Antimicrobial resistance

Policy insights

Did you know?

Antimicrobial resistance (AMR) occurs when microorganisms develop resistance to antimicrobials they are exposed to. AMR is a natural phenomenon, enhanced by persistent exposure to selective pressure enabled by high volume use of antimicrobials. The process may be reversible by reducing inappropriate use of antimicrobials.

Antimicrobial resistance
is a growing health and economic threat
requiring a multipronged response

Antimicrobial resistance (AMR) is a complex issue of global concern. AMR is not simply a problem of medical science being beaten by nature; human action and perverse incentives play a major role in its development. The misuse of antibiotics in the medical, veterinary and agricultural sectors, which include the inappropriate prescribing of antibiotics, their overuse in the livestock sector, and insufficient hygiene practices in hospital, all contribute to the rise of AMR. Global trade and travel are also accelerating the spread. At the same time, the development pipeline of new antibiotics has slowed, mainly due to insufficient incentives, allowing microorganisms to outpace the development of new drugs.

AMR poses a significant burden on healthcare systems and national budgets. The discovery of antibiotics meant that previously lethal infections could be cured and surgical procedures made safer, allowing for the development of modern medicine. With the rise of AMR, we are now heading towards a 'post-antibiotic era' where common infections may once again be fatal. Patients infected with resistant infections:

- show increased risk of complication and death. Globally, about 700 000 deaths may be caused each year by AMR. If current resistance rates increase by 40%, up to 9.5 million people may die each year.

- require more intensive and expensive care and are more likely to be admitted to hospital. Hospitals spend, on average, an additional USD 10 000 to 40 000 to treat a patient infected by resistant bacteria in OECD.

- suffer from a loss of productivity and income due to ill-health and additional time away from work. At current resistance rates, the total GDP effect in OECD, accounting for increased healthcare expenditure, would amount to 2.9 trillion USD by 2050.

OECD, with its distinctive cross-sectoral expertise and its global outreach, is placed in a unique position to help countries in tackling AMR. OECD's economic expertise includes such diverse areas as health, technological innovation and agriculture. The OECD can therefore play a critical role in providing countries a forum where governments can compare and exchange policy experiences, identify good practices and promote decisions and recommendations to comprehensively tackle AMR under the 'one-health' framework.
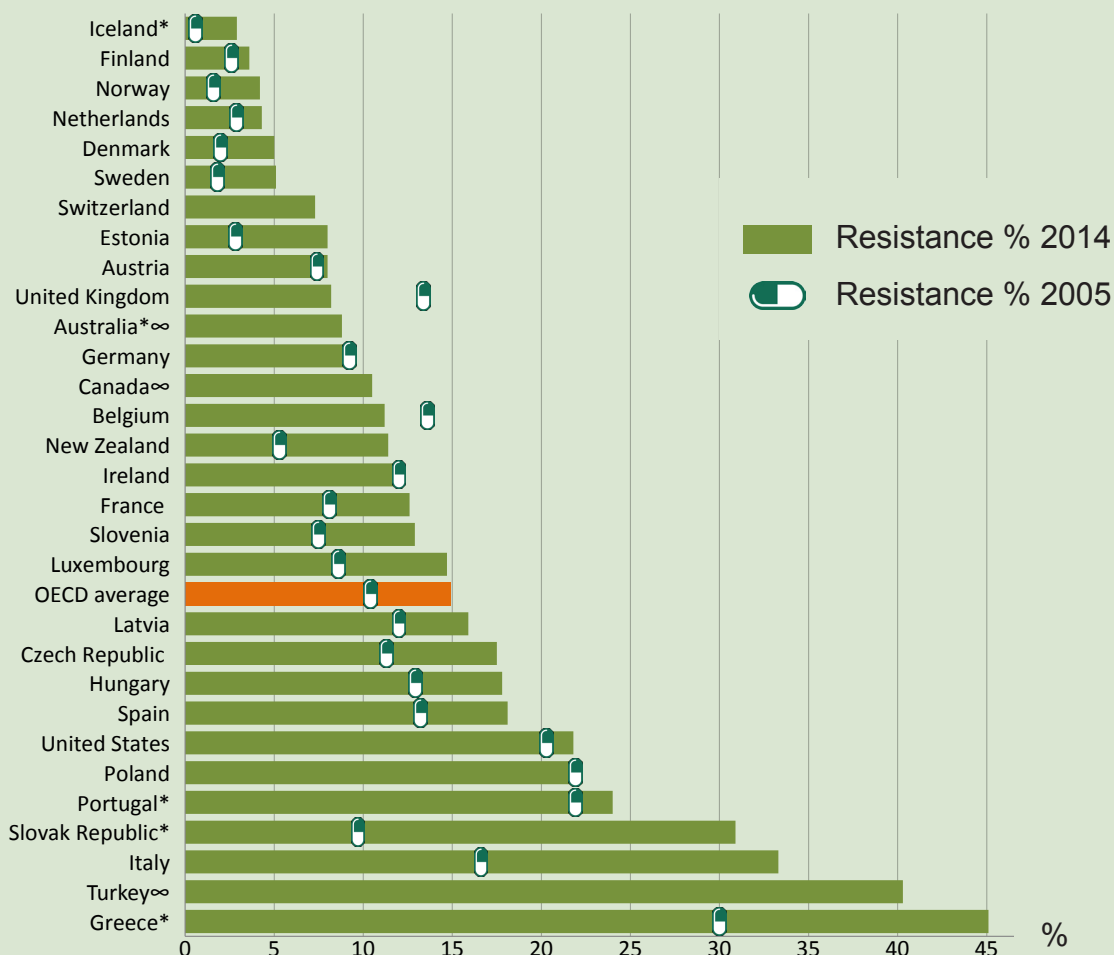
Trends across OECD countries
Antibiotic resistance is growing

