The State of the World's Antibiotics, 2015

Molly Miller-Petrie

Implementing Infection prevention and control practices for a safer world

IPNET-Kenya 2015, Naivasha, Kenya

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Global Antibiotic Resistance Partnership

The State of the World's Antibiotics, 2015 tracks this important global resource, evaluating the status of:

- Antibiotic resistance and antibiotic use in human beings and animals
- The existing antibiotic supply and pipeline
- Interventions to rationalize antibiotic use for all countries

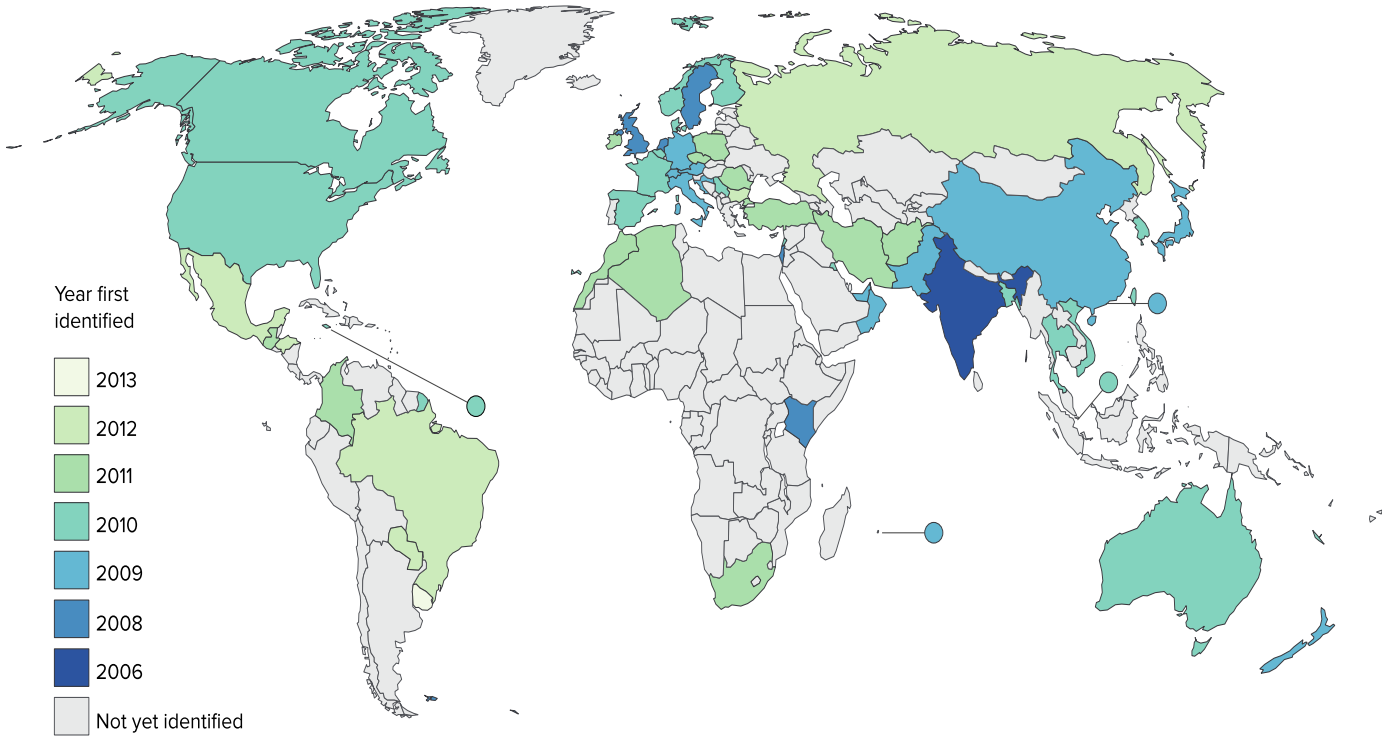

Figure 1-4: Spread of New Delhi metallo beta-lactamase: first detection, by country
Source: Johnson and Woodford 2013 (adapted)

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Ch 1: Antibiotic Resistance in 2015

- Antibiotic-resistant bacteria are increasing in prevalence worldwide, resulting in infections that are difficult and expensive to treat.

- A major driver of antibiotic resistance is antibiotic use, which is fueled by the high background burden of infectious disease in low- and middle-income countries and easy access to antibiotics in much of the world, which increases both appropriate and inappropriate use.

- Few low- and middle-income countries have national surveillance systems to monitor resistance trends and inform policy development and clinical decision-making.

