



Review of the National Action Plan for Combating Antibiotic-Resistant Bacteria

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Abstract

Improved sanitation systems, better hygiene, vaccines, and the use of antibiotics and other medications, have reduced the number of deaths caused by bacterial infections. Unfortunately, as our practices to reduce bacterial infections improve, the bacteria's defenses improve just as quickly. Bacteria can develop resistance to the antibiotics that are used to kill them. To help combat antibiotic-resistance, a national plan has been put in place. This paper reviews the updates that have been made in the 2020-2025 plan as well as the components of the plan that are still being used.



Antibiotics have been used to treat patients since the 1940s. Soon after the new treatment was developed, resistance from bacteria began being observed.

Due to years of overprescribing, and overuse in agriculture and other industries antibiotic resistance has become a serious issue. Antibacterial resistance happens when bacteria develop the ability to become resistant to the medication designed to kill them. Once the bacteria have developed this trait, they are then able to pass this information to other bacteria. Eventually enough bacteria become resistant to a certain antibiotic that it is no longer useful in certain individuals.¹

Resistant infections are difficult and sometimes impossible to treat. In most cases, antibiotic-resistant infections require extended hospital stays, additional follow-up doctor visits, and costly and toxic alternatives.¹ The Centers for Disease Control and Prevention (CDC) reports that antibiotic resistant bacteria are responsible for more than 2.8 million infections and 35,000 deaths a year in the United States.²

As this issue grows, crucial steps must be taken to combat antibiotic resistance so that we do not return to a pre-antibiotic era where small infections could be deadly. The National Action Plan for Combating Antibiotic-Resistant Bacteria (CARB) aims to help decrease the amount of antibiotic resistance.

The Executive Order 13676 established the Federal Task Force on Combating Antibiotic-Resistant Bacteria to identify actions to implement the National Strategy.³ Based on the 2014 U.S. Government's National Strategy for CARB, the first National Action Plan was released in 2015 by the Federal Task Force. The Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (PACCARB), also established by Executive Order 13676, is composed of both Federal and non-Federal subject-matter experts in human and agricultural health.³

In midst the COVID-19 pandemic, this plan has been updated to better assess and control antibiotic resistance.² In October 2020, the updates to the National Action Plan were released. This plan will range from 2020-2025 and then will likely be readjusted to better assess our standing on the issue in the future.² The 2020-2025 plan builds on the original plan released in 2015 by expanding evidence-based activities that have been shown to stop the spread of antibiotic resistance, such as increasing infection prevention and control and improving the way antibiotics are used.⁴

The new plan features the same main goals with updated objectives. The plan can be broken down into five main goals. The first goal is to slow the emergence of resistant bacteria and prevent the spread of resistant infections.³ Bacteria and fungi resistance is inevitable, but it is important to slow this process to minimize the effects on





human and animal health.³ One way to achieve this is through primary prevention of infections through infection control and other interventions.³ Also, using antibiotics in humans and animals only when needed rather than as a preventative measure will greatly help to reduce the likelihood of bacteria developing resistance.³

The Task Force on CARB anticipates challenges of trying to accomplish the goal of slowing and preventing the spread of resistant infections.³ The Task Force anticipates having difficulties changing behaviors to ensure that the optimal infections control practices and appropriate prescribing are taking place.³ Changing the way our healthcare systems have operated in the past is a challenge that will not be conquered overnight. Nonetheless, these efforts are vital to prevent future complications. Another issue will be identifying and scaling up the best practices across spectrums of care and ensuring their continuity while coordinating these practices across One Health. One Health is a collaborative and transdisciplinary approach with the goal of achieving optimal health outcomes by recognizing the interconnection between people.³

Additionally, engaging all relevant stakeholders could be another potential difficulty.³ The objectives of the CARB plan explain plans to expand on national, regional, and state capacity for detecting, containing, and preventing antibiotic-

resistant infections.³ Additional education and training to help to change current practices efforts are also being made.

The next goal that is outlined is to strengthen national One Health surveillance efforts to combat the resistance. Antibiotic resistances are no doubt a One Health issue because it affects the health of humans, animals, plants, and the environment.³ Efforts to track the resistant organisms mass scale surveillance. This requires the collaboration of many U.S. Government agencies to track and report cases of resistance.³ This plan not only brings these agencies together but sets standards for practices and deadlines to invoke results.³ There are many challenges that come from trying to strengthen the national infrastructure for surveillance of antibiotic use and resistance. Encouraging local, State, and private partners and stakeholders to collect and share data across the human, animal, plant, and environmental sectors is not an easy feat.³ Enhancing training and testing capacities will require laboratories to maintain ongoing support for staff, continuously maintaining testing equipment, and advancing testing methodologies.³ It is essential to find cost effective ways to collect and transmit the obtained data as well as practices that are time efficient. Four objectives have been put into place to help offset these perceived complications.

