“The enormous scope of the clinical and outcomes research by Yale's Center for Outcomes Research and Evaluation (CORE) in collaboration with investigators in hundreds of hospitals across China promises to provide not only critically important knowledge for the citizens of China, but a meaningful opportunity to bring the research enterprises and individuals of the two countries closer in genuine cultural understanding.”

Jerome P. Kassirer, M.D.
Distinguished Professor, Tufts University School of Medicine, Editor-in-Chief Emeritus, New England Journal of Medicine
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Introduction

Yale’s Center for Outcomes Research and Evaluation (CORE) and the Chinese National Center for Cardiovascular Diseases (NCCD) began their landmark collaboration in 2010. Since then, the two sides have come together to form a strong team that serves as a bridge between two of the world’s leading countries. The collaboration has yielded several groundbreaking national studies in China and 20 academic publications in the last two years alone, many appearing in the premier journals in their fields. Such work has brought together dozens of leading scholars in medicine, biostatistics, and epidemiology, with hundreds of on-the-ground site coordinators and administrators; involved the study of hundreds of thousands of participating patients; and is serving as a foundation for health reform and quality improvement efforts across China.

Mission Statement

To improve health and health care through international friendship, research-generation, and knowledge application. We strive to leverage the strengths of the US and China, through partnership and friendship, to foster meaningful collaboration and mutual understanding—and promote medical and public health advances. We are committed to expanding the scientific knowledge base, accelerating medical breakthroughs and cures, and sharing our findings with a global audience so that what we learn may benefit our countries and the world.

Dr. Harlan M. Krumholz, the center’s leader, meets China’s Premier, Li Keqiang, at the Great Hall of the People in Beijing to receive China’s Friendship Award, given to ‘foreign experts who have made outstanding contributions to the country’s economic and social progress.’
The extensive national hospital network that participates in the China PEACE and Chinese Cardiac Surgery Registry platforms.

The China Patient-Centered Evaluative Assessment of Cardiac Events (China PEACE) is a national network of more than 200 hospitals—spanning almost every province and autonomous region in China—that participates in research designed, managed, and disseminated by our international team. The hospital network has been involved in building numerous patient registries that can be used to answer important questions about trends and outcomes in cardiovascular care in China. It is also being used to launch one of the first multi-center text message-based mobile health interventions in China and has anchored one of the world’s largest population-based studies of cardiovascular disease.

The Chinese Cardiac Surgery Registry extends our research’s reach to the operating room. Put together, our network of 87 participating hospitals accounts for nearly half of all CABG procedures performed in China each year. It has allowed us to investigate the national prevalence and quality of coronary artery bypass (CABG) and valvular surgery in China. The network, managed by the NCCD’s top cardiac surgeons, has also been leveraged to lead two of China’s largest and earliest mHealth interventions—one web-based and the other app-based—that translate earlier research into impactful platforms for both physicians and patients. These quality improvement measures, along with our annual surgical outcomes reports, released to all free of charge, have already made a huge impact on cardiac surgery care in China. In the future, our collaborations with the NCCD’s surgical teams will break new ground by launching a large registry of young patients who suffer from congenital heart conditions, thus bringing our work into the pediatric sphere.
Cardiology—Retrospective Registry

Ischemic heart disease is an issue of great public health importance in China. As the country continues to grow economically, it faces an epidemiological transition with rising mortality due to non-communicable diseases. The first study from the China PEACE network formed the foundation for our work in China. This study built a retrospective registry of Chinese patients from 200 hospitals to find out more about trends in acute myocardial infarction (AMI) and percutaneous coronary intervention (PCI) over the last decade. Over 18,000 medical records were abstracted at three time points—2001, 2006, and 2011—to provide a nationally representative sample of patients who were discharged with a diagnosis of AMI or who had a PCI procedure in hospital. We identified large increases in the estimated national rate of hospitalization for ST-segment elevation myocardial infarction (STEMI), a growing burden of prevalent cardiovascular risk factors, persistent delays in admission to hospitals, and significant gaps in the quality of care provided to patients across China. Our team has published over 15 papers in high-impact journals such as The Lancet from this study alone. This foundational study has since informed and inspired our work to elevate the quality of care in China and improve patient outcomes.

Cardiology—Prospective Registry

To find out more about patients’ experiences after hospitalization in China for AMI and PCI, we built on the success of our retrospective registry with the PEACE prospective registries for AMI and PCI. Since 2013, just under 10,000 patients have been enrolled and followed for 12 months after their first hospitalization for AMI or PCI. An unprecedented aspect of the registries is their focus on patient-reported outcomes collected at key time points across those 12 months, through phone and face-to-face interviews. By examining patients’ clinical outcomes, as well as their own reported outcomes such as their health status, depression, stress and health-related quality of life, we hope to be able to describe their experiences and care trajectories in more meaningful detail. This approach is new in China and still on the cutting-edge in the US and Europe, where an emphasis on better understanding patients’ experiences of their illness and care is also relatively recent. The teams at Yale CORE and Fuwai Hospital are currently working to disseminate the results of multiple studies based off information collected in these registries, with over 10 papers already in progress.