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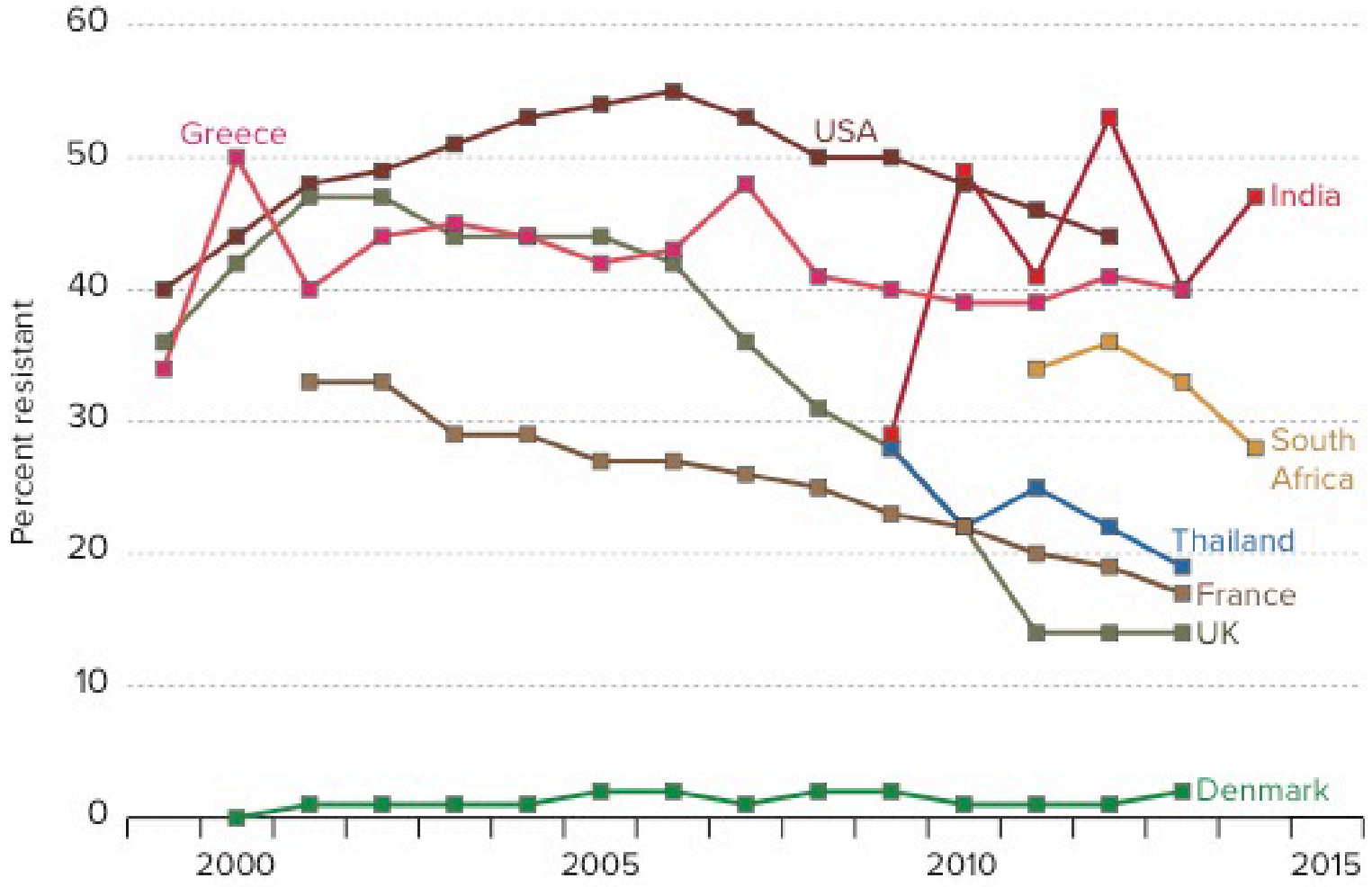

Figure ES-1: Percentage of *Staphylococcus aureus* that are methicillin resistant (MRSA) in selected countries, 1999-2014
Source: CDDEP 2015

