ROAR: A Focus on Reservoirs of Antibiotic Resistance

The Reservoirs of Antibiotic Resistance (ROAR) Project was initiated in 1997 to encourage global research and assemble information on the genotypes and phenotypes of commensal bacteria that serve as potential reservoirs of antibiotic resistance determinants for human pathogens. The ROAR Project represents the first systematic effort to compile and disseminate information on resistance in reservoir bacteria. The central goal of the ROAR Project is to determine the extent to which resistance genes are flowing from commensals to pathogens, by characterizing and tracking resistance genes in commensal bacteria. This knowledge can help to predict the emergence of new forms of resistance genes before they gain ascendency in pathogenic bacteria. To better understand the role of commensals as reservoirs of antibiotic resistance, APUA has launched the ROAR II project, a $3 million, five-year Cooperative Agreement with the National Institute of Allergy and Infectious Disease (NIAID/NIH).

Successful control of antibiotic resistance requires consideration of every potential source of resistance. Though commensal bacteria have long been believed to be important reservoirs of antibiotic resistance genes, little information is available about their carriage of such genes. The frequency of resistance genes in commensal organisms may act as a marker or predictor of the emergence of resistance in pathogenic bacteria, and collection of data on resistance gene frequencies in commensal and pathogenic organisms is necessary for the analysis of genetic exchange between these two populations. Monitoring resistance gene distribution and diversity in commensal bacteria will provide information essential for public officials and others charged with assessing risks associated with antibiotic use in human medicine, food production and agriculture.

The goal of the ROAR project is to determine the role of commensals as a reservoir or “feeder population” for the resistance that is appearing in pathogens. The issues concerning the direction and amount of gene transfer between commensals and pathogens are still debated. Understanding these processes will aid in curbing the transfer of antibiotic resistance between commensals and pathogens.

Ways to become involved with ROAR

- Send a request to subscribe to the ROAR e-list to amelie.peryea@tufts.edu
- Collaborate with ROAR through submission of existing relevant data to the ROAR database; contact Dr. Michael Feldgarden at michael.feldgarden@tufts.edu
- Respond to the latest RFP for research addressing the ROAR hypothesis; information will be posted at www.roarproject.org
- Visit our website, www.roarproject.org

APUA One-on-One

Interview with Dr. Michael Feldgarden, APUA Research Director and Principal Investigator of the ROAR Project

Q. Considering the historic, decades-long focus on pathogens as the culprit hosts for antibiotic resistance genes, what is behind the current interest in commensal organisms as possible role-players in the antibiotic resistance problem?

A. Early antibiotic use selected for resistance within the hospital environment, but we have become much more aware recently of the selective pressures operating outside of the clinical arena as a result of the large quantities of antibiotics employed in outpatient use, animal and agricultural applications. The commensal bacteria, which vastly outnumber the pathogens quantitatively, and are exposed to an onslaught of antimicrobials, have demonstrated a large capacity for the in vitro transfer of resistance genes among themselves. For example, the gut bacteria Bacteroides can readily transfer its resistance genes to the commensal staphylo-
APUA Holds Congressional Staff Briefing and Roundtable on U.S. Drug-Resistant Infections

APUA held a Congressional staff briefing on July 19, 2005 in Washington, D.C. entitled Drug-Resistant Infections in the U.S.: A Threat to Patient Safety, National Security and Health Care Costs, portraying the crisis of antimicrobial resistance (AMR) from several key perspectives. The briefing featured experts from the worlds of scientific research, health care management, and health care quality improvement. Congressman Stephen F. Lynch (D-MA) began by warning his colleagues: “It will not be long, if current trends continue, that we have some type of outbreak or breach of our current defense to certain very dangerous bacteria … It is a real threat to our national security and to global security. We’re in a race against time.”

APUA Executive Director Kathleen T. Young contrasted AMR statistics with its stark, real-life consequences by stating “you have to remember that behind every statistic is a life-and-death moment, when the doctor and patient realize that a deadly infection is not responding to the medicine that we thought we could rely on.”

