

# **Global Infectious Disease: Past, Present, Future Trend and How We Prepare for the Threat**

**全球传染病的演变、现状、未来发展趋势及社会的应对策略**

**Sheng CHEN, Ph.D**

**Professor, Department of Applied Biology and  
Chemical Technology**

**The Hong Kong Polytechnic University**

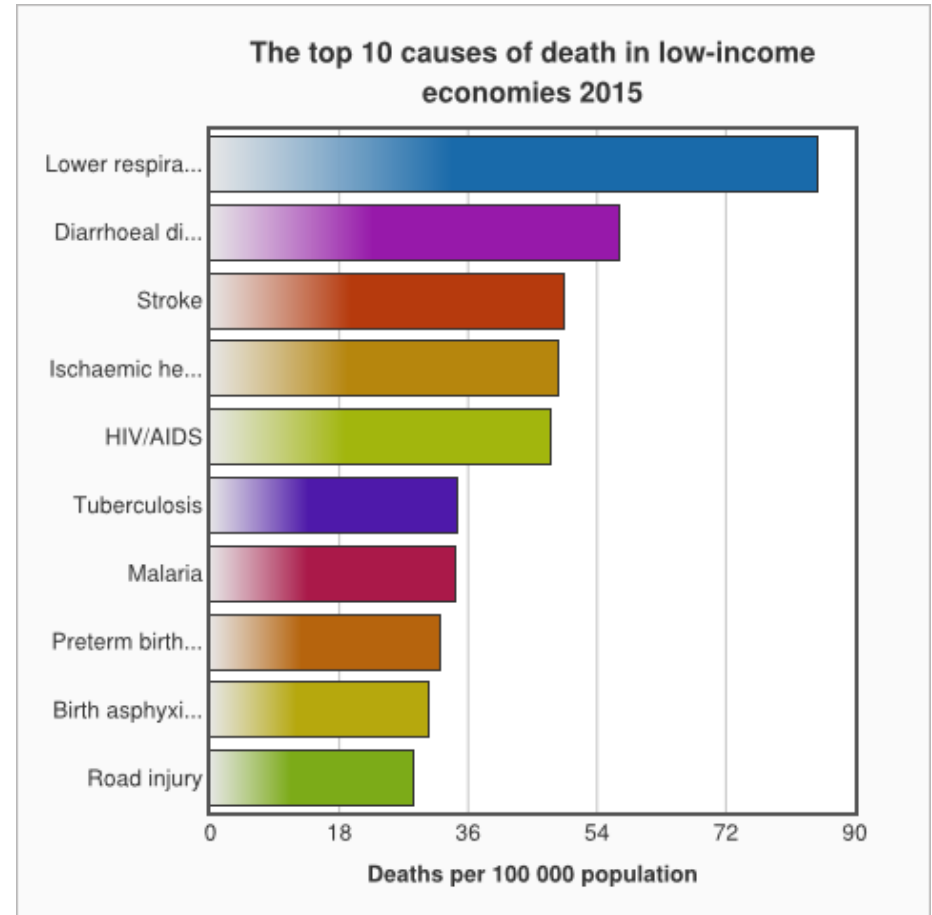
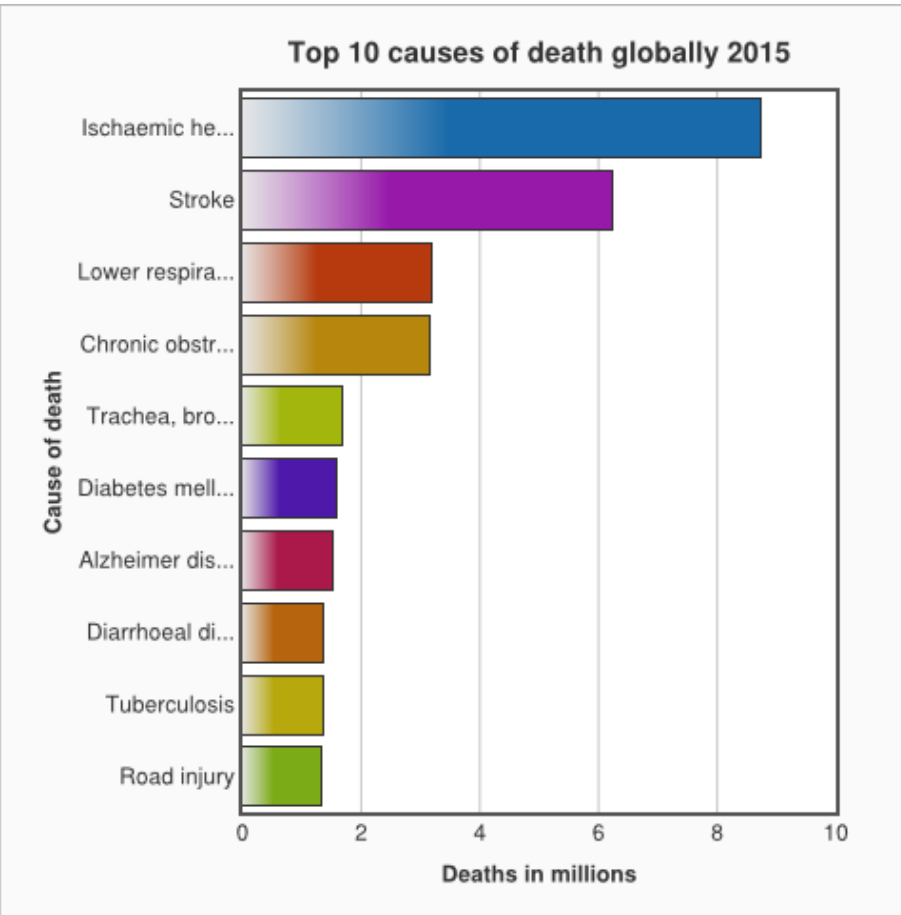
# The World is not Ready for the Next Pandemic