Six high-priority bacterial-antimicrobial resistance combinations were aggregated within each country by use of the arithmetic mean. The included combinations were: E.coli (resistant to 3rd generation cephalosporins), E.coli (resistant to fluoroquinolones), K.pneumoniae (resistant to 3rd generation cephalosporins), K.pneumoniae (resistant to carbapenems), S. aureus (resistant to methicillin), S.pneumoniae (resistant to pencillin). Data from 2014 (or latest available data) and 2005 (or 2006 if not available).

*Greece missing S.pneumoniae (resistant to penicillin) 2005 and 2014, Slovakia and Belgium missing K.pneumoniae (resistant to 3rd generation cephalosporins and carbapenem) 2005, Portugal missing K.pneumoniae (resistant to carbapenem) 2005, New Zealand missing MRSA 2014, Australia missing S.pneumoniae (resistant to penicillin) 2014, Iceland missing K.pneumoniae (resistant to carbapenem) 2014.

∞Includes resistant and intermediate data

Source: ESAC-Net Database and CDDEP

Legend:
- Resistance % 2014
- Resistance % 2005

Countries (top to bottom): Iceland*, Finland, Norway, Netherlands, Denmark, Sweden, Switzerland, Estonia, Austria, United Kingdom, Australia*∞, Germany, Canada∞, Belgium, New Zealand, Ireland, France, Slovenia, Luxembourg, OECD average, Latvia, Czech Republic, Hungary, Spain, United States, Poland, Portugal*, Slovak Republic*, Italy, Turkey∞, Greece*
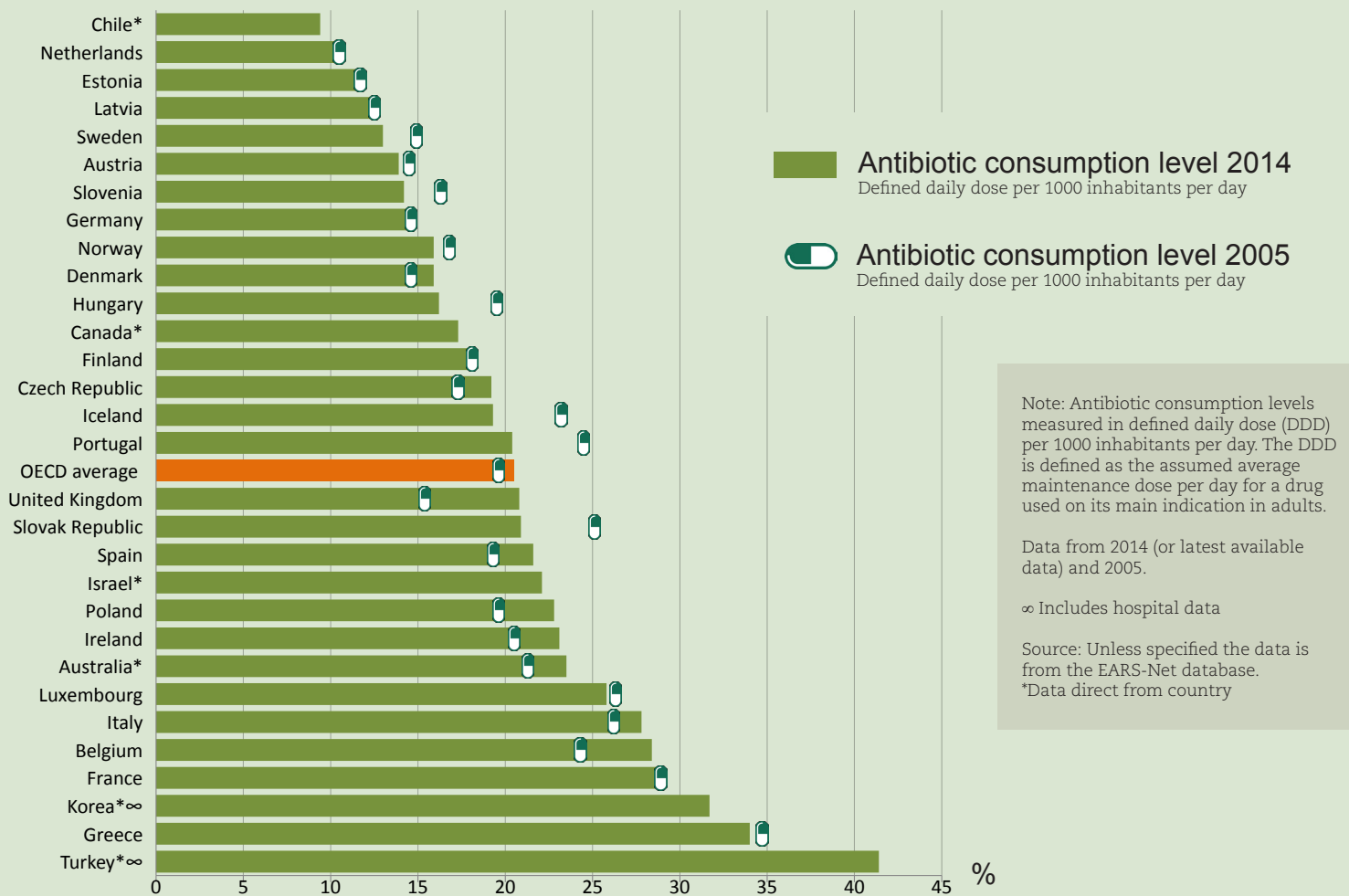
This graph illustrates the trend in levels of antibiotic resistance across OECD countries in 2014, comparing it with the levels recorded in 2005. On average, the probability of identifying a resistant infection in OECD in 2014 was about 15%. The probability of developing a resistant infection in the three countries with the highest levels of resistance is 25% higher than the OECD average and about 11 times higher than in the three countries with the lowest levels of resistance.

Between 2005 and 2014 AMR prevalence has increased in 23 out of 26 OECD countries by an average of 5% (i.e. from an average of 10% in 2005 to 15% in 2014). By looking at specific agents, 3rd generation cephalosporin-resistant E. Coli and carbapenem-resistant K. pneumoniae appear to be highest priorities. Recorded prevalence of these resistant infections increased between 3 and 4 times in OECD countries. If this trend continues we could revert to a world where simple infections are no longer treatable. This rising level of antimicrobial resistance highlights the urgent need for policy interventions to reduce antibiotic consumption, improve hygiene standards and develop novel antimicrobials.

United Kingdom is one of the few countries showing a decrease in AMR. Decreasing trends in MRSA (methicillin-resistant S. Aureus) are a major driver underpinning this decline. The UK Health Protection Agency suggested that sustained efforts to tackle MRSA transmission in hospitals may have played a critical role in achieving this result.