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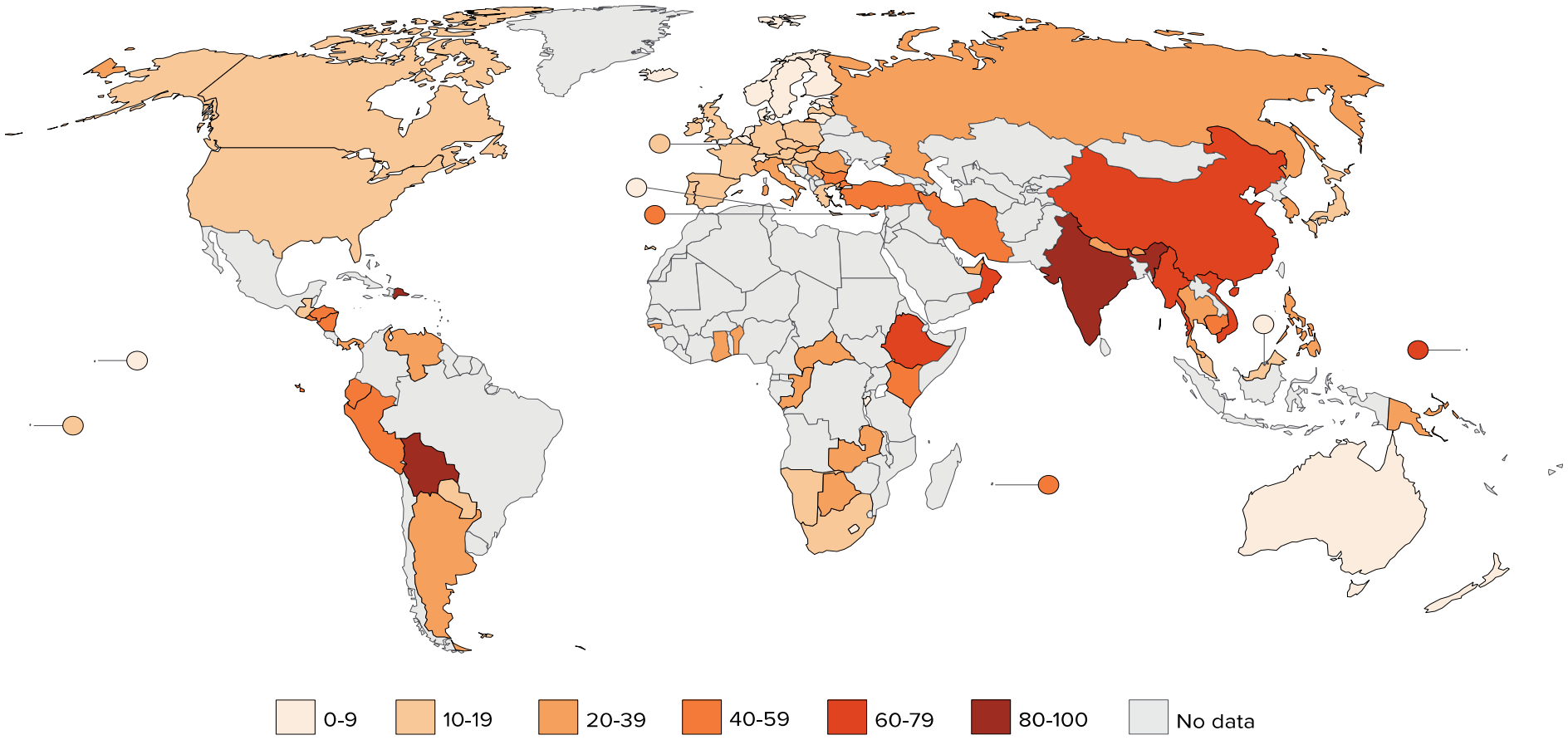

Figure 1-2: Percentage of extended-spectrum beta-lactamase producing *Escherichia coli, by country (most recent year, 2011-2014)**
Source: CDDEP 2015, WHO 2014 and PAHO, forthcoming

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Antibiotic Resistance in Africa

Kenya

- Resistance increased in *Streptococcus pneumoniae* bacteria, responsible for many respiratory tract infections, including pneumonia, which killed over 30,000 children in Kenya in 2008. Resistance to penicillin increased from 25 percent in the 1980s to 43 percent in 2003.
- Resistance in *Escherichia coli* bacteria was highest to aminopenicillins, at 88 percent in 2012. However, zero percent resistance was reported in *E. coli* to last-resort antibiotics (carbapenems).
- A 2015 study by Dr. Samuel Kariuki and colleagues found that the percent of *Salmonella* Typhi bacteria that were multidrug-resistant increased significantly from 1988 to 2008.

Antibiotic Resistance in Africa

Mozambique

- Ninety percent of *Streptococcus pneumoniae* bacteria were resistant to at least one first-line antibiotic.
- Resistance to first-line treatments for *Haemophilus influenzae* bacteria increased significantly from 2001 to 2005 in in Mozambique, approaching 50 percent.

South Africa

- In sub-Saharan Africa, the proportion of *Staphylococcus aureus* that were resistant first line penicillin antibiotics increased in the early 2000s but has decreased since 2011 in South Africa, from 34 to 28 percent.
- In 2014, resistance in *Escherichia coli* in South Africa was highest to aminopenicillins, at 80 percent, but zero percent resistance was reported to last-resort antibiotics (carbapenems).

Antibiotic Resistance in Africa

Tanzania

- High levels of resistance were reported in *Streptococcus pneumoniae* bacteria in children.
- Increasing rates of resistance were found in bacteria causing common urinary tract and sexually-transmitted infections, particularly gonorrhea and syphilis, over the last 10 to 15 years.

Uganda

- Resistance rates to most antibiotics tested of 60 to 100 percent have been reported in bacteria causing sepsis, though resistance was less than 5 percent to newer antibiotics.
- High levels of resistance to first-line treatments in *Streptococcus pneumoniae* bacteria have been detected in Uganda from 1995 to 2006.

Ch 2: Human Use of Antibiotics

- Antibiotic consumption in humans is increasing globally. The greatest increase between 2000 and 2010 was in low- and middle-income countries, but in general, high-income countries still use more antibiotics per capita.

- An estimated 80 percent of all antibiotics are used in the community, where the purchase of antibiotics without prescription is common, especially in LMICs. In many countries at all economic levels, clinicians have incentives to overuse antibiotics.

- The confluence of patients with serious medical conditions, interconnectedness of hospitals, and high density of antibiotic use make hospital antibiotic use disproportionately important.