In summarizing the findings of APUA’s recent GAARD 2005 report (see GAARD, p.7), APUA President Stuart B. Levy, M.D. noted that misuse of antimicrobials has led to some of today’s most worrisome threats, including drug-resistant forms of E. coli, Klebsiella, Neisseria gonorrhoeae, Streptococcus pneumoniae, and Staphylococcus aureus. Levy likened the threat of antimicrobial resistance to other forms of terrorism in the post-9/11 era. “… Many of these threats are more important, more real, and more possible than the threats of bioterrorism,” he said. “We are trying to alert both the scientific and the lay community, and especially our own government…”

Dale N. Gerding, M.D., Associate Chief of Staff for Research and Development at the Hines Veterans Affairs Hospital, described the frightening emergence of drug-resistant Clostridium difficile, and other species causing serious endemic hospital infections that are resistant to most antimicrobial classes, including cephalosporins, penicillins, carbapenems, aminoglycosides, and fluoroquinolones. Gerding

CONGRESSIONAL BRIEFING continued on next page
emphasized the need for incentives in new drug development, stating that between 1983 and 1987, 16 new antibacterials reached the market; but between 2003 and 2004, only three such drugs were approved. Pharmaceutical and biotechnology companies will need incentives to reverse this downward trend.

Gordon W. Grundy, M.D., Regional Medical Director for the Northeast Region of Aetna, Inc., summarized strategic solutions to this multifaceted problem. Broad-based approaches to address antimicrobial resistance – including APUA’s multi-pronged efforts in research and education – are vital. The 1999 Interagency Task Force’s Public Health Action Plan to Combat Antimicrobial Resistance has led to important domestic initiatives in surveillance, prevention and control, research, and product development. But, as Grundy warned, this well-conceived strategy will mean nothing without “comprehensive and sustained funding.”

“[AMR costs are] much bigger than any of us clearly anticipated, and a significant part of rising health care costs in this country.”

Robert Scalettar, M.D., Chair of the Coalition for Affordable Quality Health Care, concluded the briefing by explaining the health care industry’s role in attacking antimicrobial resistance. The costs of AMR have climbed to staggering levels. Hospital-acquired infections total upwards of $50 billion a year and a growing percentage of these are antibiotic-resistant. Scalettar’s take-home message: “It’s actually posing an immediate danger to patient safety – and national security. These are diseases that we are creating and we can contain… but we need the kind of funding and support that only a government can provide.”

For the complete text of this report and the presenters’ PowerPoint slides, go to www.apua.org.

Corporate Leaders Help APUA in “Preserving the Power of Antibiotics”: FY2006 Partners

APUA corporate membership provides all-important, unrestricted contributions for support of APUA core functions such as public relations, development and other core activities that support our research and educational programs.

Wyeth Pharmaceuticals, The Clorox Company and Bayer Healthcare AG have joined APUA at the highest level as platinum sponsors for FY 2006. Wyeth has earmarked funding for the APUA membership reception and Leadership Award at ICAAC 2005. APUA also welcomes Merck Research Laboratories as a new member at the benefactor level. We are likewise very grateful for the recent renewal of APUA’s long-standing partner, AB Biodisk at the benefactor level. Biomérieux has also joined as a benefactor, representing the first in the diagnostics industry.

To contain antibiotic resistance, APUA promotes the prudent use of existing antibiotics, as well as development of cost-effective infection control, diagnostics, innovative drugs and vaccines. We are grateful to all of our corporate and project partners listed on page 2 and look forward to more corporations joining their ranks. For information on becoming a corporate leader, please see www.apua.org.

2005 APUA Global Leadership Award

Each year at ICAAC, APUA presents its Leadership Award to a person who exemplifies extraordinary leadership and effectiveness in promoting prudent antibiotic use and containing resistance. This year’s award will go to Dr. Richard Besser for his role in the CDC Get Smart Campaign which, in collaboration with APUA and major medical societies, has had documented success in improving antibiotic management in the U.S.
coci. Dr. Anne Summers has described the antibiotic resistance problem as an “antibiotic resistance transfer problem”, and this in turn makes it an ecological problem—one that involves all of the bacteria within an ecological niche. Once established within the commensal habitat, antibiotic resistance becomes a very difficult problem to eradicate because of the high prevalence rates. Considering the current antibiotic saturation of some commensal habitats and the selective pressures operating on them, understanding the role of commensals becomes very important. Furthermore, commensals, such as *Acinetobacter baumannii*, are emerging as new pathogens in their own right and as such, legitimately warrant significantly more attention and investigation than they have previously received.

