Commonwealth Avenue, Boston, MA, 02215, United States
[c]University of Colorado Skaggs School of Pharmacy and Pharmaceutical Sciences, 12850 East Montview Boulevard, Aurora, CO, 80045, USA
[d]IQVIA, 37 North Wharf Road, London, W2 1AF, United Kingdom
[e]IQVIA, Kirschgartenstrasse 14, 4051, Basel, Switzerland

eClinicalMedicine
2025;88: 103485
Published Online 8 September 2025
https://doi.org/10.1016/j.eclinm.2025.103485

Summary

Background Antimicrobial resistance (AMR) poses an important global health challenge, including insufficient investment in research and development. This study quantifies the required "fair share" contributions from the G7+EU27 countries for an effective set of pull incentives for antibacterial research and development.

Methods Fair share targets within the G7+EU27 were calculated from GDP data and revenue targets from the literature, adjusted for inflation. Cefiderocol and ceftazidime-avibactam were selected as representative of key antibacterials. Revenues and volumes from IQVIA MIDAS data on these drugs were used to assess alignment with fair share targets. The study period was January 2015–December 2024.

Findings The G7+EU27 low-end, mid-range, and high-end annual revenue targets are US$258, US$363, and US$562 million in global revenues (USD 2024), respectively, consistently over ten years. An antibiotic meeting the mid-range target would be 230th in a global rank of drugs by revenues. While the UK and Italy are on track to meet annual mid-range targets going forward, other G7 countries are not, and only Italy has met cumulative mid-range targets for both drugs.

Interpretation Collectively, the G7+EU27 has not met cumulative mid-range targets. The UK meets mid-range annual targets going forward due to its antimicrobial subscription program. Italy meets mid-range targets due to higher use and may continue to meet them due to an "orphan" reimbursement fund for antibiotics. German, French, and Japanese antibacterial pull incentives have not met the mid-range targets. No G7 member meets high-end targets at current unit prices or volumes. A revenue guarantee pull incentive designed to top-up market revenues could support innovation and accelerate access without relying on higher prices or volumes. Progress in the UK and Italy demonstrates that meeting fair share targets are achievable within different national contexts.

Funding MG was supported by a post-doctoral fellowship at Boston University. ASK's work was funded by Arnold Ventures and International Collaborative Bioscience Innovation & Law Programme (Novo Nordisk Foundation grant number NNF23SA0087056). While KO is Executive Director of CARB-X, this work was not funded under any CARB-X grant.

Keywords: Antibacterial; Innovation; Pull incentives; Push incentives; Research and development

Introduction

Antimicrobial resistance represents an important global health challenge that could undermine decades of medical progress.[1] As microbes continue to evolve, the effectiveness of existing antimicrobials diminishes, necessitating the development of novel therapies.

*Corresponding author. 765 Commonwealth Avenue, Boston, MA, 02215, United States.
E-mail address: mko@bu.edu (K. Outterson).

Research in context

Evidence before this study

Before conducting this study, we searched for past proposals on the economic models, political commitments, and studies on the impact of antibacterial market issues. We used PubMed, OVID, and Google Scholar databases without restricting language or publication type. The search terms used were ((“pull incentive*” OR “financial incentive*” OR “market incentive*”) AND (“fair share” OR “equitable contribution*” OR “GDP-proportional model*”) AND (“antimicrobial*” OR “antibiotic*” OR “antibacterial*”)). This search yielded 48 results on PubMed and 1200 articles on Google Scholar. While existing evidence acknowledged the need for international collaboration, few studies specifically addressed fair share contributions proportional to GDP.

Added value of this study

This study introduces a structured, inflation-adjusted fair share model for antibacterial pull incentives based on GDP data from G7+EU27 countries. Using the Biomedical Research and Development Price Index to update older estimates, this research provides a more current and contextually relevant basis for fair share contributions over time. Additionally, this study explores pull incentives within national contexts, using antibacterial revenue data to identify departures from fair share contributions. This study illustrates the gaps in equitable financial responsibility from the G7+EU27 to support antibacterial pull incentives.

Implications of all the available evidence

National and regional antimicrobial resistance research and development solutions must reach the necessary global scale. This study’s inflation-adjusted fair share model for antibacterial pull incentives aligns with the economic capacities of the G7+EU27, supporting equitable contributions without overburdening individual nations. The findings indicate that UK and Italy are likely to meet the annual fair share targets going forward and demonstrate the gap to be filled in the remaining countries via pull incentives that prioritize global access and stewardship.

Access to existing antimicrobials will save lives, but sustainable solutions require research and development. A recent scenario estimated more than 11 million lives could be saved by 2050 with an improved pipeline of antibacterial drugs targeting Gram-negative bacteria.[2]

Despite the critical need for new therapeutics, the antimicrobial research and development ecosystem is in crisis, due to reduced funding of critical research and development and the economic disincentives from low initial revenues, especially for antibacterials.[3–12] “Push” and “pull” incentives are complementary strategies to address these challenges. Push incentives, such as public-private partnerships that provide financial and non-financial support during the research process, have been created to help projects advance toward market authorization. Push incentives paid prior to market authorization remain underfunded by $250–400 million per year.[3–11] Pull incentives, by contrast, are paid subsequent to market authorization and effective access.