Cardiac Surgery—Prospective Registry

The Chinese Cardiac Surgery Registry is a prospective registry that, since 2013, has enrolled thousands of patients who have undergone CABG or valvular surgery in China. Like the China PEACE prospective AMI and PCI registries, it follows patients for one year after discharge from their procedure and collects information on complications and outcomes. We use this information to generate quarterly and annual surgical outcome reports that we release to all surgical teams in China.
This has allowed our team to extend its impact to countless Chinese operating rooms. There is also evidence that this and other resources have contributed to a marked improvement in complication and in-hospital mortality rates after CABG in China over the past five years. In a paper that our team will publish later this year, we found that isolated CABG-related in-hospital mortality, major complication rates, and length of stay (LOS) have improved in large urban teaching hospitals in China over the last decade. These rates are now approaching those seen in the US, though prescription rates for secondary prevention drugs and cardiac rehabilitation therapies remain lower in China than the US. This registry has already produced 17 published papers, with many more in the works.

**Mobile Health Interventions**

Our team has also leveraged the China PEACE and Chinese Cardiac Surgery Registry networks to design and implement interventions geared toward directly improving care quality and patient outcomes. The MISSION-1 study is an ongoing web- and mobile-based intervention that provides education on the most-up-to-date prescription practices to physicians caring for patients who have undergone a coronary bypass. Its sister study, MISSION-2, is an ongoing app-based intervention focused on improving medication adherence in coronary bypass patients. The studies are some of the earliest academic forays into the exciting space of mobile health (mHealth) in China, which boasts the world’s largest number of smartphone users and is increasingly an innovation leader in the development of health-based devices and apps.
Our team is uniquely positioned to harness China’s growing entrepreneurial spirit in the field of e-and mHealth—much of the innovation actually takes place in the NCCD’s backyard, at nearby Peking and Tsinghua universities—to improve the country’s health system and outcomes. A new, patient-centered mHealth texting intervention—China PEACE-III—is slated to begin in the summer of 2016, where high-risk patients will receive texts encouraging them to live more heart-healthy lives. In this intervention, we will target factors such as high rates of smoking, lack of physical activity and high blood pressure. In the future, this intervention will also introduce wearables to monitor patients’ vital signs and experiment with artificial intelligence to make texts ‘smarter,’ more interactive, and better tailored to a patient’s individual needs and goals.

The Qingdao Port Study

The Qingdao Port Cardiovascular Health Study marked Yale CORE’s and the Chinese NCCD’s first foray into population-based health studies. In collaboration with the Qingdao Port Group, a large company based in the northeastern coastal city of Qingdao, over 32,000 employees of the port group have been studied from 2000 through 2013. In bringing together data collected from annual health assessments and biospecimen analyses over many years, the project has important resemblances to the Whitehall Study from the UK. Findings from preliminary and published work suggest that China’s working-age population has experienced a dramatic increase in cardiovascular risk factors, including hypertension, hyperlipidemia, diabetes, and high body mass index. The rise of such risk factors in China’s working population coupled with a rapidly aging population due to the One Child Policy suggests that the productivity gains essential to continued high economic growth may be threatened.

The team reviews study data with a nurse in the port city of Qingdao
The Millions Persons Project

The team’s most ambitious initiative to-date is the **Millions Persons Project (MPP)**, which will leverage our experience with patient registries to **collect important health data from 4 million people across China**, making it one of the **world’s largest academic population-based studies**. China is in the midst of a historic and monumental demographic transition: driven in large part by rapid economic growth, its population is becoming increasingly old and decreasingly rural. This has contributed to a **dramatic rise in chronic and non-communicable diseases**, especially cardiovascular diseases. The pilot study for the MPP, completed in 2015 after collecting information on 400,000 people, found that **roughly 1 in 4 Chinese adults screened was at high risk for cardiovascular disease**.

By bringing together information on blood pressure, height, weight, diet, smoking and lifestyle with data collected from blood, urine, and genetic samples, the MPP will offer an **unrivalled platform** for the application of **innovative statistical, epidemiological, and big data techniques** to investigate cardiovascular disease trends, outcomes, and pathologies in more detail. Much like the **Precision Medicine Initiative** launched by the NIH in 2015, our MPP initiative will bring together collaborators in fields as diverse as medicine and applied math to accelerate scientific breakthroughs and find new cures. **The project also serves as a showcase for the strengths of our team’s partnership**, where the will, ingenuity, and grand vision of our China-based collaborators are paired with the traditional strength of Yale’s cutting edge research.