"when I was a kid, the disaster we worried about most was a nuclear war. But today, if anything kills over 10 million people in the next few decades, it's most likely to be a highly infectious virus, rather than a war. Not missiles, but microbes."

*In a memorable 2015 TED talk*



# Top 10 Causes of Death Globally 2015



**In low-income economies: Lower respiratory infections, Diarrheal diseases. HIV/AIDS, Tuberculosis, Malaria**

# List of Major Epidemics in the 21 Century

- **2000~2006**

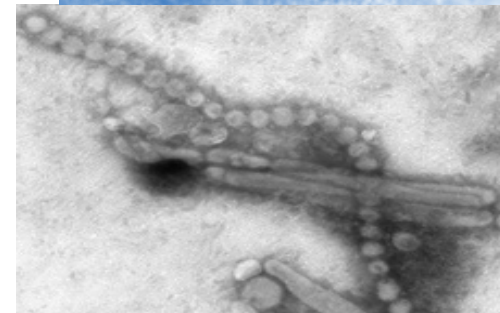
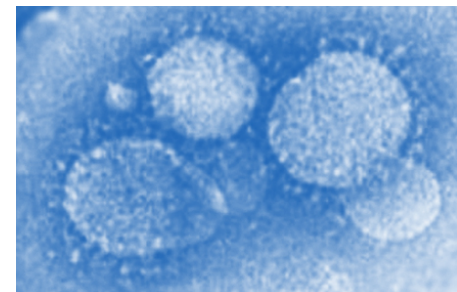
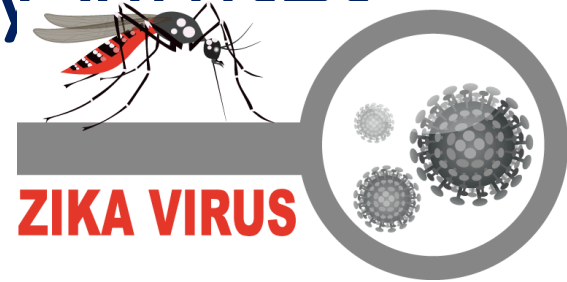
- 02~03, SARS in Asia and Canada (775)
- 05~06, Dengue fever in Singapore and India (<100)