The third goal is to advance development and use of rapid and innovative diagnostic tests for identification and





characterization of resistant bacteria.³ New diagnostic tests are urgently needed to detect antibiotic resistance and to improve surveillance, the control of infections, and treatment decision-making by providers. The major issue to this is introducing new diagnostics that lack research on their appropriate use in clinical and veterinary care and a lack of point-of-care antibiotic resistance diagnostics in outpatient settings.³ There also needs to be a development of an incentive program to promote validation, adoption, and appropriate use of new and currently available diagnostics. The high cost of developing new diagnostics with the limited return on the investment is a huge difficulty that this plan hopes to not only address but to overcome by increasing education and showing the importance of these developments as well as to find ways to incentivize developments.

The fourth goal is to accelerate basic and applied research and development for new antibiotics, other therapeutic, and vaccines. While surveillance and management are extremely important aspects of the plan, the development of better therapeutics are equally important. Tracking the issue allows us to know where we stand, but if we want to stay ahead of the issue it is important that new therapies are being created to help decrease current and possible future resistance. Research can help to improve our understanding of the many factors that contribute to the emergence, spread, and persistence of antibiotic

resistance and can support new strategies or preventing and mitigating infections.³ Improving on existing therapies is also important. Research on alternative to antibiotics, including bacteriophages, monoclonal antibodies, immune modulators, and phytochemicals, suggests that these products can help prevent and treat infections in humans and animals without promoting antibiotic resistance.³ Effective vaccines that prevent infection are another alternative to the use of antibiotics. Other research and innovative products like biotherapeutics including microbiome-based products, prophylactic monoclonal antibodies, and decolonizing agents, could expand the range of strategies and help reduce the impact of antibiotic resistance.³ The discovery of new classes of antibodies with activity against gram-negative bacteria is also very challenging.³ Not only is it hard to find all these break throughs, but there is also the lag time to consider. The time that it takes for these discoveries to be made and then to be applied to development of new therapies and then to be distributed in medical practices. This involves more research and more education before the real impacts of the research finding can be felt. The main focuses of this goal are just as trying to increase the amount of research so that we can hopefully find new and better way of navigating through this impediment.

The last goal is to improve international collaboration and capacities for antibiotic-resistance prevention,





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surveillance, control, and antibiotic research and prevention.³ As outlined in the National Biodefense Strategy, the U.S. Government Global Healthy Security Strategy, and in accordance with the U.S. Government's engagement through the Global Health Security Agenda, the U.S. Government works to enhance the capacities of governments, civil society, academia, and the private sector in partner countries and the international community to address the emergence, spread, and impact of antibiotic resistance.³ To do this it is crucial to be able to rapidly detect and contain antibiotic-resistant pathogens.³ Enhancing the global efforts as well as establishing a well-functioning internal network to detect and respond to antibiotic resistance is a lofty task. This requires an alignment of many resources in the U.S and the rest of the world.³ Accomplishing this goal is extremely important so that all other efforts are not in vain. It is to be noted that the problem of antibiotic resistance is a threat to the humans, animals, plants, and the environment everywhere not just the United States. "Microbes don't respect borders. They don't respect political boundaries. They don't respect political ideology. So, whatever our borders and national ideologies are, we need to work together; otherwise, it's going to take a terrible toll." States Martin Blaser, MD, chair of the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (PACCARB).²

Although it is evident that the plan falls short in some areas even with the updates, the existence of this plan is an extremely important start. "Having a National Action Plan for CARB is important both symbolically and functionally," said David Hyun, MD, senior officer with the Pew Charitable Trusts' antibiotic resistance project. "When the first plan came out in 2015, it sent an important signal that the US recognized and is working to combat the growing threat of antibiotic resistance, and by issuing an updated plan, the U.S. is sending a clear message that the fight against superbug remains a national priority."²

The National Action Plan for CARB does not specifically address the need for incentives to fix the financial model for antibiotics, which is widely seen as a roadblock to bringing innovative new antibiotics to market.² The plan will be reassessed at its completion in 2025 which will allow an opportunity to adjust the current goals and objective to better decrease the emergence and spread of antibiotic-resistant infections and to better address issues like the current financial model.³

Within five years the previous portion of the CARB plan was also able to accomplish several objects. By working together on local, state, territorial and international levels the U.S Government has established the nation-wide Antibiotic Resistance Laboratory Network (AR Lab





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Network).³ New programs were developed to improve antibiotic usage in healthcare. Biopharmaceutical accelerator, CARB-X, was initiated to help develop and approve new diagnostic and treatment options.³ Moving forward into the next five-year plan it will be interesting to see what progress is made on the updated plan objectives.



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