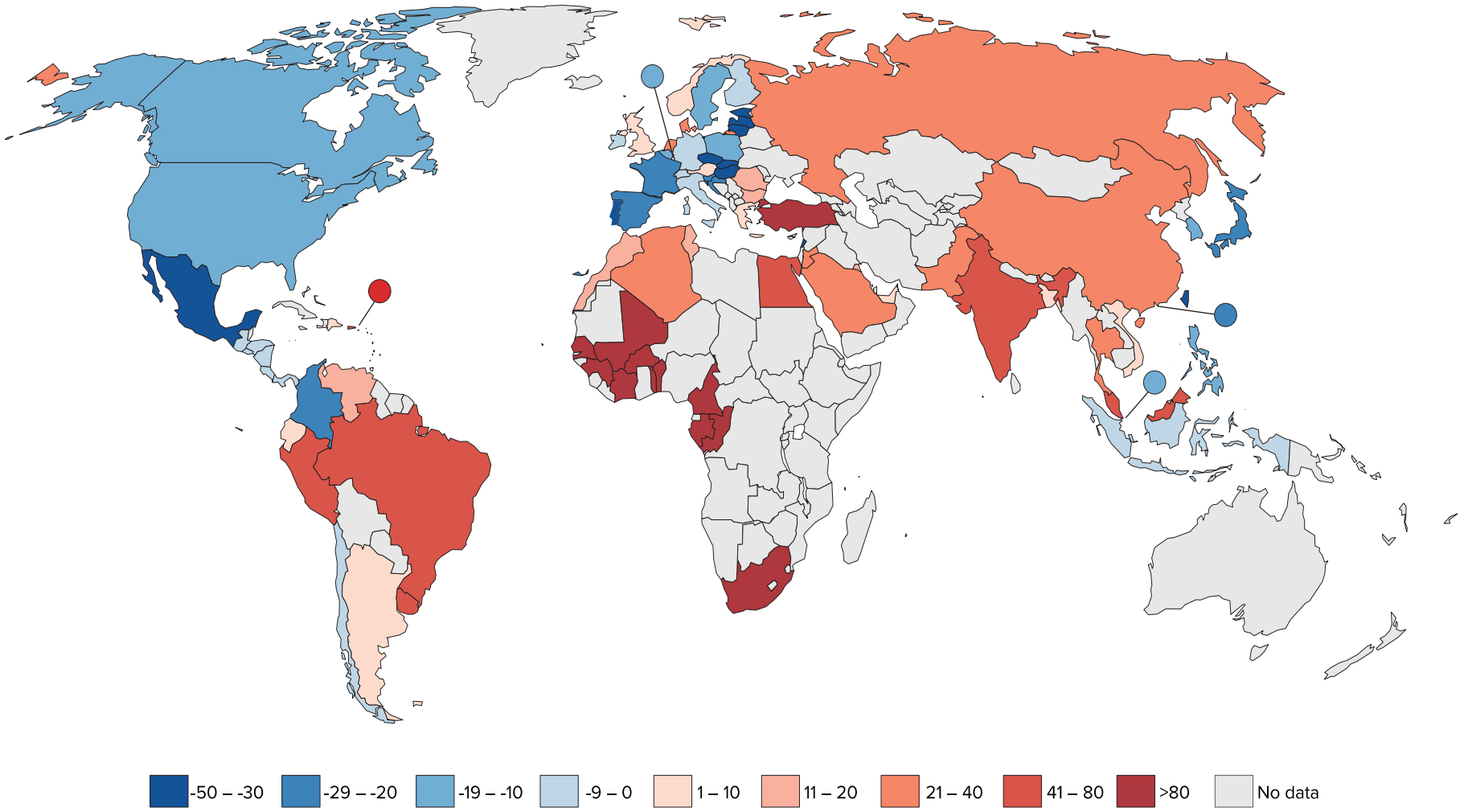

Figure 2-4: Percentage change in antibiotic consumption per capita 2000–2010*, by country
Source: Van Boeckel et al. 2015 (adapted)