- **2007~2017**

- 08~09, Cholera in Zimbabwe (4293)
- 09, flu pandemic worldwide (14286)
- 10~present, Haiti cholera outbreak (9985)
- 11~present, measles in Congo (>4500)
- 2012 yellow fever outbreak in Darfur, Sudan (847)
- 2012~present, worldwide Middle East respiratory syndrome coronavirus (**MERS**) outbreak (>1000)
- 13~16, **Ebola** virus epidemic in West Africa (>11000)
- 2015 Indian **swine flu** outbreak (2030)
- 2015–16 **Zika** virus epidemic
- 2016–17 Yemen cholera outbreak (1614)
- 2013~present, H7N8 in China and Hong Kong

# Characteristics and Trend of Infectious Diseases caused by *Viruses*

- Very contagious and usually cause epidemics or pandemics
- Mostly related to community acquired infections
- More severe and high mortality rate
- It comes and goes without clear signs
- Newly emerging and re-emerging viral infections will be continued in the future
- Trend is getting more frequent
- Cholera is one of the major bacterial diseases causes epidemics or pandemics



# "nightmare" and "catastrophic threat" of antimicrobial resistance

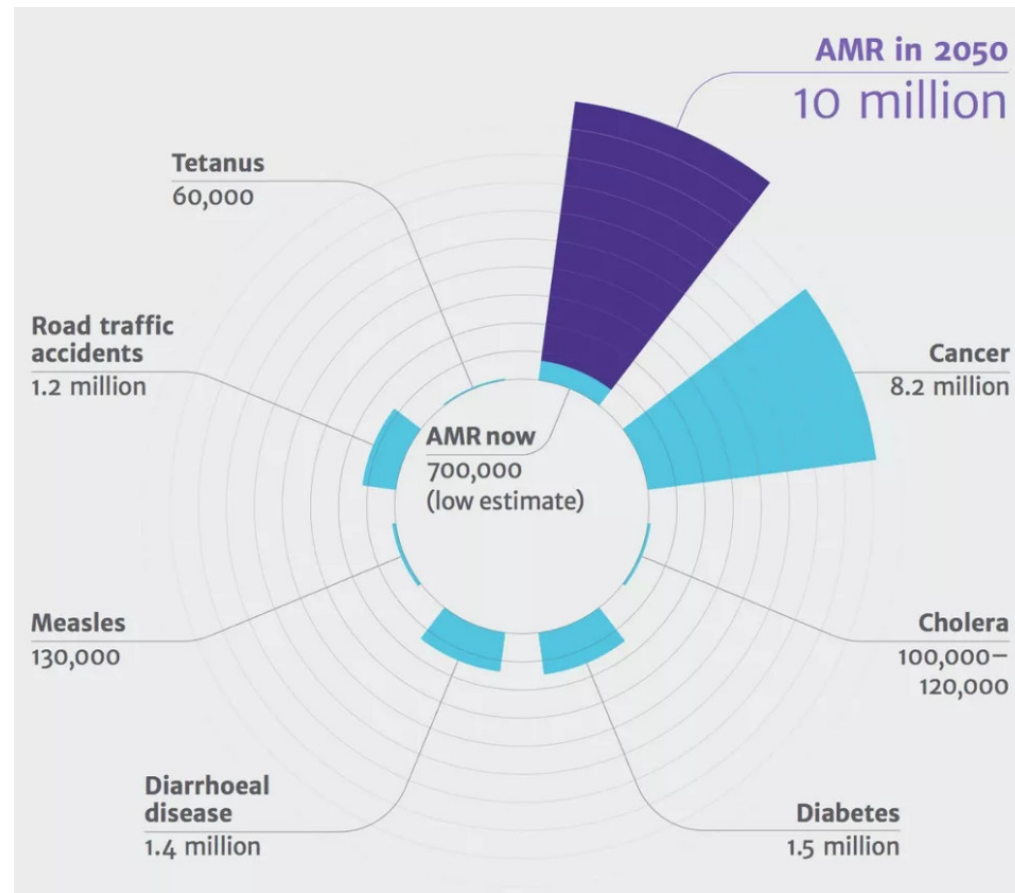
## 2013 US CDC report

Estimated minimum number of illnesses and deaths caused by antibiotic resistance\*:

