

Infosys Prize in Life Sciences 2016

The Infosys Prize in Life Sciences for 2016 was awarded to physician–scientist Gagandeep Kang for her contributions in the field of infectious diseases, particularly the natural history of rotavirus infections and disease in children under 5 years of age. Rotaviruses are a leading cause of severe dehydrating gastroenteritis in this age group. Globally, rotavirus diarrhoea results in over 215,000 deaths each year, of which nearly 25% occurs in India. Kang's work and involvement in public health policies within India and abroad have enabled the introduction of vaccines and public health measures to reduce the burden of rotavirus disease, as well as other infectious diseases in children, and thus have far-reaching implications for child health.

Kang is currently the Executive Director of the Translational Health Science and Technology Institute (THSTI) in Faridabad. Prior to this position, she was a Professor of Microbiology and Head of the Wellcome Trust Research Laboratory and the Department of Gastrointestinal Sciences at the Christian Medical College, Vellore. Over the past 20 years, she has built a diverse team, including epidemiologists, pediatricians, gastroenterologists, psychologists, nutritionists, microbiologists, biochemists, field workers and nurses, to carry out comprehensive studies on enteric infections in children, testing of vaccines, and evidence-based research that informs national health policy. Her work involves a combination of observational, mechanistic and interventional studies to estimate the burden of enteric infectious diseases and the consequences of intestinal infections on immune responses, gut function and nutrition in children.

A substantial part of Kang's research focused on rotaviruses. While rotavirus disease in India had been previously investigated, the studies differed in design, populations examined, and methodologies used, making the collation of data difficult. With support from the Indian Council for Medical Research, the National Institute of Epidemiology, the US Center for Disease Control and the World Health Organization, Kang developed a network of clinical surveillance sites and laboratories across India using standardized molecular protocols and reagents to evaluate the burden of rotavirus

disease in Indian children. Work from this network demonstrated that rotavirus infections result in approximately 40% of diarrhoea hospitalization in young children all over the country and were caused by a wide variety of virus strains. Concomitantly working in an urban slum population in Vellore, she established the single largest birth cohort of children in the world to study the natural history of rotavirus infections. Mothers were recruited during pregnancy and the children were followed up from birth for three years, with twice weekly home visits, collection of stool samples every two weeks to evaluate asymptomatic infections and during all diarrhoeal episodes, as well as serum samples every six months to evaluate seroconversion following infection. This seminal work on rotavirus epidemiology showed that (i) rotavirus infections in Indian children occur earlier in life than most populations, with over 50% of children experiencing a primary infection under six months of age; (ii) frequent reinfections occur in this population with high viral diversity and (iii) the rate of protection against subsequent rotavirus diarrhoea following prior infections was low. These data sharply contrasted previous work from other countries, where two infections with rotavirus provided complete protection against subsequent disease. These results led to the prediction that rotavirus vaccines, which had at this point been successfully introduced in many developed countries, would not work as well in developing countries. Indeed, the immunogenicity and efficacy of rotavirus vaccines have been substantially lower in low-income countries with the greatest disease burden.

Nonetheless, the introduction of vaccines could potentially save hundreds of thousands of lives in high-disease-burden settings. Since vaccine costs were prohibitive for large-scale introduction in resource-poor settings, efforts were made to support the development of rotavirus vaccines to be manufactured in middle-income countries. Kang joined these initiatives in 2007 and established validated assays in her laboratory for the clinical evaluation of rotavirus vaccines that met national and international regulatory standards, a first for a developing country laboratory. Working in partnership

with Government and non-governmental agencies, she provided laboratory support, critical qualified reagents and training in validated assays for rotavirus vaccine manufacturers in India, China and Brazil, and also carried out phase I–III studies of rotavirus vaccines. In 2009, she joined a multi-decade collaborative effort among industry, academic institutions and the Governments of India, Norway and the US to introduce an indigenous rotavirus vaccine in India. Her study site in Vellore enrolled and followed 1500 children up to two years of age for the clinical trial, was the referral laboratory for rotavirus genotyping and etiology of diarrhoea assessment for all sites in the country, and led the analysis of safety evaluation for intussusception. This clinical trial conducted to the highest standards of ethics and quality resulted in the vaccine being fast-tracked for licensing. The vaccine was introduced in the national immunization programme by the Government of India in 2016.

It is evident that India and other developing countries provide unique challenges for introduction of effective measures to counter rotavirus disease. Kang continues to work on identifying the causes of poor immunogenicity of rotavirus vaccines in developing countries and the correlates of protection from disease in order to improve the effectiveness of vaccines. In new collaborative studies conducted in Vellore, her group showed that enteric virus infections interfere with oral poliovirus vaccine (OPV) immunogenicity in Indian infants and are associated with changes in innate and adaptive immune responses that predict seroconversion to OPV. Similar studies are now being established to assess immune responses to rotavirus vaccines. In addition, Kang has an extensive body of work on neonatal rotavirus infections, virus evolution and reassortment, and the epidemiology of other enteric pathogens such as *Cryptosporidium* and noroviruses, that are increasingly recognized as leading causes of diarrhoea in children.

