

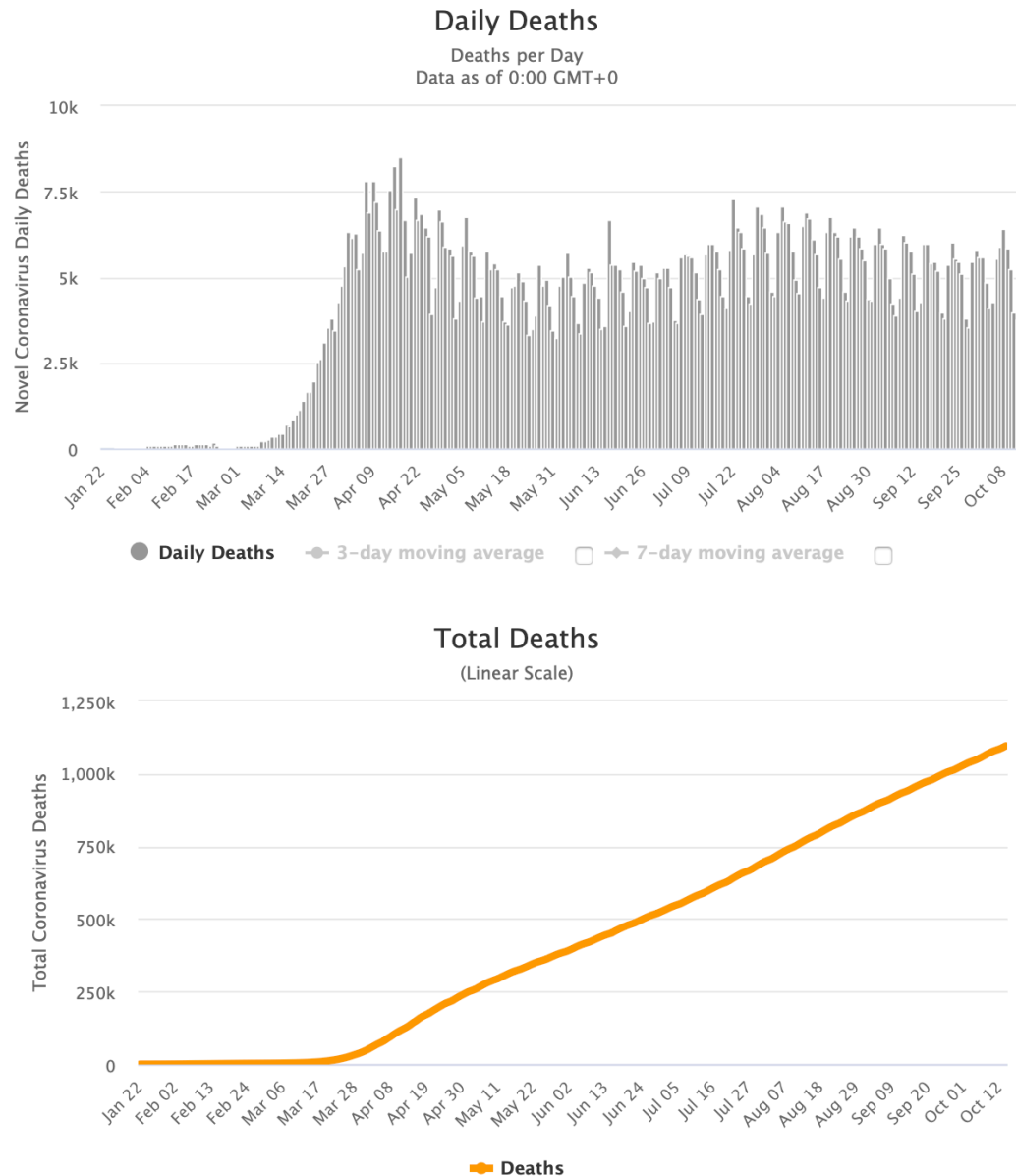
The Emergence of Antimicrobial Resistance Globally



Timothy R. Walsh, OBE



The Global Cost of COVID versus AMR?



Global economic cost of pandemic heading for \$28 trillion, says IMF

IMF expects growth over the coming years to be considerably lower than expected before the pandemic, meaning total foregone output could add up to \$28 trillion by 2025

Ben Chu Economics Editor | @Benchu_ | 1 day ago



Gita Gopinath, the IMF's chief economist, said the world economy was experiencing the "worst crisis since the Great Depression" of the 1930s (AFP via Getty Images)



The Two Worlds?

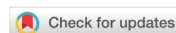
High income Countries

- Respectable taxation systems
- Controllable corruption
- Appropriate funded healthcare (usually public)
- Decent sanitation
- Clean portable water
- Industrial waste controlled
- Antibiotic stewardship - variable
- Microbiology support – good
- Democratic governments

?