At least  **2,049,442** illnesses,  
 **23,000** deaths

*\*bacteria and fungus included in this report*

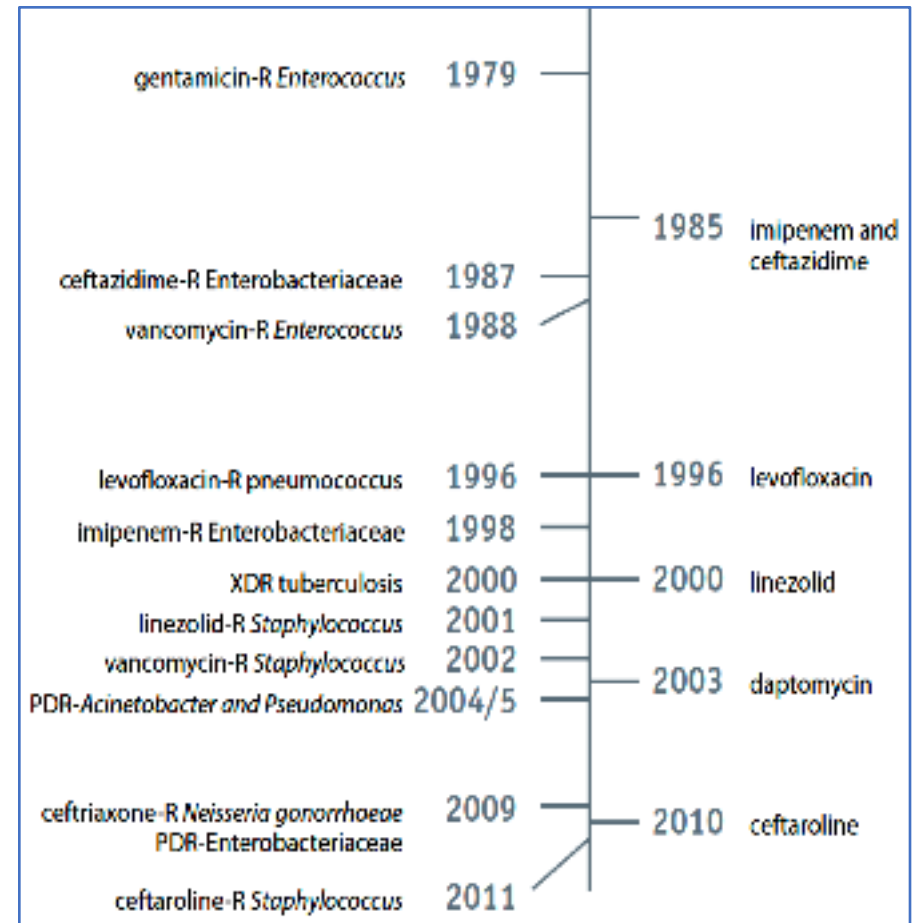
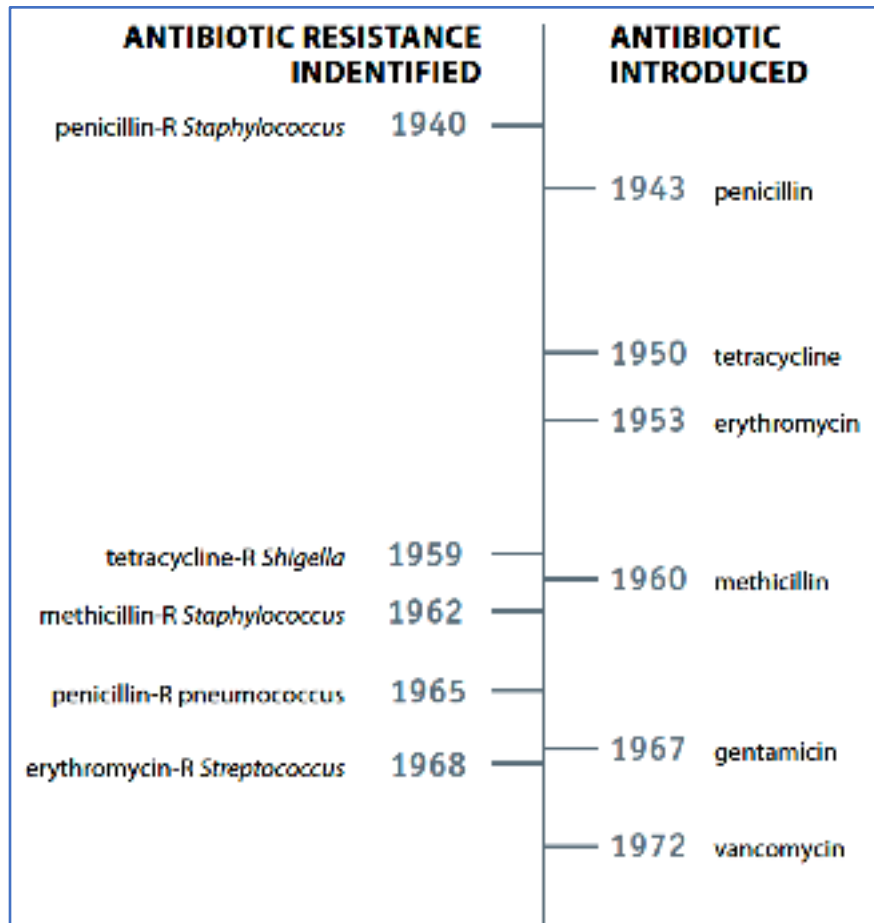
## UN meeting on antibiotic resistance