Human consumption of antibiotics remained substantially stable between 2005 and 2014

Antibiotic consumption level 2014
Defined daily dose per 1000 inhabitants per day

Antibiotic consumption level 2005
Defined daily dose per 1000 inhabitants per day

Note: Antibiotic consumption levels measured in defined daily dose (DDD) per 1000 inhabitants per day. The DDD is defined as the assumed average maintenance dose per day for a drug used on its main indication in adults.

Data from 2014 (or latest available data) and 2005.

∞ Includes hospital data

Source: Unless specified the data is from the EARS-Net database.
*Data direct from country

Antibiotic consumption and, in particular, inappropriate use are among the main causes underpinning the development of antibiotic resistance. In 2014, average antibiotic consumption in OECD was about 20.5 defined daily dose per day (DDD) per 1 000 inhabitants. Antibiotic consumption in the highest consuming country is more than twice the OECD average and 4.4 times higher than the lowest consuming country. Between 2005 and 2014 OECD countries have increased antibiotic consumption by an average of 4%.

OECD analyses show that inappropriate use may account for up to 50% of all antimicrobials consumed in human health care. In some healthcare services (e.g. long-term care and general practice), inappropriate consumption may be as high as 90% of total consumption. An even greater proportion of antibiotics are misused in the livestock sector. Some of the most common factors influencing inappropriate

use of antimicrobials include cognitive biases and poor information in patients and physicians as well as organisational factors and perverse economic incentives.
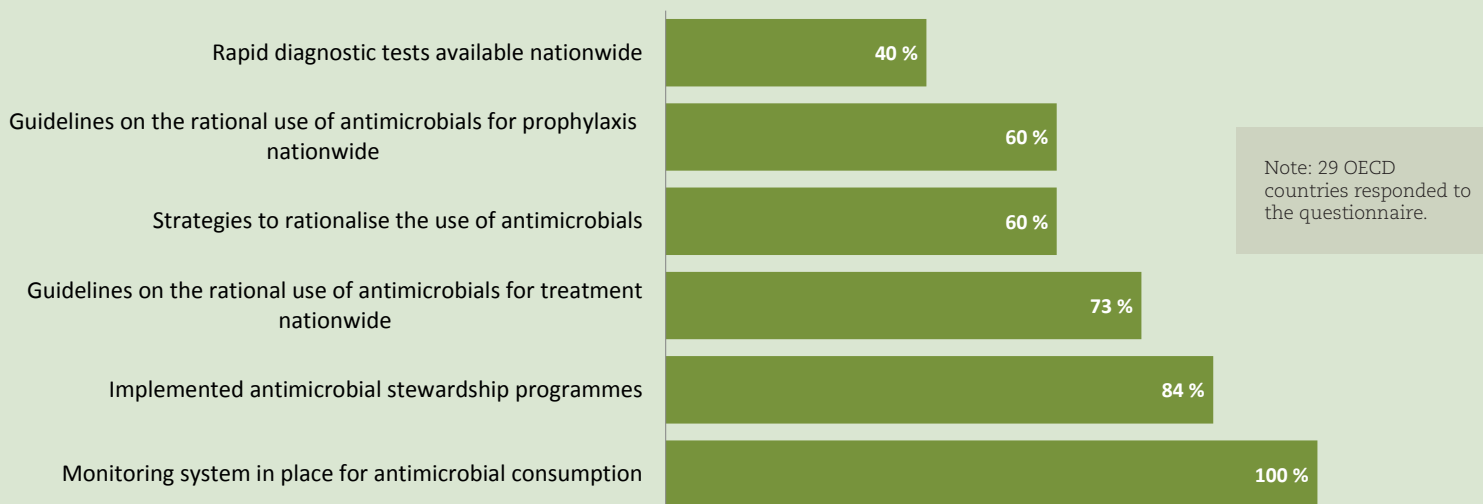
As part of broader national strategies to prevent AMR, OECD governments are adopting a comprehensive set of policy actions to address inappropriate consumption of antimicrobials. These include information and education policies, organisational changes, including stewardship programmes, use of new technologies and economic incentives.

Did you know?

In 2014, antimicrobials accounted for about 3% of the total value of pharmaceutical sales for humans in OECD.