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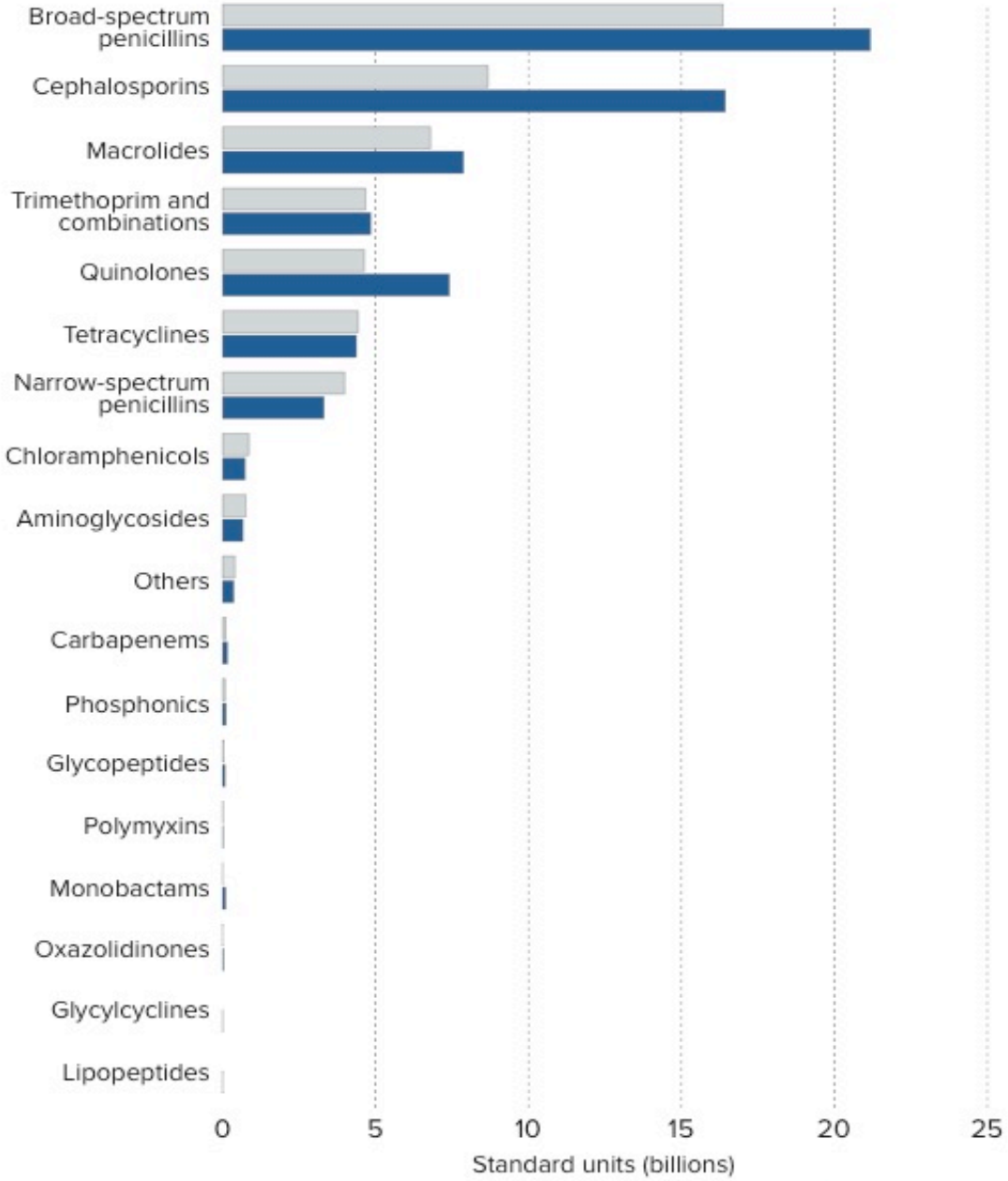

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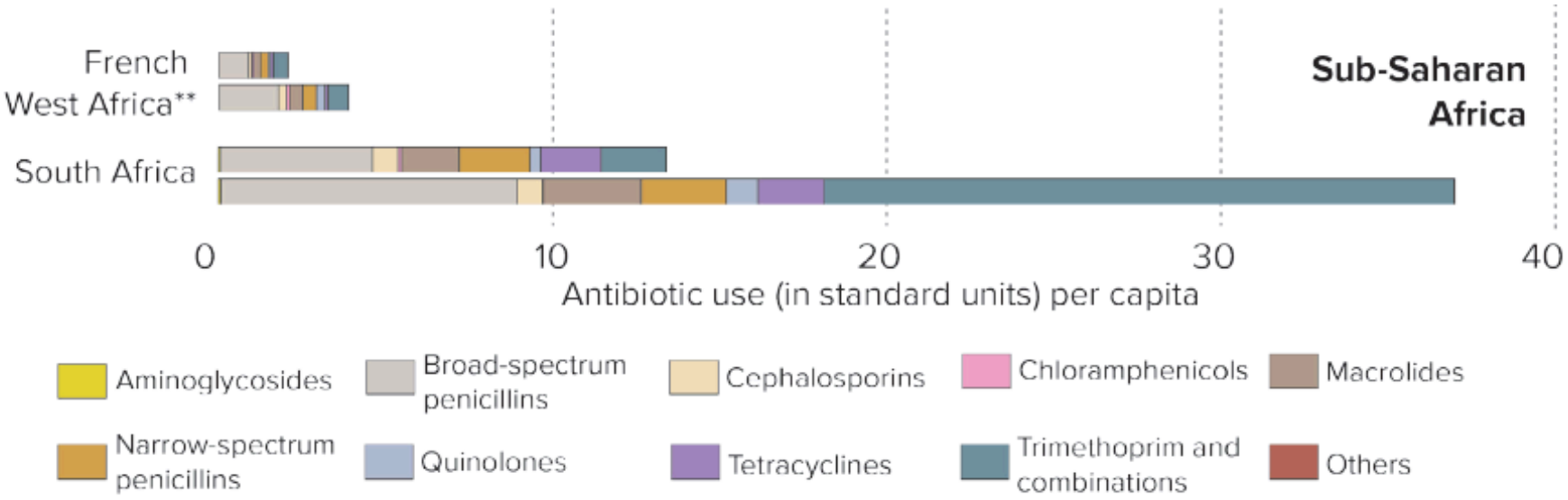
Figure 2-1: Global antibiotic use by class, 2000-2010
Source: Van Boeckel et al. 2014 (adapted)