Kang's work is an example of how holistic approaches are critical to successfully address questions of public health importance. Apart from fundamental questions such as 'what is the

burden of disease?’ and ‘what strains contribute to this burden?’, she designed a number of studies to address other critical questions required to inform public policy and to design interventions: What are the economic costs associated with disease? What is known about the transmission of these viruses and their presence in the environment? Can household and community-level interventions (such as solar disinfection, filtration and point of use chlorination) be effective in reducing disease burden?

Matching the spectrum of her scientific work, Kang has worked with a wide range of individuals starting from investigators in leading public health and research laboratories worldwide to a strong and committed army of grassroot-level workers; she engages with local community health leaders to heads of Government and non-governmental public health agencies, and has employed a wide variety of techniques ranging from simple laboratory assays to state-of-the-art molecular methods and the use of geographic information systems to map diseases. Her work extends from providing evidence for the need for specific strategies for prevention and control of diseases, to the effect (or lack of effect) of interventions.

Kang’s expertise in public health is recognized globally. She serves as a member of the National Technical Advisory Group on Immunization and WHO’s Global Advisory Committee on Vaccine Safety, Immunization and Vaccine Implementation Research Advisory Committee, among others. She is Chair of WHO’s Southeast Asian Region’s Immunization Technical Advisory Group. She is an Independent Director of the Biotechnology Industry Research Assistance Council established by the Government of India and Hilleman Labo-

ratories, a partnership established to make affordable vaccines by Merck and the Wellcome Trust. She has published over 250 papers in national and international journals, and has received numerous recognitions and awards: She is an elected Fellow of all the three Indian science academies, a Fellow of the Royal College of Pathologists in the UK and the American Academy of Microbiology, where she is the only Indian woman elected to the fellowship. She is also the first woman and the first person from a low or middle-income country to edit the prestigious *Manson’s Textbook of Tropical Medicine*, the holy book of Tropical Medicine. She is a recipient of the National Award for Woman Bio-scientist from the Government of India and is a role model for young investigators, particularly women.

From the beginning of her scientific career, Kang retained a keen interest in honing the next generation of scientists and enabling them to be successful in their research careers. She has been the Program Director of a Global Infectious Disease Research (GIDR) Training Grant from the NIH Fogarty International Center, USA for over a decade and is building enteric infectious disease research capacity in India through strong collaborations and high-quality training. With GIDR support and through other grants, every graduate student and postdoctoral trainee from Kang’s group has participated in multiple national and international meetings. Many have trained in laboratories outside their institution, which allows them to gain a wider exposure to research. Several trainees from Kang’s group are recipients of the DBT–Wellcome Trust India Alliance Early Career Fellowships that will allow them to make an early start in establishing independent research careers. Kang has

worked with fellows and trainees both within India and outside, and is widely respected for her teaching and mentoring.

The hallmark of Kang’s work is interdisciplinarity and collaboration, with a committed, systematic and rational approach to addressing problems. She is known for her effective communication and presentation skills. As many of Kang’s trainees, mentees and collaborators affirm, she leads by example. The impact of Kang’s work is perhaps best summarized in the message from Inder Verma, head of the jury for the Infosys Prize: ‘Prof. Kang’s tremendous achievements in translational and clinical science reflect her scientific breadth and depth, her willingness to tackle hard problems pertaining to human health in India, her ability to forge national and international collaborations to take critically-needed comprehensive approaches, and her inspiring leadership and mentorship.’ Her laboratory in Vellore is now a reference centre for rotaviruses and other tropical infectious diseases, and is ably managed by young investigators who trained with Kang. In her current position at THSTI, Kang aims to build effective programmes that use mechanistic insights to develop new products and strategies for prevention and control of infectious and metabolic diseases in India and enable the next generation of scientists and public health leaders to address still larger problems in health in India and globally.

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2017 King Faisal International Prize for Science and Medicine

The King Faisal Foundation in Riyadh, Saudi Arabia has awarded the 2017 King Faisal International Prize (KFIP) for Medicine (topic: Biologic Therapeutics in Autoimmune Diseases) to Tadimitsu Kishimoto of Japan in recognition of his prominent role in developing a novel

biologic therapy for autoimmune diseases. The Prize for Science in the field of physics has been awarded to Daniel Loss of Switzerland and Laurens W. Molenkamp of the Netherlands. Loss is a pioneer in the theory of spin dynamics and spin coherence in quantum dots

showing promise for practical applications in spin quantum computers. Molenkamp has contributed significantly to the experimental field of spintronics.

The Prize consists of a certificate, hand-written in Diwani calligraphy, summarizing the work of the laureate; a