Policies that promote the rational use of antimicrobials

Share of OECD countries that have implemented policies to promote the rational use of antimicrobials

Policy	Share
Rapid diagnostic tests available nationwide	40 %
Guidelines on the rational use of antimicrobials for prophylaxis nationwide	60 %
Strategies to rationalise the use of antimicrobials	60 %
Guidelines on the rational use of antimicrobials for treatment nationwide	73 %
Implemented antimicrobial stewardship programmes	84 %
Monitoring system in place for antimicrobial consumption	100 %

Note: 29 OECD countries responded to the questionnaire.

Governments are adopting a broad range of policy approaches to curb harm related to inappropriate use of antimicrobials in humans. In the majority of cases, actions to decrease ineffective use of antimicrobials are part of broader strategies to tackle AMR. A recent survey showed that about 60% of OECD countries have produced strategies to rationalise the use of antimicrobials and an additional 37% are in the process of developing one.

Education and information activities are at the core of most strategies to reduce inappropriate use of antimicrobials. This type of action usually targets both the general population, through mass media campaigns, and medical doctors. For example, about three in four OECD countries have implemented national guidelines on the rational use of antimicrobials for treatment – although national guidelines for prophylaxis use are less common. Combining the implementation of guidelines with training programmes, for example as part of continuing medical education schemes, provides a more effective approach.

Organisational changes in the health care sector are an effective option to rationalise use of antimicrobials. The implementation of stewardship programmes and greater use of rapid diagnostic tests has been shown to reduce inappropriate use of antimicrobials with no negative impact on the health of patients. The vast majority of OECD countries (84%) implements stewardship programmes but, in about half of the cases, these programmes are only implemented at the sub-national level. Use of rapid diagnostic tests is even more limited. Rapid diagnostic tests are only available nationwide in 40% of OECD countries.

Establishing an effective surveillance system is fundamental for developing and informing any strategy aimed to rationalise antimicrobial prescriptions and to tackle AMR. All OECD countries have a system in place to monitor antimicrobial consumption, but in a number of cases the monitoring system can only provide data for specific care providers (hospital data) or financing agents (insurers). Conversely, only one in three OECD countries have assessed the extent of overuse of antimicrobials.

Consumption of antibiotics in agriculture accounts for the majority of total antibiotic use

Sales of antimicrobial agents marketed mainly for food-producing animals in mg/population correction unit (PCU), 2014
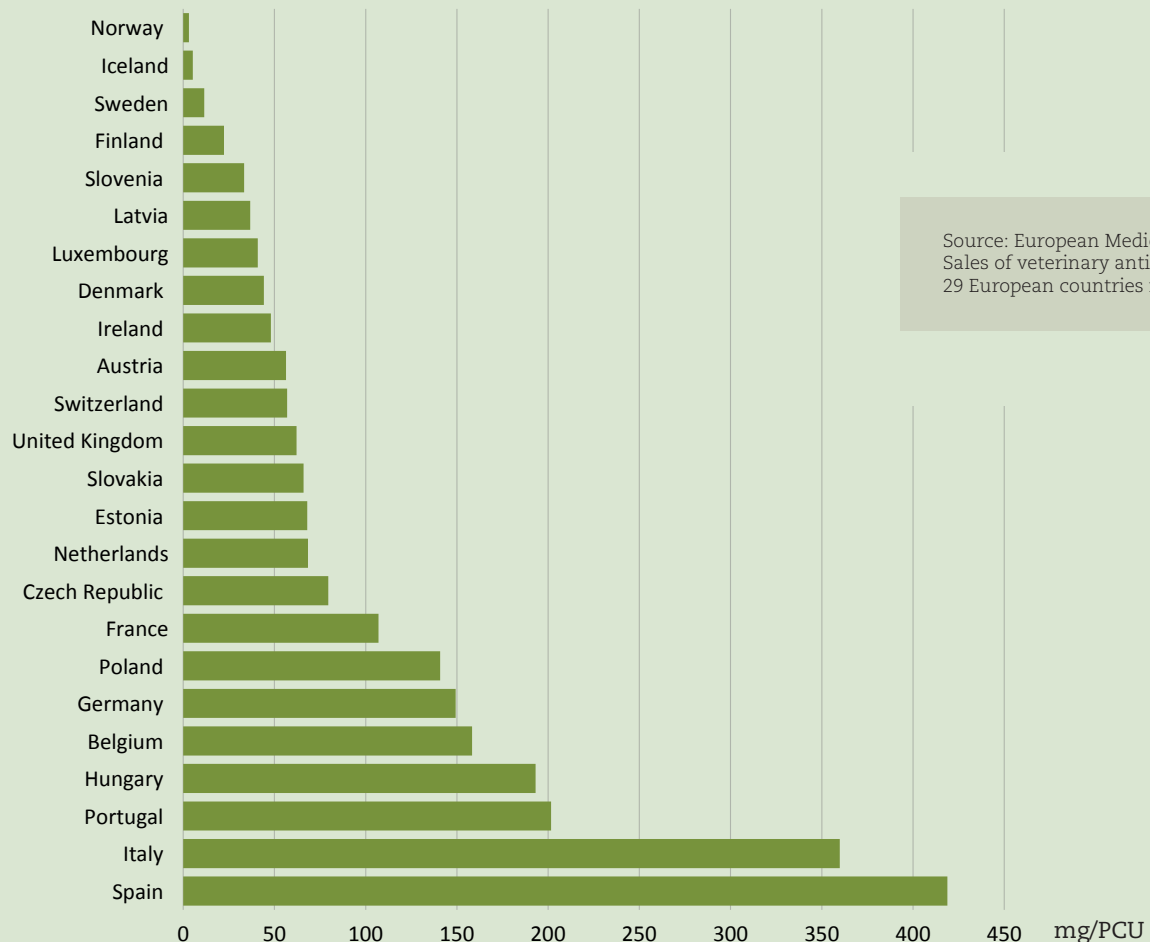
Source: European Medicines Agency (2016). Sales of veterinary antimicrobial agents in 29 European countries in 2014.