Antimicrobial pull incentives must operate at proper global scale to function optimally.[13,14] Additionally, pull incentives designed to offer monetary rewards regardless of sales volume (known as “delinked” pull incentives) operate without requiring boosted sales volumes that might undermine stewardship efforts.[15] Support for push and pull incentives has been expressed in the Political Declaration of the United Nations General Assembly[11] and Health Ministers’ Declarations in the last four G7 meetings hosted by the UK, Germany, Japan, and Italy.[4,16–20] The countries of G7+EU27 are well-positioned to assume the costs of antibacterial research and development innovation, given their financial resources and the consistent political support for push and pull incentives at the G7 (with the EU27 as a member).[3–5,8] Low- and middle-income countries are important partners with stakes in ensuring appropriate access to innovative medicines.[21] Low-income countries should not be expected to contribute financially, although have important roles to play, alongside others, in infection control and prevention, stewardship, and access. Middle-income countries may participate as research and development funders to the extent that resources allow, reflecting a flexible and inclusive approach to scaling the initiative.

In previous work, Outterson provided a “best estimate” of US$310 million in global revenues (based on 2019 dollars) required each year for ten years to create an effective incentive and proposed to split this cost among G7+EU27 countries according to a “fair share” principle by which countries would contribute according to their relative gross domestic products.[8,22–25] This study examines annual antibacterial revenue and volume data to estimate whether G7+EU27 nations are achieving investment comparable to this fair share target for antibacterial pull incentives. We focus on two novel antibacterials—cefiderocol and ceftazidime-avibactam—as proxies for “high impact” drugs, because they qualified for the UK pilot and hold the potential for useful clinical impact. They both have achieved higher global revenues than other recently-approved antibacterials, due to a confluence of factors we do not analyze here.

We also note that access to new antibacterials is a serious issue, with substantial gaps in registration and access around the world.[26,27] All countries paying a pull incentive will certainly require both regulatory registration and access within their territories, but collectively the G7+EU27 also have an opportunity to dramatically expand access to these drugs globally.

Methods

Fair share calculations

We conducted a fair share calculation for the G7+EU27, based on Gross Domestic Product (GDP) data in USD obtained from the Organization for Economic Co-operation and Development (OECD) database.[28] Each country's GDP share was determined relative to the combined G7+EU27 as a proxy for economic capacity. This economic baseline provided a foundation for apportioning each country's financial responsibility within the emerging global antimicrobial resistance pull incentive framework based on prior estimates of the required global revenues for an effective pull incentive.[29] We used the "best-estimate" mid-case for global revenue targets (other cases are presented in the Supplement). To account for inflation, we applied the Biomedical Research and Development Price Index.[30]

Monthly sales volume and revenue data collection and analysis

Monthly sales volume and global revenue data for cefiderocol and ceftazidime-avibactam were extracted from the IQVIA Multinational Integrated Data Analysis System (MIDAS) database. Data were included from January 2019 to December 2024 for cefiderocol and from January 2015 to December 2024 for ceftazidime-avibactam. MIDAS does not include per country monthly revenue data prior to July 2017, so for ceftazidime-avibactam data from 2015 to January 2018, we used annual, global data. MIDAS data included annual volume used (in treatment days) for our study drugs per country, so for per-country revenue for ceftazidime-avibactam prior to 2018, we divided annual revenue numbers by the proportion of total annual treatment days recorded in each country. IQVIA MIDAS records data on the volume of branded and generic products dispensed in both retail and hospital pharmacies. Data sources are manufacturers, wholesalers, and hospital and retail pharmacies. IQVIA MIDAS is an IQVIA proprietary information service which integrates IQVIA's national audits into a globally consistent view of the pharmaceutical market, and provides estimated product volumes of registered medicines, trends and market share through retail and non-retail channels. IQVIA national audits and IQVIA MIDAS® reflect local industry standard source of pack prices, which might be list price or average invoice price, depending upon the country and the available information; they do not take into account rebates or clawbacks, details of which are normally confidential and could be substantial, and therefore these estimated prices do not reflect net prices realized by the manufacturers. Sales values reflected in these IQVIA audits are calculated by applying such relevant pricing to the product volume data collected for, and reflected in, such audits. In addition, to allow the national audit sales values to be viewed at a common sales level, MIDAS applies a single average industry margin to the locally reported values.

For this study, we include revenues from any source. MIDAS data do not include pull incentive payments, such as from the UK's pilot subscription pull incentive or Sweden's antibacterial access program, which were in place during our study period. The UK pilot program, which the UK has since adjusted to create a permanent program, guaranteed revenue for cefiderocol and ceftazidime-avibactam, regardless of sales volume, based on an assessment of the social value of each drug. The UK offered the manufacturers of these drugs an annual payment of up to GBP 10 million, commencing in July 2022 (Crabb N, NICE, personal communication). We do not know the actual amount paid, but assumed the maximum of GBP 10 million, calculated based on the July 1, 2022 exchange rate, which was approximately 1.22 GBP to USD. We recognize the positive future impact of the 2024 increases in payments under the UK program, which more than doubles the maximum annual amounts payable to GBP 23.7 million.[17] Our 2024 numbers for the UK also assumed the maximum payment allowed, at a July 1, 2024 exchange rate of 1.26 GBP to USD. Sweden's antibacterial access program is a revenue guarantee "top-up" not to exceed SEK 4,000,000 (approximately €358,000) per drug.[31] To our knowledge, the top-up amounts paid for cefiderocol and ceftazidime/avibactam are not publicly reported (see Supplement). We also have not observed the Japanese antibacterial pilot pull incentive make a publicly announced payment during our study period. In any event, the amounts proposed by Japan are modest. We also note prospective changes in Italian antibacterial reimbursement announced at the G7 in 2024 and adopted by the Italian Parliament in 2025[19] and two proposals in the EU (the HERA revenue guarantee and the Transferrable Exclusivity Voucher),[32] but none of these payments occurred during the study period.[19]

Pull incentive targets were calculated per drug at the time of first entry into any market globally. While companies always delay or stagger registration or introduction of antibacterials, even within the G7, companies may accelerate market introductions if pull incentives were available.[26] The annual pull incentive target was adjusted for inflation to the first year of each drug ($315.5 million for cefiderocol; $282.6 million for ceftazidime/avibactam). That revenue amount is assumed to be constant over ten years, consistent with the previous estimate by Outterson[29] and current UK practice. Cumulative pull incentive amounts were calculated based on the number of years since the new drug was first approved in the G7+EU27. While this is presented as a point estimate here, the underlying model includes some uncertainty around a range.