Antibiotic use in Africa



*Much of the increase in antibiotic consumption in South Africa can be attributed to the WHO recommended use of co-trimoxazole as prophylaxis for HIV patients

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Ch 3: Antibiotics in Agriculture and the Environment

- As global demand for animal protein grows, antibiotics are increasingly used to raise food-producing animals in intensive production—increasing the prevalence of antibiotic-resistant bacteria in livestock, poultry, and aquaculture, with spillovers that affect human health.

- Livestock farmers must be provided the tools to optimize production systems without antibiotic growth promoters and to minimize antibiotic use for disease prevention.

- We recommend phasing out sales of feed pre-mixed with antibiotics and reducing the use of antibiotics to prevent animal diseases in all countries.

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igrams per 10 km^2 pixels) 2010

Source: Van Boeckel et al. 2015

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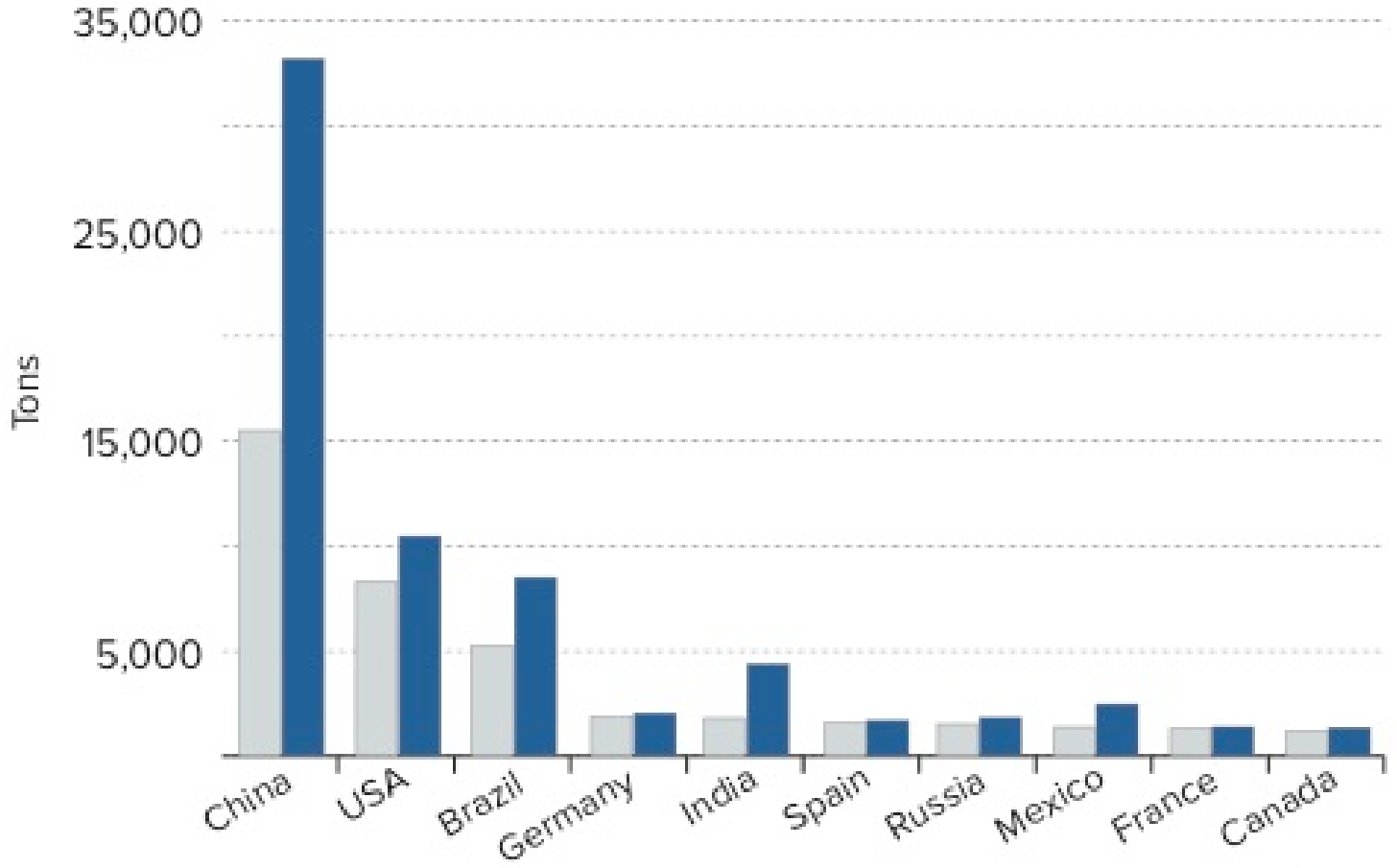

Figure ES-3: Antibiotic consumption in livestock, top ten countries 2010-2030 (projected for 2030)
Source: Van Boeckel et al. 2015

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Ch 4: the Global Antibiotic Supply and its Effectiveness

- New antibiotics are more expensive and out of reach for many who need them, especially in low- and middle-income countries with a high burden of infectious diseases.