**Q. With your background in the study of population biology, what led you to become interested in the ROAR project and what do you find most fascinating about it?**

**A.** There have been many studies performed, both *in vitro* and *in situ*, looking at the mechanics of gene transfer, spread and stability. Such experiments can help us predict what *could* potentially happen under a defined set of conditions. This is certainly important to know. But defining exactly what actually *did* happen historically is crucial and the study of phylogenetics is indispensable to answering these questions. In order to devise useful policy for directing the management of antibiotics and the control of resistant infections, it is essential to know, for example, when and where a resistance gene moved from one species to another. When a gene has adapted or evolved with new resistance, one would like to know whether that event took place for example, in the hospital or in the agricultural environment. Delving into the history of antibiotic resistance is crucial to answering these questions.

The new opportunities now available for obtaining genetic data make it possible to devise large databanks relatively easily and inexpensively. The next exciting challenge is designing good experiments, using appropriate collections of data and strains that will let us answer these history questions.

**Q. One component of the ROAR online databases is a searchable annotated library of the published literature on commensal bacteria. What makes the ROAR literature database a unique and useful tool?**

**A.** The goal here has been to cull the literature for reports on resistance in bacteria inhabiting environments in which no related pathogenesis is apparent. Many of these reports are obscure, simply because the search term “commensal” is only infrequently used as a descriptor in existing databases. Likewise, a broader search using “antimicrobial resistance” will identify sources dealing largely with pathogens. The ROAR annotations provide added value by carefully defining the geographical site, the host, and the environmental habitat from which the isolates are derived, the complete range of antimicrobials tested, as well as the susceptibility testing methods used and other genetic analyses employed. The search terms have been customized from a careful examination of the literature and by anticipating how researchers will likely utilize the literature database.

Creating this database has also allowed the ROAR team to locate researchers specializing in the field and is helping identify potential sources of isolates for populating the ROAR isolate database. The two databases will be linked—such that, when available, specific data on individual isolates can be quickly accessed. Ultimately, the literature database will serve as an excellent source of geographically defined data that can be paired with data derived from clinical isolates found in geographically similar sources.

**Q. A second novel component of ROAR is its ever-expanding isolate database. What kinds of data are sought at present, and are there certain parameters that need to be met to qualify for submission?**

**A.** Since the goal of ROAR is to rapidly populate its new database, it is very much open to receiving data from a wide variety of species. The ideal dataset would encompass everything ranging from the resistance phenotypes for a wide array of antibiotics, information about the genes involved, such as presence/absence data and complete genetic sequences, whether antibiotic resistance genes are located on the plasmid or chromosome, to including some kind of genetic typing such as multilocus sequence typing that would allow some standardized inter-laboratory comparisons. Realistically, however, many of the datasets we receive, particularly datasets from older studies, will lack certain kinds of genetic information. Thus, the larger proportion will consist mainly of phenotypic data. Currently, we are focusing on fleshing out a smaller subset of data in detail by locating collections of *E. coli* that have already been partially characterized.

For submission to the ROAR database, data should be based on single isolates, not aggregated or summarized. The database is currently accepting information from all species, but there should be a primary focus on commensal bacteria derived from non-pathological states, although pathogens isolated from the same habitat as commensals are of definite interest and would be included. At a minimum, antibiotic susceptibility data are sought, but the data should be accompanied by some epidemiological information. In terms of strains, both ‘snapshot’-type examinations or longitudinally based surveys are useful. Specific susceptibility methodologies are not required, but the parameters should be clearly defined to aid the ROAR team in standardizing the output. Within a few months, we anticipate introducing to the ROAR website a standardized, on-line data-submission template, which will guide investigators as to the types and formats of data sought and which should facilitate the uploading...
of individual strain data. In the interim, interested researchers should contact a member of the ROAR team with a brief synopsis of their data to discuss its suitability for the database.

**Q. What are some of the possible investigations that might be envisioned using the ROAR database?**

**A.** The ROAR database consists of raw, isolate-based data, not summary statistics, so for every strain, the resistance data can be downloaded along with all its demographic and genetic attributes, where available. Importantly, by accumulating and organizing this large amount of data, ROAR gives researchers the opportunities to devise hypotheses involving any antibiotic of interest. For example, if certain patterns of antibiotic resistance linkages are observed in specific habitats or time frames, one or more hypotheses can be devised and then tested against certain demographic variables to find why a certain phenomenon occurs in a specific environment or under certain conditions. A unique role for APUA is undertaking projects that are of public utility for the scientific community as a whole, as opposed to having to focus on a very narrowly-defined question; ROAR is a good example of that investigative approach.