Revenue and pull incentive estimates were adjusted for inflation using the Biomedical Research and Development Price Index[33] and are presented in 2024 USD.

Annual prices per treatment day were calculated by dividing annual revenue by annual treatment days. Treatment days were calculated by multiplying the strengths associated with each drug by the daily dose listed on each drug's label.

These results were compared to the annual revenues of all new Anatomical Therapeutic Chemical (ATC) J01 "antibacterials for systemic use" that entered the global market between March 2013 and March 2024 and to the global revenues for the top 250 pharmaceuticals on the market in March 2023 to March 2024, using IQVIA data. No correlations were run as this study is not designed for causal inference.

Ethics

This study used aggregated data from the IQVIA MIDAS database and did not involve human participants or identifiable personal data. Therefore, ethics approval was not required.

Role of funding source

MG was supported by a post-doctoral fellowship at Boston University. ASK's work was funded by Arnold Ventures and the International Collaborative Bioscience Innovation & Law Programme (Novo Nordisk Foundation grant number NNF23SA0087056). While KO is Executive Director of CARB-X, this work was not funded under any CARB-X grant. The funding sources had no role in the study design, data collection, data analysis, data interpretation, or writing of the manuscript.

Results

The 2024 USD fair share revenue targets for the G7+EU27 required to support antibacterial innovation are presented in Table 1. We report three estimates here: low-end, mid-range, and high-end, which should correspond to the public health value of an innovative antibiotic.

Fig. 1 illustrates the cumulative revenue of antibiotics in the J01 class first approved globally by a stringent drug regulatory authority between March 2013 and March 2024. Revenues are reported in 2024 dollars. For the two drugs analyzed by this study, the value of the mid-range revenue target in nominal dollars at the time of each drug's approval is shown as well. Low-end and high-end revenue targets are shown in the Supplement. Only G7/EU27 revenue is shown for the study drugs. Neither drug has produced cumulative revenue in the G7/EU27 comparable to the cost of a mid-range pull incentive starting in the year of each drug's first approval. Ceftazidime-avibactam cumulative revenue just surpassed a low-end pull incentive in its 10th year after approval (see Supplement Figure S1a).

Table 2 illustrates the annual revenue for cefiderocol and ceftazidime-avibactam in the G7+EU27 from 2015 to 2024. In 2024, ceftazidime-avibactam reached annual revenue of $336 million and cefiderocol reached $219 million. Annual cefiderocol revenues therefore still fall short of its mid-range revenue target ($315.5 million, inflation adjusted back to the year of market entry, 2020). Ceftazidime-avibactam revenues surpassed its mid-range annual revenue target ($282.6 million, inflation adjusted back to the year of market entry, 2015) seven years after market launch.

Fig. 2 shows cumulative revenue gap (or surplus) for ceftazidime-avibactam and cefiderocol for each G7 country and the entire EU27. The data show variations across countries. Cumulative revenues for these two drugs in G7 members remain below mid-range revenue targets, except Italy (both drugs) and the US (ceftazidime/avibactam only). No countries other than Italy achieved the high-range targets for either drug (Supplement, Figure S2b).

Table 3 shows the maximum top-up payments required in each G7 member if a mid-range pull incentive had started at the year of first approval for each drug. Although cumulative mid-range targets have not been met for either drug, for ceftazidime-avibactam, top-up payments would have decreased over time and would not be paid at all for some years in some countries. For cefiderocol, top-up payments would also have decreased over time, but Italy would have paused top-up payments, in 2022. Under the UK subscription program, the UK met its annual mid-range target for ceftazidime-avibactam and cefiderocol in 2022 and 2023 respectively. Note that the maximum values are required only if companies bringing new antibacterials to the market choose to register and make them practically available across all of the G7+EU27. No pull incentive should be paid by a government for any portion of the 10-year period during which the antibacterial was not accessible in that territory.

While meeting estimated revenue targets would be economically significant for the sponsor of a new antibiotic, in the context of the entire market for pharmaceuticals, such revenue would not be blockbuster levels. Fig. 3 shows global revenue for all patent-protected pharmaceutical products between March 2023 and March 2024. An antibiotic receiving global revenues equal to the mid-range targeted value of $363 million per year would be the 230th best-selling on-patent pharmaceutical globally in 2024.

Discussion

We evaluate the extent to which the G7+EU27 countries generated annual revenues around new antibiotics sufficient to provide a sustainable global market for new antibacterial innovation. Current revenue data from the two best-selling recently-introduced antibiotics (cefiderocol and ceftazidime-avibactam, as proxies for future antibacterials) show shortfalls in many countries for the mid-range target and all countries for the high-end target. The UK met the goal due to its subscription-based pull incentive, which guarantees revenues independent of sales volumes. In Italy, increased product use may be driven by local resistance patterns and revenues are likely to increase under newly implemented reimbursement policies. By contrast, other G7 and the rest of the EU27 countries do not achieve targets in most scenarios evaluated, a gap that could be remedied by a combination of tailored national and regional push and pull incentives. Recent reimbursement reforms in France and Germany may have increased revenues for covered antibiotics, but these reforms have not yet been sufficient to close the gaps. The pull incentive pilot in Japan is too new and very modest in size compared to the targets for Japan's market.