Agriculture's share of global antibiotic consumption is high and rising, as the demand for animal proteins increase, especially in low and middle income countries. Overall, agriculture accounts for over 75% of annual antimicrobial consumption in the EU and the US. However in 24 EU countries, consumption has fallen by 12% between 2011 and 2014, and this trend is expected to continue as farmers become more aware of the downside risks arising from antimicrobial resistance. Globally, antibiotic consumption is concentrated, with four countries - China, US, Brazil and India - accounting for almost 50% of global usage.

Of the 27 classes of antibiotics currently available, only seven classes are used exclusively in agriculture, with the remainder used for human health and in animal production. Tetracyclines, penicillins and macrolides account for over three-fifths of antibiotic usage in agriculture. With no new antibiotics developed for more than 40 years, agriculture is using more medically "potent" antibiotics in treating livestock. This raises serious concerns in the public health arena over the use of "last resort" antibiotics in agriculture, and consequently the emergence and spread of resistance, e.g. colistin, macrolides.

The widespread use of antibiotics in agriculture has significant implications for livestock productivity and food security as well as human health. Antibiotic usage in animal agriculture is complex as antibiotics are used not only for therapeutic purposes, but also for the prevention of infectious diseases and to promote animal growth. More than 80% of OECD countries have banned the use of antibiotics for growth promotion, but across developed and developing countries they are widely used to prevent disease, and often when one animal becomes sick the whole herd is treated. With the growing awareness and understanding of the risks arising from the excessive use of antimicrobials in intensive livestock production, farmers are moving to alternative measures such as improved husbandry, improved biosecurity and nutrition, as well as selective vaccination programmes.

There are major data and information gaps on the use of antibiotics in agricultural production and on the development and spread of resistance. The lack of registration of antimicrobial sales is a major barrier in many countries, as much of the sales are "over the counter" with no records or surveillance of usage. Moreover, it is critical to have better information on antibiotic consumption by species, farming systems and purpose in order to design appropriate country specific measures to counter the growth in AMR.

Stronger action and economic incentives to support the development of new antimicrobials are badly needed

The last major new class of antibiotic was discovered in 1987 and the approval of novel therapies has fallen eight-fold since then. Since 2000, only five new classes of antibiotics have been put on the market and none of these target gram-negative bacteria, which are often deadly. Given current policies, market conditions alone do not provide sufficient incentives to business for the development of new antibiotics as the expected profitability of investing in this area is significantly lower than for other therapeutic categories (e.g. cancer).

Policy options to support the development of new treatments can be divided into two broad categories. Upstream interventions target the early phases which are the most uncertain part of developing any medical technology.