## Consequence

- Cripple the ability to fight routine infectious diseases
- Lost many life-saving and life-improving modern medical advantages

# Timeline of Key Antibiotic Resistance Events



**Bacterial resistance increases sharply    New antibiotic development lags behind**

# Multidrug-resistant Bacterial Pathogens

- Microorganisms with a threat level of urgent
  - Clostridium difficile
  - Carbapenem-resistant Enterobacteriaceae
  - Drug-resistant Neisseria gonorrhoeae
- Microorganisms with a threat level of serious
  - Multidrug-resistant Acinetobacter
  - Drug-resistant Campylobacter
  - Fluconazole-resistant Candida (a fungus)
  - Extended spectrum  $\beta$ -lactamase producing Enterobacteriaceae (ESBLs)
  - Vancomycin-resistant Enterococcus (VRE)
  - Multidrug-resistant Pseudomonas aeruginosa
  - Drug-resistant non-typhoidal Salmonella
  - Drug-resistant Salmonella Typhi
  - Drug-resistant Shigella
  - Methicillin-resistant Staphylococcus aureus (MRSA)
  - Drug-resistant Streptococcus pneumoniae
  - Drug-resistant tuberculosis

**Most are related to hospital acquired infections and widely present year long**

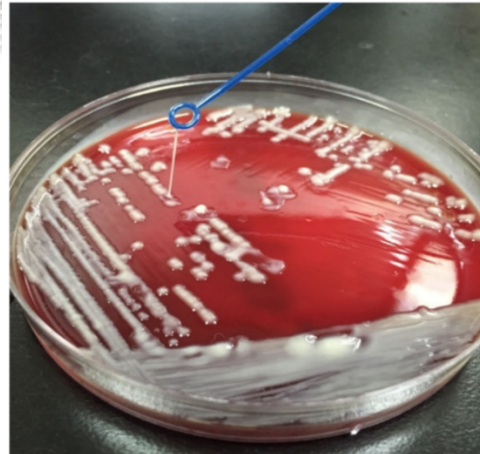
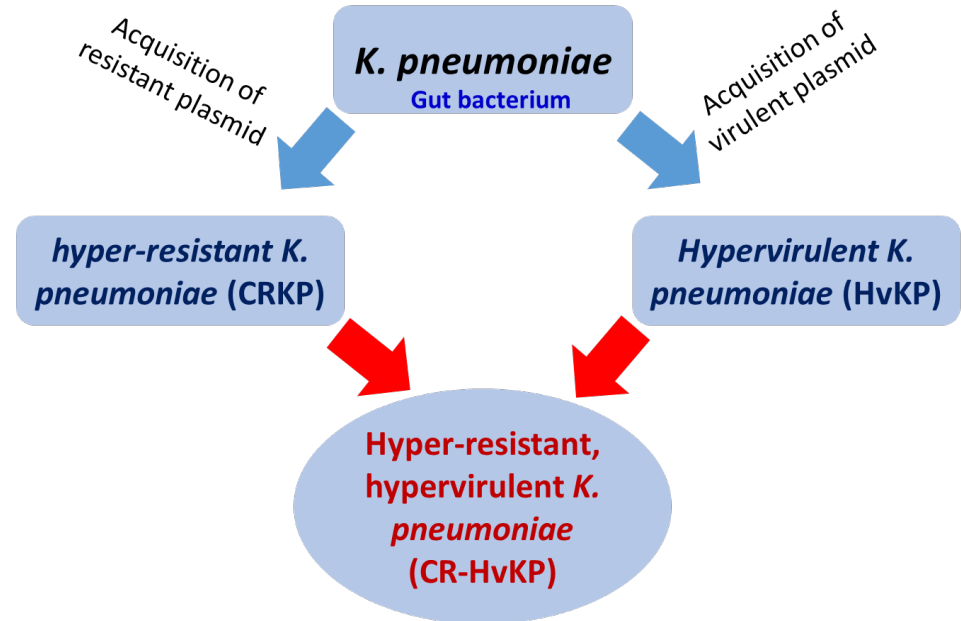