	Gross Domestic Product (USD $T)	% of G7+EU	G7+EU27 fair share estimate pre-inflation (USD $M)	G7+EU27 fair share estimate post-inflation adjustment (USD $M)		
				Low-end	Mid-range	High-end
United States	27.3	40.6%	126	105	147	228
EU27	27.2	40.4%	125	104	147	227
Germany	*5.9*	*8.7%*	*27*	*22*	*32*	*49*
France	*4.2*	*6.2%*	*19*	*16*	*23*	*35*
Italy	*3.5*	*5.1%*	*16*	*13*	*19*	*29*
Japan	6.3	9.3%	29	24	34	52
United Kingdom	4.0	6.0%	19	15	22	34
Canada	2.5	3.7%	11	9	13	21
G7 + EU 27	**67.3**	**100%**	**310**	**258**	**363**	**562**

Note: italicized Member States of the EU27 are not double counted.

Table 1: **Fair share revenue targets for antibacterial innovation, G7+EU27 (2024 USD).**

Achieving mid-range targets does not require additional expenditures of $363 million per drug per year, since existing revenues reduce the top-up (or revenue guarantee) needed (see Table 3). For example, if a

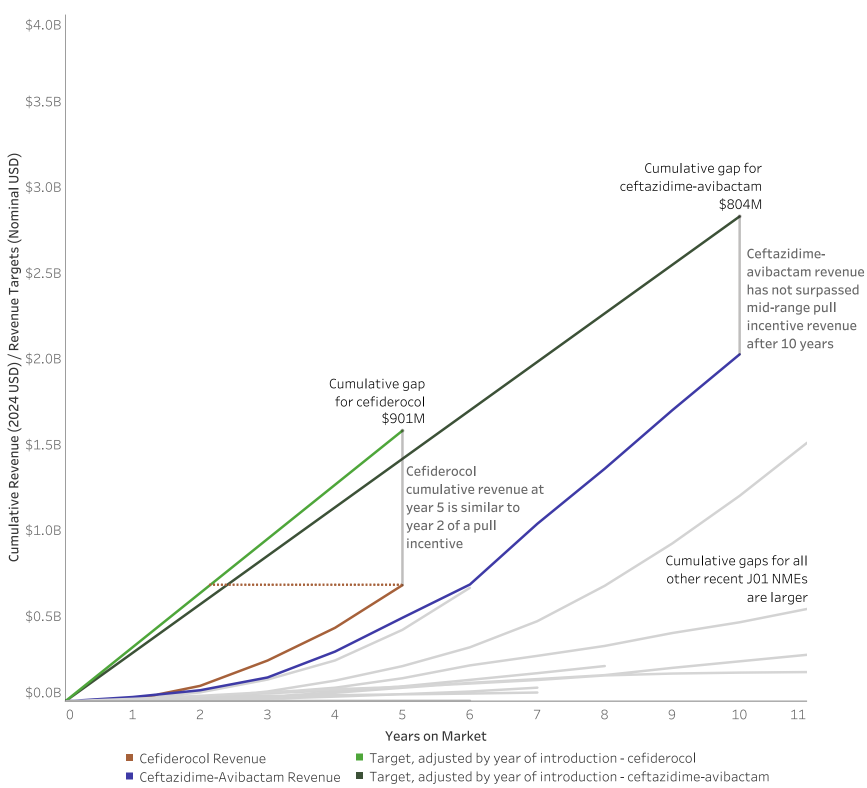

Fig. 1: **Cumulative global revenues of recent antibiotics compared with cumulative mid-range revenue targets, by years on market (Revenue: 2024 USD/Targets: Nominal USD).** Source: IQVIA MIDAS, Full year (FY) 2013–2024 revenue data reported on a constant U.S. dollar basis (LCUS), which removes the impact of currency exchange rates. For low-range and high-range pull incentive targets, see the Supplement.

Drug	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Ceftazidime-avibactam	$20	$31	$63	$126	$169	$169	$315	$299	$329	$336
Cefiderocol	$0	$0	$0	$0	$0	$9	$71	$137	$184	$219

Source: IQVIA MIDAS, annual and monthly revenue data reported on a constant U.S. dollar basis (LCUS), which removes the impact of currency exchange rates.

***Table 2:* Annual revenues for cefiderocol and ceftazidime-avibactam, G7+EU27 (nominal USD $M).**

revenue guarantee pull incentive for ceftazidime-avibactam had been implemented in 2015, Italy would have needed to pay a top-up of $14 million in each of the first three years and $2 million in year four. Beginning in year 5, no top-up would have been required from Italy as revenues thereafter exceeded the target. In France, revenues after the third year of ceftazidime-avibactam being on the market would also have reduced the top-up needed, with the top-up temporarily paused in 2021. In the UK, no top-ups were required for ceftazidime-avibactam from the year delinked pull incentives were initiated, and for cefiderocol, no top-ups were required from the year after. In the US, top-ups for ceftazidime-avibactam would have paused in 2019, resumed in 2020, and paused again thereafter. While cefiderocol has been on the market for five fewer years, similar trends are seen, with ordinary revenues expected to cover a growing proportion of the annual revenue guarantee over time. For the EU27 collectively, top-ups would have declined