**Q. What are some of the biggest challenges now facing the building of the ROAR databases?**

**A.** Standardization of the data is the greatest challenge at present. The compilation of diverse data that are derived internationally and were initially collected with many different objectives will face challenges in standardization. This is why a ROAR subfocus for year four is to gather a completed set of standardized data on a single species that can be used to initiate some of the sought-after analyses outlined in the original ROAR objectives. Ideally, we would like to see researchers start adopting certain standardized methodologies to help overcome these difficulties.

**Q. ROAR has funded a number of smaller consortium studies (see below). What is the discreet function of these in furthering the ROAR project goals?**

**A.** There are really several functions. First, the more people involved in research on commensals, the more we understand the basic biology of resistance in commensals. Second, they initiate pilot studies that demonstrate a potential for delivering something much larger. Another goal is to answer certain specific questions regarding the interaction of resistance genes between commensals and pathogens. Lastly, we will use the data from these studies to help populate the ROAR database with the ideal standardized data that we seek.

**Q. Where is ROAR headed and what impacts do you envision the ROAR project might have on the detection and management of antibiotic resistance in pathogenic bacteria?**

**A.** In the near future, one of the real questions we would like to model is the likelihood that resistance genes will move from commensal to pathogenic populations. Can models be devised that will predict whether certain events will occur and what kind of ecological circumstances will favor or disfavor this movement? The challenge here is to develop models that will “talk” to the kinds of epidemiological data available. Once we obtain a phylogenetic distribution of how antibiotic resistance is distributed along the family tree of *E. coli*, we can ask, for example, are some branches more likely to attract resistance genes? Ultimately, when we understand the role of commensals more thoroughly, we will be able to devise interventions that can check and roll back antibiotic resistance.

Dr. Michael Feldgarden received his Ph.D. in Biology from Yale University where he conducted research on the evolution of resistance to colicins. He has also investigated the ecology of bacterial speciation in soil bacteria. While a Research Assistant Professor in the Department of Ecology and Evolution at SUNY Stony Brook, in collaboration with Dr. Daniel Dykhuizen, he used DNA sequence data, phylogenetic reconstruction, and other molecular evolutionary tools to identify candidate genes that might be involved in urinary tract infections.

Dr. Feldgarden spoke with Science and Editorial Consultant Bonnie Marshall.

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**ROAR Year 3 Funded Projects**

**Streptococcus mitis** biovar 1 and its potential as a reservoir for *S. pneumoniae*. Susan K. Hollingshead, University of Alabama at Birmingham, Investigator

To understand the extent of gene flow from the reservoir *S. mitis* biovar 1 to *S. pneumoniae*, we intend to identify to what extent these two bacteria share a common gene pool, how readily unselected genes are transferable by transformation, and to what extent mobile genetic elements are shared.

**Escherichia coli** of poultry: A plasmid-mediated reservoir of resistance genes? Lisa K. Nolan and Timothy Johnson, Iowa State University, Investigators

This project characterizes an avian *E. coli* (AEC) plasmid (pTJ100) to enhance our knowledge of the evolution of R plasmids, the impact of animal production practices on plasmid evolution, and the role these plasmids may play as a reservoir of antimicrobial resistance genes for human pathogens.

**High-throughput molecular genotyping of environmental and human staphylococci carrying class I integrons.** Anne O. Summers, University of Georgia, Investigator

A screening of *Staphylococcus aureus* strains from companion animals and from hospitalized and non-hospitalized humans has found intI1 ampllicands in all three groups. Flexible, inexpensive microarrays to genotype MGE-related loci in integrase-positive staphylococci from commercial poultry litter, from domestic pets, and from humans and an inexpensive, facile high-throughput plasmid profiling technology will be used to determine whether these loci reside on plasmids or the chromosome.
FDA Bans the Use of Baytril (Enrofloxacin) in Poultry

The campaign to end the overuse of antibiotics in animals has had a recent victory. U.S. Food and Drug Administration (FDA) Commissioner Lester Crawford recently announced the agency’s final decision to no longer allow distribution or use of the antimicrobial drug enrofloxacin for the purpose of treating bacterial infections in poultry. Enrofloxacin, a fluoroquinolone animal drug closely related to ciprofloxacin, is marketed as ‘Baytril’ by Bayer Corporation. “The FDA action marks the first time the agency has accepted that antibiotic use with selection of resistant bacteria in animals leads to the spread of resistant bacteria to people,” said APUA President Dr. Stuart Levy.