**MAJOR ACCOMPLISHMENTS**

- Nearly 30 publications in peer-reviewed academic journals
- More than five years of partnership between US and Chinese researchers
- The construction of multiple registries with over 20,000 enrolled patients
- Three innovative mHealth trials currently in the field
- One of the largest public health screening studies ever conducted

“**Distinguished by its strong design, rigorous quality control, and cutting-edge data analysis, the China PEACE study is an exceptional model for high-level multi-center clinical research in cardiovascular disease. We are looking forward to broader and deeper cooperation between CORE and the NCCD based on the solid foundation they have built during their first five years of their partnership.**”

**Ye Li, Chief, Planning Division**
Department of Health Science, Technology and Education
National Health and Family Planning Commission
Future Projects

The China PEACE V: Chronic Disease Registries initiative will build upon the knowledge and experience we have generated in our previous studies by constructing five new chronic disease registries. The registries will enroll patients who have experienced stroke, chronic kidney disease, diabetes, heart failure, and valvular heart disease. Our team will lead the design and construction of the registries on heart failure and valvular heart disease while serving as a consultant on the others. Although China has made significant progress in expanding health insurance and access to care over the past decade, due to its unique demographic and economic circumstances, the country now faces a dual burden of disease: infectious diseases in the countryside and chronic diseases in urban areas. This initiative will harness our extensive network of hospitals to address the growing need to understand chronic disease prevalence and care in China at a time when, for the first time, urban residents outnumber rural residents. The share of the Chinese population living in urban areas is projected to rise from 51% today to US levels (80%) by 2030, suggesting that the burden of chronic conditions like heart failure and stroke will only increase. Our project will meet the urgent need to provide more evidence about chronic disease care in China so that effective economic, social and health policies can be made and implemented.

Lancet Commission on Primary Care in China

In the past, The Lancet has launched commissions on climate change, medical education, HIV/AIDS, and planetary health, with an aim to place a spotlight on neglected, emerging, or seminal topics in global public health. A newly announced Lancet Commission led by one of our team’s leaders, Prof. Lixin Jiang from the NCCD, will inform future policy and research on primary care in China. This is an incredibly important topic in China, which currently lacks a functioning primary care system. Most care in the country is delivered in hospitals, where space, resources, and clinical care teams are increasingly stretched. The rise of non-communicable and chronic diseases in China necessitates a change, and the government has started to invest heavily in village and community health centers to develop a more proactive and responsive primary care system. However, there is a lack of consensus on what China’s primary care system could and should look like. Our commission will involve partnerships with a number of leading health experts from the US and China to define the scope of the issue and offer recommendations and potential solutions. The end product of the 18-month commission will be a 25-30,000 document with profound academic and policy impacts.
LEADERSHIP

Lixin Jiang is an internationally renowned researcher in cardiovascular disease control and management. Based at Beijing’s Fuwai Hospital, she is also the Assistant Director at China’s National Centre for Cardiovascular Diseases (NCCD), Co-Director of the China Oxford Centre for International Health Research, and Director of the National Cardiovascular Bio-bank Centre in China. Her work in nationwide care quality assessment and improvement has greatly informed healthcare policy on the management of major diseases in China, particularly cardiovascular disease. She has authored 96 original research papers and reviews and has led 6 large-scale clinical trials involving over 100,000 Chinese patients, with several further studies currently under way. Dr. Jiang is also Editor-in-Chief of The Lancet (Chinese Edition). She received a Bachelor of Medicine from Xuzhou Medical College, a Master of Medicine (Cardiology) from Peking University Health Science Center, and a PhD (Cardiology) from the Chinese Academy of Medical Sciences and Peking Union Medical College.

Harlan M. Krumholz is the Harold H. Hines, Jr. Professor of Medicine, Epidemiology and Public Health at the Yale School of Medicine in New Haven, CT, and is a practicing cardiologist. He serves as Director of CORE and Co-Director of the Robert Wood Johnson Foundation Clinical Scholars Program at Yale. He has led research and initiatives to improve the quality and outcomes of clinical decisions and health care delivery, reduce disparities, enable transparency in practice and research, and avoid wasteful practices. He is a member of the Association of American Physicians, the American Society for Clinical Investigation, and the National Academy of Medicine. He has also been awarded the People’s Republic of China’s Friendship Award, the country’s highest honor to “foreign experts who have made outstanding contributions to the country’s economic and social progress.” He received a BS from Yale, a masters in Health Policy and Management from the Harvard University School of Public Health, and an MD from Harvard Medical School.
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“Knowledge generated from these studies has been published in premier journals, and will inform policy-making and clinical practice. The collaboration makes enormous contributions in promoting medical and public health advances, informing China’s health reform and also helping to reduce the soaring disease burden faced by our two countries and the world.”

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