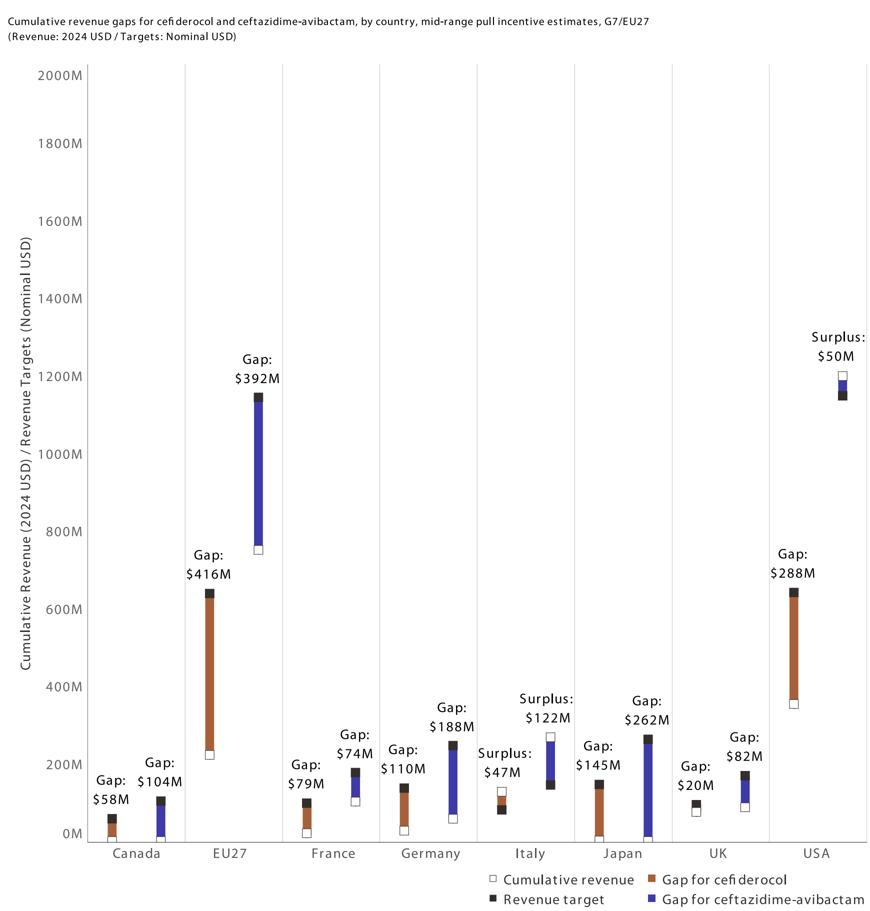

***Fig. 2:* Cumulative revenue gap (or surplus) for cefiderocol and ceftazidime-avibactam, by country, mid-range pull incentive estimates, G7+EU27 (Revenue: 2024 USD/Targets: Nominal USD)**. Source: IQVIA MIDAS, annual revenue data reported on a constant U.S. dollar basis (LCUS), which removes the impact of currency exchange rates. Note: EU27 includes data for France, Germany, and Italy. For low-range and high-range pull incentive targets, see the Supplement.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Canada										
Ceftazidime-avibactam	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10
Cefiderocol						$12	$12	$12	$12	$12
France										
Ceftazidime-avibactam	$18	$18	$12	$4	$3	$5		$5	$6	$7
Cefiderocol						$20	$17	$16	$15	$12
Germany										
Ceftazidime-avibactam	$25	$25	$19	$21	$19	$18	$14	$15	$16	$16
Cefiderocol						$27	$22	$20	$21	$19
Italy										
Ceftazidime-avibactam	$14	$14	$14	$2						
Cefiderocol						$16	$6			
Japan										
Ceftazidime-avibactam	$26	$26	$26	$26	$26	$26	$26	$26	$26	$26
Cefiderocol						$29	$29	$29	$29	$28
UK										
Ceftazidime-avibactam	$17	$17	$15	$15	$13	$13	$12			
Cefiderocol						$19	$17	$2		
US										
Ceftazidime-avibactam	$90	$75	$54	$9		$16				
Cefiderocol						$118	$70	$62	$34	$4
EU27										
Ceftazidime-avibactam	$114	$114	$102	$71	$45	$22				
Cefiderocol						$128	$108	$77	$63	$40

Note: EU27 includes data for France, Germany, and Italy. Blank values after 2015 for ceftazidime-avibactam or 2020 for cefiderocol indicate that revenues in that country for that year were higher than what would be paid for an annual mid-range pull incentive. For low-range and high-range pull incentive targets, see the Supplement.

Table 3: **Maximum top-up payments required for ceftazidime-avibactam and cefiderocol if mid-range pull incentive had been initiated in year of first approval, by country (Million 2024 USD).**

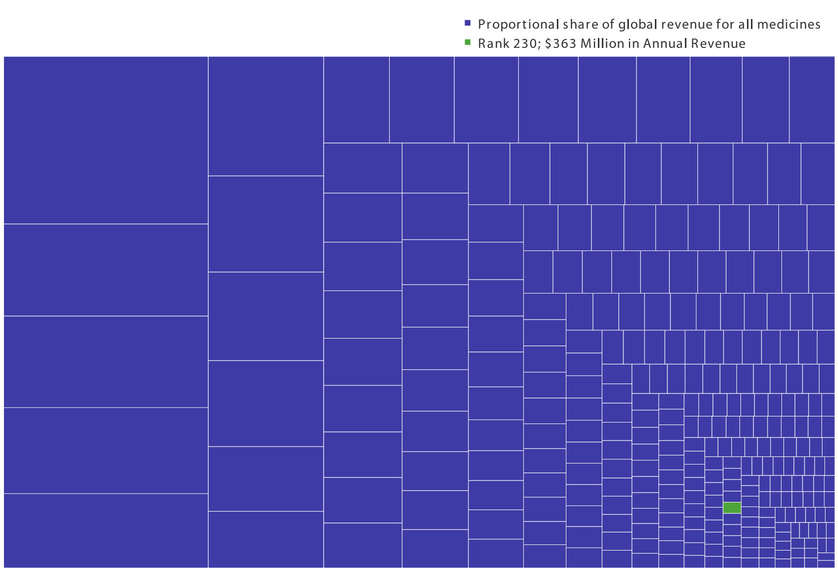

Fig. 3: **An antibacterial with global revenues equal to the mid-range pull incentive target would rank #230 in global revenues in 2024.** Note: Figure shows up to Rank 300. Source: IQVIA MIDAS, annual revenue data reported on a constant U.S. dollar basis (LCUS), which removes the impact of currency exchange rates. For low-range and high-range pull incentive targets, see the Supplement.

substantially over time and would have paused starting in 2021 for ceftazidime/avibactam. If the sponsoring company failed to register or make the antibacterial available in any particular country, then the top-up payment in that year would be zero, as access should be a condition of the payment. Thus, Table 3 represents maximum values, assuming sponsors change past practice and register widely and promptly.