Interventions are designed to shift the risk on the funding body and encourage enterprise participation. Downstream mechanisms aim to boost the reward at the end of the development process and facilitate the market entry of drugs. These levers reduce the risk to sponsors (because they only reward successful research) but they may inflate the size of the intervention because companies would need strong incentives to invest on an uncertain return far in the future.

It is crucial that any initiative to incentivise the development of new antimicrobials is closely connected with other key interventions to rationalise use of antimicrobials, including increasing access when needed, and to tackle AMR. Failing to do so would only postpone the problem and provide no long-lasting and sustainable solution.

Number of new antimicrobials approved by the United States Food and Drug Administration since 1983

No. of new antibiotics

| Year | 1983-1987 | 1988-1992 | 1993-1997 | 1992-2002 | 2003-2007 | 2008-2012 |
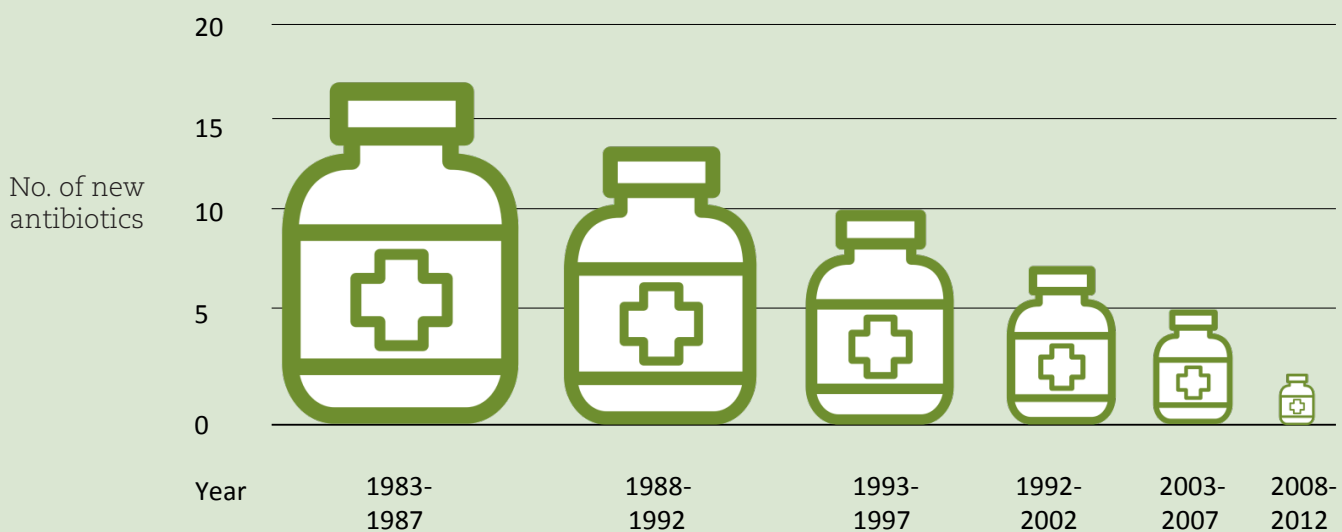
Source: OECD (2015). Antimicrobial resistance in G7 countries and beyond: economic issues, policies and options for action.

Conclusion
Effective policy actions are required to tackle AMR

The health and economic burden of AMR is significant and has the potential to become catastrophic if appropriate action is not taken urgently. AMR can be successfully tackled by:

- Strengthening existing surveillance and monitoring systems in both the community and hospital setting.

- Adopting a globally agreed set of measurable targets for reducing AMR incidence among humans and livestock.

- Strengthening ongoing efforts to rationalise the use of antimicrobials and preventing the spread of AMR in humans and in the livestock sector.

- Fostering the research and development of new antimicrobial therapies, including improved biosecurity measures in agriculture.

- Enhancing coordination between countries to develop a true global action plan to tackle AMR. These plans should adopt a broader 'one-health' approach covering human health, agriculture and the environment.

The OECD can provide a forum for discussion and is currently undertaking comprehensive work in AMR including a health economic evaluation to identify the most cost-effective strategies to tackle AMR in humans, as well as an economic analysis of the benefits and costs of antibiotic usage in livestock production and the economic feasibility of sustainable alternatives. There is an urgent need for greater collaboration to combat the imminent threat of AMR.