# Continuous Evolution of Antibiotic Resistance in Bacterial Pathogens

New Superbug  
*mcr-1*  
Discovered



Superbugs  
The Year  
In Review



THE LANCET  
Infectious Diseases

Available online 29 August 2017  
In Press, Corrected Proof

Articles

A fatal outbreak of ST11 carbapenem-resistant hypervirulent *Klebsiella pneumoniae* in a Chinese hospital: a molecular epidemiological study

Danxia Gu MS <sup>a, d, †</sup>, Ning Dong MS <sup>e, f, †</sup>, Zhiwei Zheng BS <sup>e, f</sup>, Di Lin MS <sup>a</sup>, Man Huang MD <sup>b</sup>, Lihua Wang MS <sup>c</sup>, Edward Wai-Chi Chan PhD <sup>e, f</sup>, Lingbin Shu MS <sup>a</sup>, Jiang Yu MS <sup>a</sup>, Dr Rong Zhang PhD <sup>a, g, h</sup>, Dr Sheng Chen PhD <sup>e, f, g, h</sup>

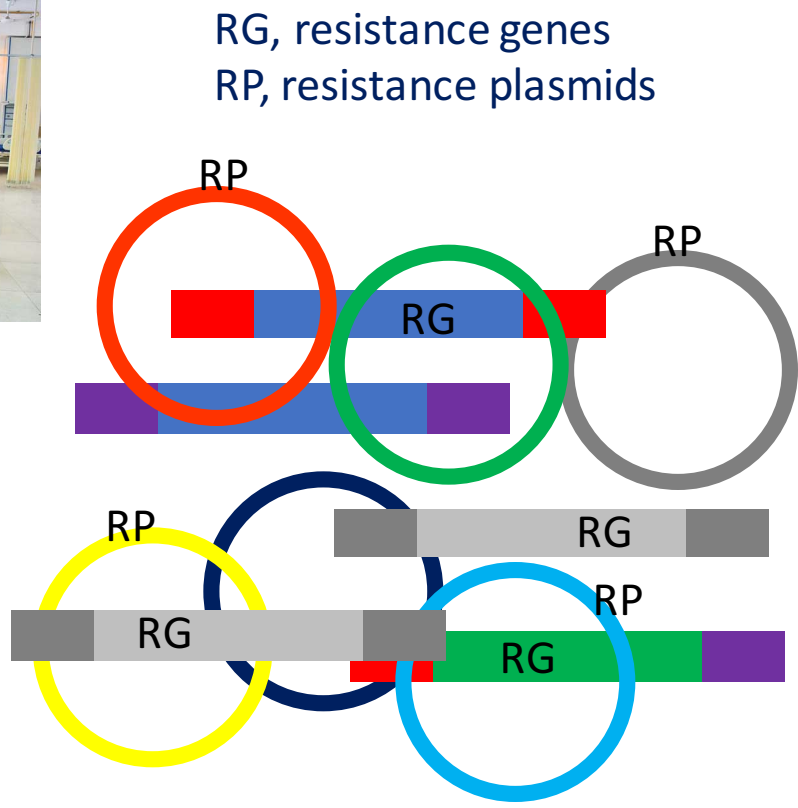
# Resistance Development Trend in the Future



Hospital



Animal and human gut



Soil and water



Food

**Many things could happen in this mixture?**



# How Do We Prepare for the Threat of Infectious Diseases?