Revenue guarantees would therefore most help support new antibiotics in the early years following market introduction. While the top-up cost to governments will be lower than the revenue targets, for the small biotech companies responsible for most antibacterial innovation, this top-up is important as it sets a delinked floor for revenues, enabling investment to bring qualifying drugs to market and support commercialization and access in the years after launch. Companies incur significant expenses to launch drugs in new countries; predictable revenue guarantees can support timely registration and access. Revenue guarantees are also delinked from sales volumes, in that the company is guaranteed revenues even if sales volumes are low. Fully delinked pull incentives, as in the UK, that are paid independent of sales volumes may support stewardship by removing financial incentives for manufacturers to overpromote the drug.

A key strength of a fair share model lies in its alignment with health security. By apportioning costs across the G7+EU27, the framework ensures that all benefit without any single nation bearing disproportionate financial responsibility. Antimicrobial resistance problems in each country are deeply interconnected and resistant pathogens can cross borders easily[34,35]; thus, addressing antimicrobial resistance requires a collective commitment.[36] A coordinated response is not merely an act of solidarity, but a pragmatic necessity to protect health systems. For high-income countries, investing in a fair share model mitigates long-term risks: unchecked antimicrobial resistance could destabilize health systems, trade, and security, leading to far costlier crises.

Another key aspect is the interplay between push and pull incentives, which complement each other to support a cohesive antimicrobial resistance research and development pipeline. Push incentives de-risk preclinical and early clinical research and development. Reasonable pull incentives for meaningful innovation provide market stability and ensure a return on investment that attracts pharmaceutical companies, lowering the overall risk of the antimicrobials market, which may encourage investors to fund or acquire small- and moderate-sized entities in late clinical development. Improved coordination between push and pull incentives bridges the gap between discovery and market readiness, maximizing the impact of both incentive types. Since promising projects are vulnerable as they transition from discovery to market, recent analyses have called for increases in push incentives to set the table for success with pull incentives.[13,14]

While this study provides a framework for understanding fair share contributions for pull incentives, several limitations must be acknowledged. First, the model upon which the fair share estimates are built assume that 50% of pre-clinical costs are met through push incentives. Push incentives have been substantially underfunded, which weakens this assumption, and their future is even more in doubt with massive cuts to publicly funded scientific investment announced in the US in 2025.[2–11,29] Push and pull incentives can to some degree substitute for each other. For example, if proposals for European milestone prizes are adopted,[14] these additional push incentives could reduce the amount of pull incentives required. Second, the study focuses on two antibacterials with relatively higher revenues as case studies, which limits the generalizability of the findings across other antibiotics. We did not consider whether these antibiotics provide additional clinical value or the benefits of any of the other J01 products evaluated in the study, but pull incentives should be reserved for antibiotics that provide meaningful patient and population health benefits, as well as economic benefits such as improved productivity. To the best of our knowledge, neither drug received late-stage government-funded push incentives for preclinical or clinical development. Third, the targets presented are for the average drug receiving a pull incentive. As noted previously,[29] targets should be higher for drugs with substantial clinical benefits over existing options and lower for other drugs that do not offer these advantages. National targets are a floor, not a cap, and for that reason, drugs that sell well due to local resistance patterns should retain these revenues. Fourth, the fair share model also assumes that public financial support for clinical trials (e.g., subsidies from G7+EU27 governments) will offset national contributions to pull incentives, avoiding duplication of public investment.[29] For example, if the US provided $100 million in clinical trial funding for a drug, its 10-year pull incentive obligation would decrease by $10 million per year for that drug. Fifth, this analysis relies on revenue and pricing data from the IQVIA MIDAS database, which, while comprehensive, may not fully capture variations in market conditions or pricing strategies across countries. Sixth, additional funds will be needed to support global access to any drug receiving a pull incentive, in order to address the regions with highest mortality. Finally, while the G7+EU27 represents a sizeable portion of global economic capacity, contributions from other high-income and middle-income nations could further enhance the sustainability and scalability of pull incentives, including market access to ensure that antibacterials are available broadly, not just in high-income countries.

The only country to make a substantial delinked pull incentive payment during our study period was the UK, and that payment helped meet the country's fair share targets. The UK program demonstrated that fair share targets are achievable through proactive policy measures. For Italy, local epidemiology may have driven revenues, and the newly announced pull incentive could help Italy continue to meet fair share targets. The Japanese pull incentive did not make any payments during the time frame of this study and in any case is much smaller than Japan's annual fair share. The German and French reimbursement reforms may have increased revenues, but substantial revenue gaps remain. Certain proposed pull incentives in the European Union (e.g., the HERA revenue guarantee) could help close the gaps, if enacted. To the extent gaps remain, the G7+EU27 should consider adopting pull incentives to close the funding gap. With decisive action, these countries can restore the antibacterial pipeline.