The FDA’s Center for Veterinary Medicine initiated proceedings to withdraw the use of enrofloxacin in poultry in response to mounting scientific evidence, including APUA’s 2002 FAAIR Report (see www.APUA.org), that such use is causing the emergence of resistant strains of the bacterium Campylobacter. Campylobacter normally live in the digestive tract of poultry. Campylobacter that are resistant to fluoroquinolones survive treatment with the drug, multiply in the poultry, and subsequently spread during transportation and slaughter, contaminating both poultry carcasses and retail meat products purchased by consumers.

Campylobacter bacteria are a significant cause of food-borne illness in the U.S., in some cases causing severe illness and complications such as reactive arthritis and blood stream infections. Treatment of fluoroquinolone-resistant Campylobacter bacterial infections with ciprofloxacin and other fluoroquinolones is ineffective. This treatment failure prolongs the length of infections and increases risk of serious complications. According to Centers for Disease Control and Prevention statistics, resistance to ciprofloxacin in Campylobacter causing human infections increased from negligible amounts before 1995, when the Cipro-like drug was approved for use in poultry, to 21 percent in 2002.

“We applaud the decision taken by the FDA to withdraw approval of enrofloxacin antibiotic in poultry,” said Fred Angulo DVM, PhD, Chief of the Foodnet/NARMS Unit of the National Center for Infectious Diseases. “Scientific studies by CDC, by state health departments, and by others documented the increase in fluoroquinolone-resistant Campylobacter, linked these infections to eating poultry, and showed that the infections with resistant strain lasted longer, even if they were treated.”

The Union of Concerned Scientists (UCS) called the ban a ‘victory for public health’. While UCS and other consumer groups applauded the decision, some industry groups are concerned. The Animal Health Institute, which represents makers of animal drugs, said in a statement that “the loss of (enrofloxacin) leaves poultry producers without an important tool to treat sick poultry, and it will reduce animal health and welfare while increasing animal death and suffering.”

Dr. Anthony Cox, a risk assessment professional who testified on behalf of Bayer in the FDA proceedings, is equally disappointed. “To me, the FDA’s decision marks a historic shift away from rational, consequence-driven decision-making and toward precautionary, concern-driven decision-making as a basis for regulatory action,” said Dr. Cox. “I believe that applying risk analysis to quantify and compare the total major human health consequences—both good and bad—of different animal antibiotic use policies would serve the public interest and protect public health far more effectively than the concern-driven approach that FDA is now endorsing.”

Despite these concerns that the ban will cripple poultry producers, many in the industry, including Tyson, Perdue, and Foster Farms announced before the ban that they no longer use enrofloxacin in chickens produced for human consumption, while major chicken purchasers including McDonalds, Burger King, and Subway have instructed their suppliers to stop using fluoroquinolones in the chicken they purchase.

According to Dr. Levy “the next goal is to get farm animal producers to eliminate use of antibiotics as growth promoters, an action taken by the European Union and the subject of bills now in Congress.” To this end, the American Public Health Association, Food Animal Concerns Trust, the Union of Concerned Scientists, the American Academy of Pediatrics, and Environmental Defense in April petitioned FDA to ban the use of seven classes of medically important antibiotics as feed additives for chickens, hogs, and beef cattle.

In addition, the American Medical Association and nearly 300 other groups are supporting the bipartisan ‘Preservation of Antibiotics for Medical Treatment Act’, legislation introduced by senators Edward Kennedy (D-MA) and Olympia Snowe (R-ME) that would phase out the non-therapeutic use of medically important antibiotics unless the FDA finds that they pose no danger to human health.

“This decision by the FDA comes at a critical moment in our quest to control antibiotic resistance in bacteria causing infectious diseases,” said Dr. Stuart Levy. “With few drugs in the pipeline and bacteria becoming increasingly resistant, we need to eliminate uses which enhance resistance emergence.” The final decision took effect September 12, 2005. Bayer Corporation has elected not to appeal the decision.