- New agents are not the only, or the most important, tools in maintaining the global stock of antibiotic effectiveness. Conserving the effectiveness of existing antibiotics and complementary technologies are vital.

- An “empty pipeline” argument has led to an emphasis on incentives for new antibiotic development to the exclusion of policies that encourage antibiotic conservation.

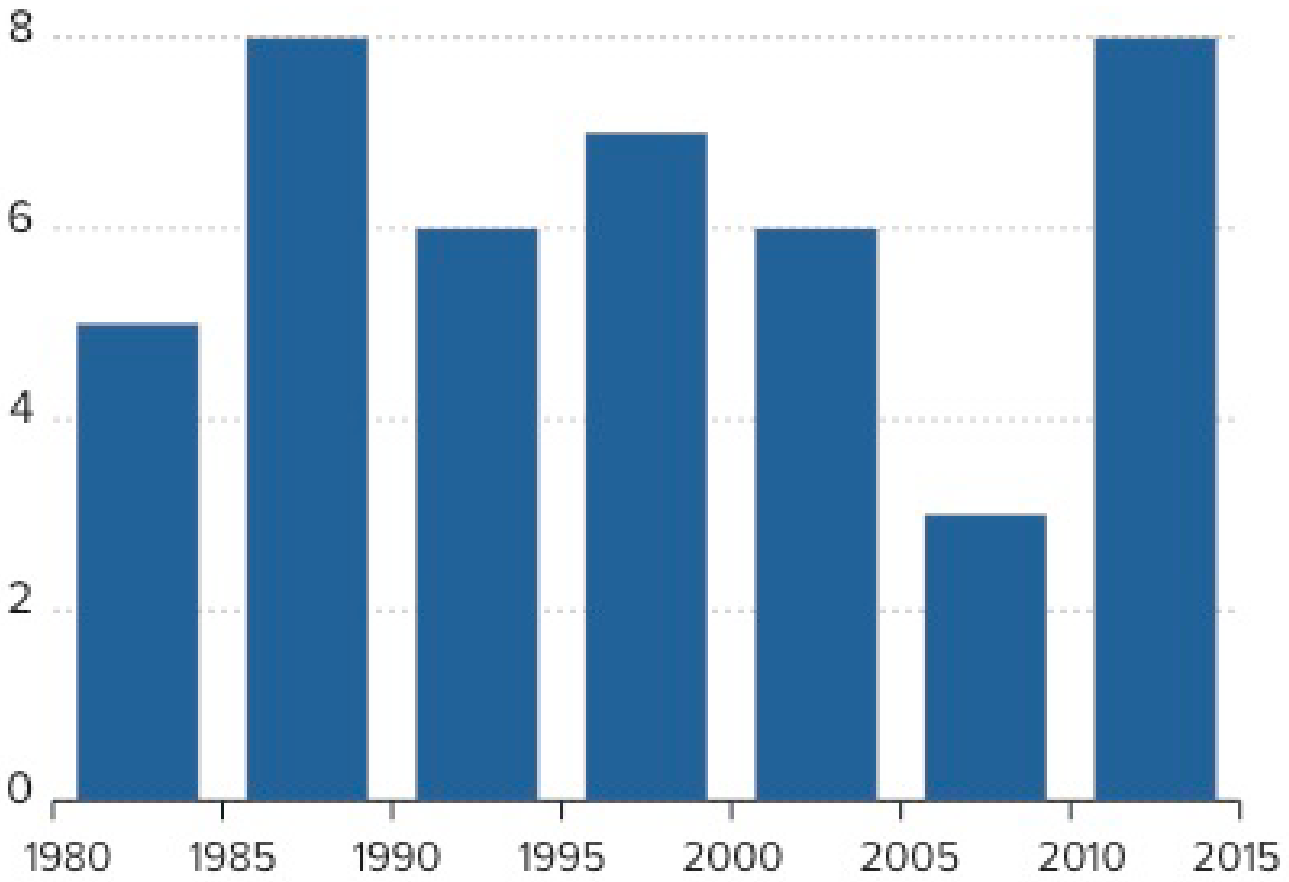

Figure ES-4: Systemic new molecular entity (NME) antibiotics still marketed in the US by period of introduction, 1980-2015*
Source: Outterson et al. 2013