Contributors

MG contributed to conceptualization, data curation, formal analysis, investigation, methodology, project administration, validation, writing—original draft, and writing—review and editing. MM contributed to data curation, formal analysis, investigation, methodology, validation, visualization, writing—original draft, and writing—review and editing. RF contributed to data curation, methodology, writing—original draft. MN contributed to data curation. MN and RF accessed and verified the underlying data from IQVIA. ASK contributed to supervision, writing—review, and editing. KO contributed to conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, resources, supervision, validation, writing—original draft, and writing—review and editing.

Data sharing statement

The data underlying this study are proprietary to IQVIA and were accessed under license. Researchers may request access to IQVIA MIDAS data directly from IQVIA.

Declaration of interests

MN and RF are employees of IQVIA. MM reports consulting work for the AMR Industry Alliance Secretariat, unrelated to the present study. KO is the principal investigator and Executive Director for CARB-X, a major funder of antibacterial R&D grants, funded by six G7 countries and three charitable foundations (Wellcome Trust, Novo Nordisk Foundation, and Gates Foundation). The work in this paper is explicitly outside the scope of the funded work at CARB-X. Additionally, KO was a speaker at grand rounds in 2025 at Tufts University Medical Center and received an honorarium. This was not related to this paper. All other authors declare no competing interests.

Acknowledgements

The statements, findings, conclusions, views and opinions contained and expressed in this research article are based in part on data obtained under license from the following IQVIA information service(s): IQVIA MIDAS®. Copyright IQVIA. All Rights Reserved. The statements, findings, conclusions, views and opinions contained and expressed herein are not necessarily those of IQVIA or any of its affiliated or subsidiary entities. We thank Marco Travaglio, PhD (IQVIA, London) for his support in facilitating access to the IQVIA MIDAS dataset and clarifying data interpretation. Two of the co-authors are employed by IQVIA, which did not charge for this license.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.eclinm.2025.103485.

References

1 Murray CJ, Ikuta KS, Sharara F, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet*. 2022;399(10325):629–655.
2 Naghavi M, Vollset SE, Ikuta KS, et al. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. *Lancet*. 2024;404(10459):1199–1226.
3 G7. *G7 health ministers' meeting United Kingdom*. Department of Health & Social Care; 2021 [cited 2024 29 Aug]. Available from: https://www.gov.uk/government/publications/g7-health-ministers-meeting-june-2021-communique/g7-health-ministers-meeting-communique-oxford-4-june-2021.
4 G7. *G7 Finance Ministers' statement on actions to support antibiotic development*. United Kingdom: HM Treasury; 2021 [cited 2024 29 Aug]. Available from: https://assets.publishing.service.gov.uk/media/61b364d1d3bf7f0551f2d431/AMR_-_G7_Finance_Ministers_statement_on_supporting_antibiotic_development_-_final_-_13_Dec_2021.pdf.
5 G7. *G7 Finance Ministers' statement on actions to support antibiotic development: Annex A*. United Kingdom: HM Treasury; 2021 [cited 2024 29 Aug]. Available from: https://assets.publishing.service.gov.uk/media/61b365038fa8f5038358c1de/AMR_-_G7_Finance_Ministers_statement_on_supporting_antibiotic_development_-_annex_A_-_final_-_13_Dec_2021.pdf.
6 Anderson M, Panteli D, van Kessel R, Ljungqvist G, Colombo F, Mossialos E. Challenges and opportunities for incentivising antibiotic research and development in Europe. *Lancet Reg Health Eur*. 2023;33:100705.
7 Gotham D, Moja L, van der Heijden M, Paulin S, Smith I, Beyer P. Reimbursement models to tackle market failures for antimicrobials: approaches taken in France, Germany, Sweden, the United Kingdom, and the United States. *Health Policy*. 2021;125(3):296–306.
8 Anderson M, Panteli D, Mossialos E. *How can the EU support sustainable innovation and access to effective antibiotics? Policy options for existing and new medicines Denmark*. WHO Regional Office for Europe; 2023 [cited 2024 Sep 11]. Available from: https://iris.who.int/bitstream/handle/10665/369638/Policy-brief-51-1997-8073-eng.pdf?sequence=2.
9 Global Coalition on Aging. The role of G7 governments in global efforts to encourage antimicrobial development through a pull incentive: challenges and collaboration USA: Global coalition of aging [cited 2024 Sep 11]. Available from: https://globalcoalitiononaging.com/wp-content/uploads/2024/05/GCOA_G7Governments_English_FINAL.pdf; 2024.
10 Asia-Pacific Economic Cooperation Health Working Group. Gap analysis of economic incentives for antimicrobials in APEC economies: addressing barriers to market entry and new drug development Singapore: Asia-Pacific Economic Cooperation [updated March 2024; cited 2024 Sep 11]. Available from: https://www.apec.org/docs/default-source/publications/2024/3/224_hwg_-gap-analysis-of-economic-incentives-for-antimicrobials-in-apec-economies.pdf?sfvrsn=3d4c4afa_2; 2024.
11 United Nations General Assembly. Political declaration of the high-level meeting on antimicrobial resistance: united nations [cited 2024 Oct 14]. Available from: https://www.un.org/pga/wp-content/uploads/sites/108/2024/09/FINAL-Text-AMR-to-PGA.pdf; 2024.
12 McEnany M, Outterson K. Changes in revenues associated with antimicrobial reimbursement reforms in Germany. *Humanit Soc Sci Commun*. 2024;11(1):1–12.
13 One Health Global Leaders Group on Antimicrobial Resistance. *Recommendations to address the antibiotic pipeline and access crisis in human health*. Global Leaders Group on Antimicrobial Resistance; 2024 [cited 2024 Dec 23]. Available from: https://www.amrleaders.org/resources/m/item/glg-recommendations-to-address-the-antibiotic-pipeline-and-access-crisis-in-human-health.
14 European Commission, European Health and Digital Executive Agency. *Study on bringing AMR medical countermeasures to the market—final report*. Brussels: Publications Office of the European Union; 2023.
15 Kesselheim AS, Outterson K. Fighting antibiotic resistance: marrying new financial incentives to meeting public health goals. *Health Aff*. 2010;29(9):1689–1696.
16 G7 Germany. G7 health ministers' communiqué Germany: G7 Germany; 2022 [cited 2025 1 Jan]. Available from: https://g7germany.de/resource/blob/974430/2042058/5651daa321517b089cdccfaffd1e37a1/2022-05-20-g7-health-ministers-communique-data.pdf.