For more on the ongoing debate over whether the use of antibiotics in food animals threatens human health, join the ROAR email discussion forum and see APUA Newsletter Vol. 22 No. 2 at www.apua.org.
GAARD

The 2005 Report of the Global Advisory on Antibiotic Resistance Data (GAARD), entitled “Global Antimicrobial Resistance Alerts and Implications” has been published as a supplement to Clinical Infectious Diseases (CID), 15 August 2005, Volume 41. The report provides a uniquely comprehensive view of drug resistance patterns across the major infectious diseases by combining findings from diverse international surveillance systems run by the world’s leading infectious disease experts. The document focuses on the most troubling and urgent infectious disease threats whose cures are imperiled by antimicrobial resistance: HIV/AIDS, tuberculosis, malaria, gonorrhea, pneumonia, and hospital-associated infections. The full report is accessible on the CID web site at www.journals.uchicago.edu/CID/home.html.

GAARD will hold its next formal Steering Committee meeting at this year’s Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC) in Washington, D.C. on Sat., Dec. 17. APUA convened the first GAARD meeting in 1998. Since then, the group has held regular meetings and has combined data for special studies.

APUA President Honored by ASM Tribute Publication

The American Society for Microbiology has announced the release of a new publication: Frontiers in Antimicrobial Resistance: A Tribute to Stuart B. Levy, edited by David G. White, Michael N. Alekshun and Patrick F. McDermott. The volume is a state-of-the-art review of antimicrobial and anticancer drug resistance written by acknowledged experts in the field. For more information, visit http://estore.asm.org.

APUA WELCOMES

APUA-Romania

- MIRCEA ANGELESCU, Professor of Infectious Diseases, “Matei Bals” Infectious Diseases Institute, Editor-in-chief “Toxicologie si terapeutica medicala”, President
- ELISABETA BENEA, Infectious Diseases Specialist, Assistant Professor, Medical Manager of “Matei Bals” Infectious Diseases Institute, Vice-president
- DANA DUMITRASCU, economist, “Matei Bals” Infectious Diseases Institute – Secretary-Treasurer
- ROXANA FILIP, microbiologist, Suceava, Microbiology Section Coordinator
- GABRIEL-ADRIAN POPESCU, Infectious Diseases Specialist, Assistant Professor, “Matei Bals” Infectious Diseases Institute, Editor-in-chief “Infectio.ro”, Chapter Coordinator

The chapter is engaged in the following ongoing research activities:

- Treatment of infections due to ESBL-producing bacteria
- Therapeutic options in community-acquired Pseudomonas aeruginosa infections
- First regimens in community-acquired Staphylococcus aureus infections
- Tigecycline versus vancomycin plus aztreonam in severe skin infection treatment
- Ertapenem in severe bacterial infections

APUA-Nepal

APUA-Nepal, in association with Nepal Veterinary Chemists and Druggists Association, organized an interactive program on “Use of Antibiotics in Veterinary and Public Health” on August 21, 2005 in Kathmandu. Two papers were presented at the Interactive Program. One theme paper on “Use of Antibiotics in Veterinary and Public Health” was presented by APUA-Nepal President Prof. Dr. Kumud K. Kafle and another paper on “Usefulness of feed additives” by Dr. J. L. Amatya, a veterinary physician. The interactive program, which was attended by 71 professionals from medical, veterinary, pharmacy and microbiology specialties, was covered by national television.

Like many of APUA’s chapters, APUA-Nepal publishes a Newsletter for local health professionals. A recent editorial noted: “We hope this newsletter will help in a small way not to lose focus from the ever-increasing problem of bacterial resistance.”

In Memoriam

It is with deep regret that APUA announces the sudden passing of Prof. Leonid S. Stratchounski on June 7, 2005. Prof. Stratchounski was the leader of the APUA-Russia Chapter and a prominent scientist in the field of antimicrobial therapy. His leadership and enthusiasm will be greatly missed.
Alliance for the Prudent Use of Antibiotics
75 Kneeland Street
Boston, MA 02111 U.S.A.

If you are concerned about the public health threat of antibiotic resistance, become part of the solution. Make a tax-deductible contribution and join our global network of citizens, clinicians, researchers and policy makers.

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...containing global antibiotic resistance through local action

Founded in 1981 as a nonprofit organization, APUA is the only organization in the world solely dedicated to strengthening society's defenses against infectious diseases through research and education on antibiotic use and antibiotic resistance. APUA's mission is to improve infectious disease treatment and control worldwide through promoting appropriate antibiotic access and use and reducing antibiotic resistance. With members in over 100 countries and numerous foreign affiliated chapters, APUA provides a unique network to support country-based activities and facilitate international planning and communication. APUA's resources include an international scientific advisory board with members of national academies of medicine and science and a professional staff with specialized expertise. APUA's global network of affiliated chapters serves to tailor interventions to local customs and practices.

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