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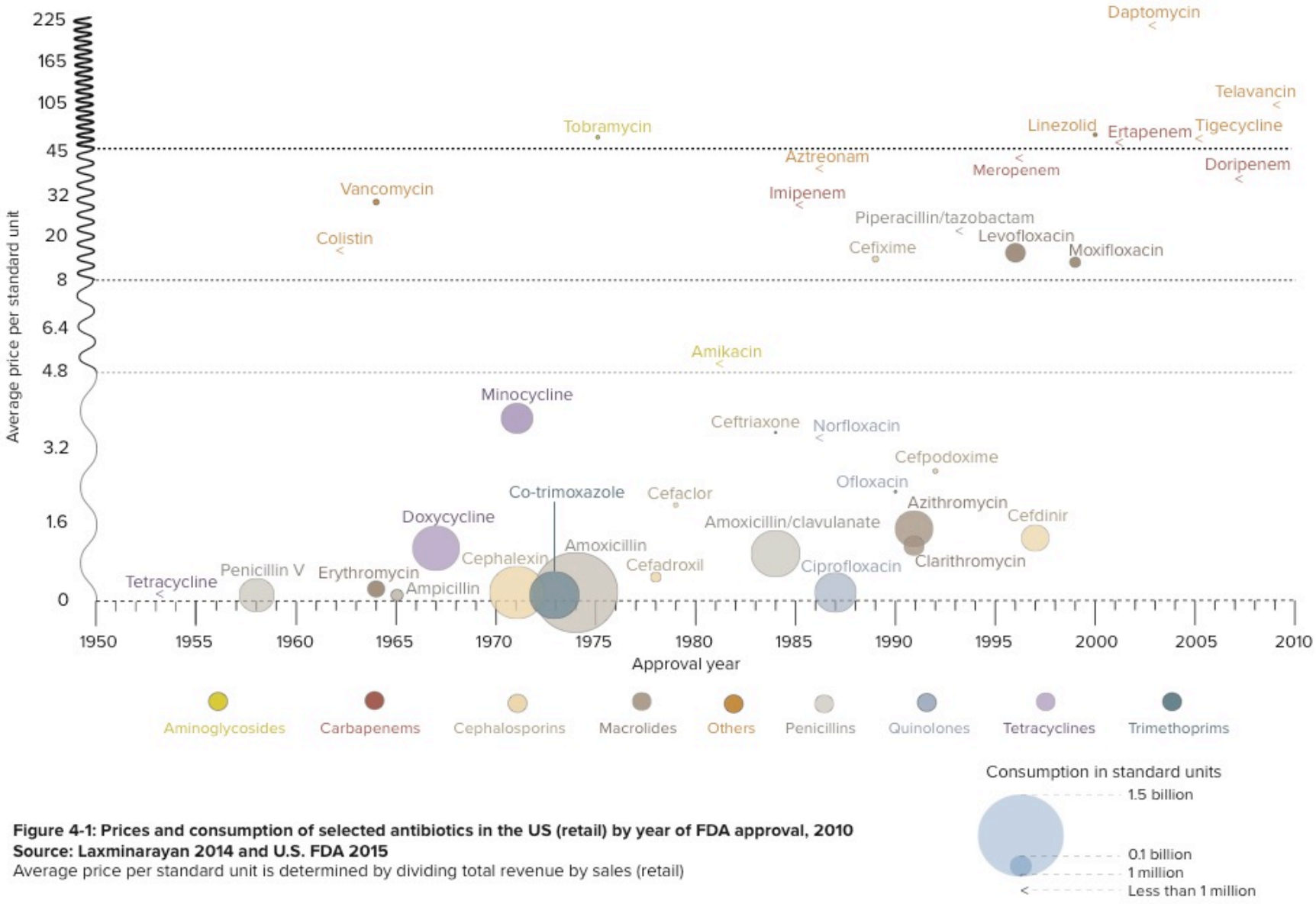

Figure 4-1: Prices and consumption of selected antibiotics in the US (retail) by year of FDA approval, 2010
Source: Laxminarayan 2014 and U.S. FDA 2015
Average price per standard unit is determined by dividing total revenue by sales (retail)

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Ch 5: What Works at the Country Level

- Antibiotic resistance is a global problem, but the solutions are at the national and regional level. Benefits of conservation accrue locally and contribute to antibiotic effectiveness globally.

- Antibiotic use can be rationalized by reducing the need for antibiotics through better public health, by curbing unnecessary use, and by improving access where use is warranted.

- National strategies should address incentives for conservation in hospital and community settings and in the agricultural sector. Solutions should target both healthcare providers and the public.

1. Reduce the need for antibiotics through improved water, sanitation, and immunization

2. Improve hospital infection control and antibiotic stewardship

3. Change incentives that encourage antibiotic overuse and misuse to incentives that encourage antibiotic stewardship

4. Reduce and eventually phase out subtherapeutic antibiotic use in agriculture

5. Educate health professionals, policy makers, and the public on sustainable antibiotic use

6. Ensure political commitment to meet the threat of antibiotic resistance

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The Global Antibiotic Resistance Partnership (GARP)

- GARP is a network of interdisciplinary working groups catalyzing the development and implementation of national action plans to address antimicrobial resistance.
- GARP is currently commencing Phase III, during which the partnership will expand into regional hubs in south and Southeast Asia and south and east Africa.

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