17 G7 Hiroshima Leaders' Communiqué. The white house [cited 2025 1 Jan]. Available from: https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/20/g7-hiroshima-leaders-communique/; 2023.
18 G7 Italia. G7 health ministers' communiqué: G7 Italia [cited 2024 26 Dec]. Available from: https://www.g7italy.it/wp-content/uploads/G7-Health-Ministers-Communique.pdf; 2024.
19 Felice DD, Rex J. Italy delivers a national pull incentive (with a budget of EUR 100 million a year): AMR.Solutions [updated Jan 9, 2025; cited 2025 Jan 29]. Available from: https://amr.solutions/2025/01/09/italy-delivers-a-national-pull-incentive-with-a-budget-of-eur-100-million-a-year/; 2025.
20 Leonard C, Crabb N, Glover D, et al. Can the UK 'Netflix' payment model boost the antibacterial pipeline? *Appl Health Econ Health Policy*. 2023;21(3):365–372.
21 McDonnell A, Klemperer K, Pincombe M, Bonnifield RS, Yadav P, Guzman J. *A new grand bargain to improve the antimicrobial market for human health*. Washington, DC and London, UK: Center for Global Development; 2023. Available from: https://www.cgdev.org/sites/default/files/new-grand-bargain-improve-antimicrobial-market-human-health.pdf.
22 Evans EJ, Meyer A, Conti RM. *Sizing A market entry reward for the development of new antibiotics USA: Harvard Kennedy school*. Mossavar-Rahmani Center for Business and Government; 2024 [cited 2024 Sep 11]. Available from: https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/Final_AWP_232.pdf.
23 Polek B, Fürst W, Bachmann V, Blankart R. *Effective antibiotics for the Swiss health care system: today and in the future*. Bern, Switzerland: Swiss Round Table on Antibiotics; 2024.
24 Piddock LJV, Alimi Y, Anderson J, et al. Advancing global antibiotic research, development and access. *Nat Med*. 2024;30(9):2432–2443.
25 Wasan H, Reeta K, Gupta YK. Strategies to improve antibiotic access and a way forward for lower middle-income countries. *J Antimicrob Chemother*. 2024;79(1):1–10.
26 Outterson K, Orubu ESF, Rex J, Årdal C, Zaman MH. Patient access in 14 high-income countries to new antibacterials approved by the US food and drug administration, European Medicines Agency, Japanese pharmaceuticals and medical devices agency, or Health Canada, 2010-2020. *Clin Infect Dis*. 2022;74(7):1183–1190.
27 Kållberg C, Årdal C, Salvesen Blix H, et al. Introduction and geographic availability of new antibiotics approved between 1999 and 2014. *PLoS One*. 2018;13(10):e0205166.
28 Organisation for Economic Co-operation and Development (OECD). *Annual GDP and components - expenditure approach, US $, current prices, current PPPs, millions*. Paris: OECD; 2023 [cited 2024 Oct 15]. Available from: https://data-viewer.oecd.org/?chartId=d0b1bdef-b021-484b-92ec-0b2affbdfab6.
29 Outterson K. Estimating the appropriate size of global pull incentives for antibacterial medicines: study examines global antibacterial pull incentives. *Health Aff*. 2021;40(11):1758–1765.
30 National Institutes of Health. *Gross domestic product (GDP) price index*. National Institutes of Health; 2024 [updated January 2024; cited 2024 Oct 28]. Available from: https://officeofbudget.od.nih.gov/gbipriceindexes.html.
31 Tillgänglighet till vissa antibiotika. En pilotstudie av en alternativ ersättningsmodell: folkhälsomyndigheten. Available from: https://www.folkhalsomyndigheten.se/contentassets/07fcf723e25240e5b837b7baed99666e/tillganglighet-till-vissa-antibiotika-en-pilotstudie-av-en-alternativ-ersattningsmodell.pdf; 2023.
32 *Reform of the EU pharmaceutical legislation*. European Commission; 2023. Available from: https://health.ec.europa.eu/medicinal-products/legal-framework-governing-medicinal-products-human-use-eu/reform-eu-pharmaceutical-legislation_en.
33 Chowdhury DR. *Biomedical research and development price index*. Bethesda, MD: National Institutes of Health; 2023. Available from: https://officeofbudget.od.nih.gov/pdfs/FY23/gbi/BRDPI%20Table%20of%20Annual%20and%20Cumulative%20Values_for_1950_through_2028.pdf.
34 Pitchforth E, Smith E, Taylor J, Davies S, Ali G-C, d'Angelo C. Global action on antimicrobial resistance: lessons from the history of climate change and tobacco control policy. *BMJ Glob Health*. 2022;7(7):e009283.
35 Huttner A, Harbarth S, Carlet J, et al. Antimicrobial resistance: a global view from the 2013 world healthcare-associated infections forum. *Antimicrob Resist Infect Control*. 2013;2:1–13.
36 Bokhary H, Pangesti KN, Rashid H, Abd El Ghany M, Hill-Cawthorne GA. Travel-related antimicrobial resistance: a systematic review. *Trop Med Infect Dis*. 2021;6(1):11.