Low-Middle income Countries

- Broken taxation system
- Corruption is the norm
- Healthcare systems are invariably private (even public hospitals)
- Poor sanitation
- Contaminated portable water
- Industrial waste uncontrolled
- Antibiotic stewardship – poor
- Microbiology support – weak
- Instable governments and war



STUDY PROTOCOL

REVISED **ACORN (A Clinically-Oriented Antimicrobial Resistance Surveillance Network): a pilot protocol for case based antimicrobial resistance surveillance [version 2; peer review: 4 approved]**

Paul Turner ^{1,2}, Elizabeth A. Ashley ^{2,3}, Olivier J. Celhay ⁴, Anousone Douangnouvong³, Raph L. Hamers ^{2,5}, Clare L. Ling^{2,6}, Yoel Lubell ^{2,4}, Thyl Miliya¹, Tamalee Roberts ³, Chansovannara Soputhy¹, Pham Ngoc Thach⁷, Manivanh Vongsouvath³, Naomi Waithira ^{2,4}, Prapass Wannapinij⁴, H. Rogier van Doorn ^{2,8}

Global Initiatives to tackle AMR



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The Fleming Fund brings evidence and people together to encourage action against drug resistance for a healthier world.

We support low- and middle-income countries to generate, share and use data to improve antimicrobial use and encourage investment in AMR.

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Call for participation: Global Antimicrobial Resistance Surveillance System (GLASS)

In May 2015, the Sixty-eighth World Health Assembly adopted the global action plan on antimicrobial resistance. One of the five strategic objectives of the action plan is to strengthen the evidence base through enhanced global surveillance and research.

WHO has developed the Global Antimicrobial Resistance Surveillance System (GLASS) to foster standardized AMR surveillance globally.

Surveillance

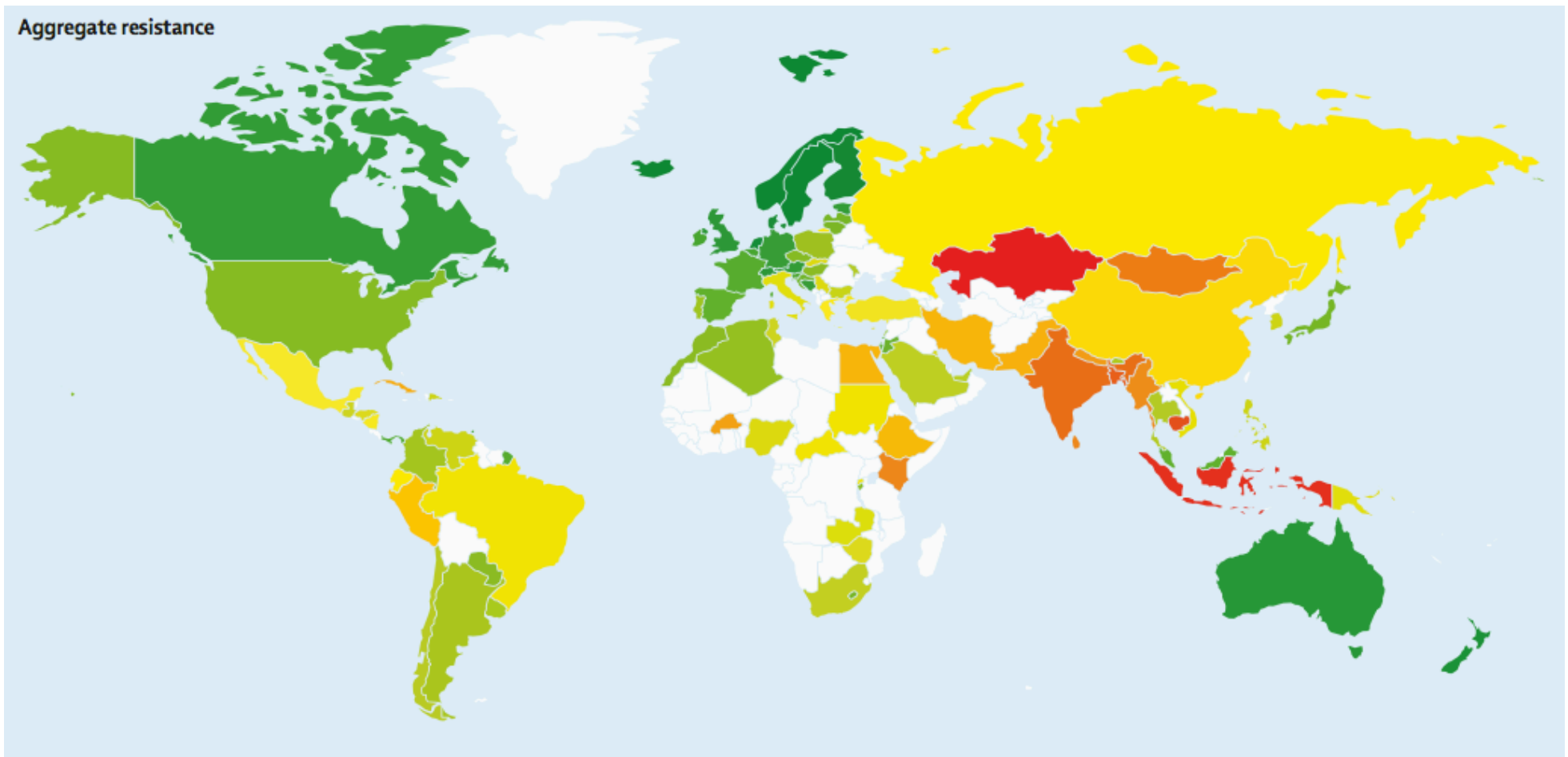
[Global Antimicrobial Resistance Surveillance System \(GLASS\)](#)

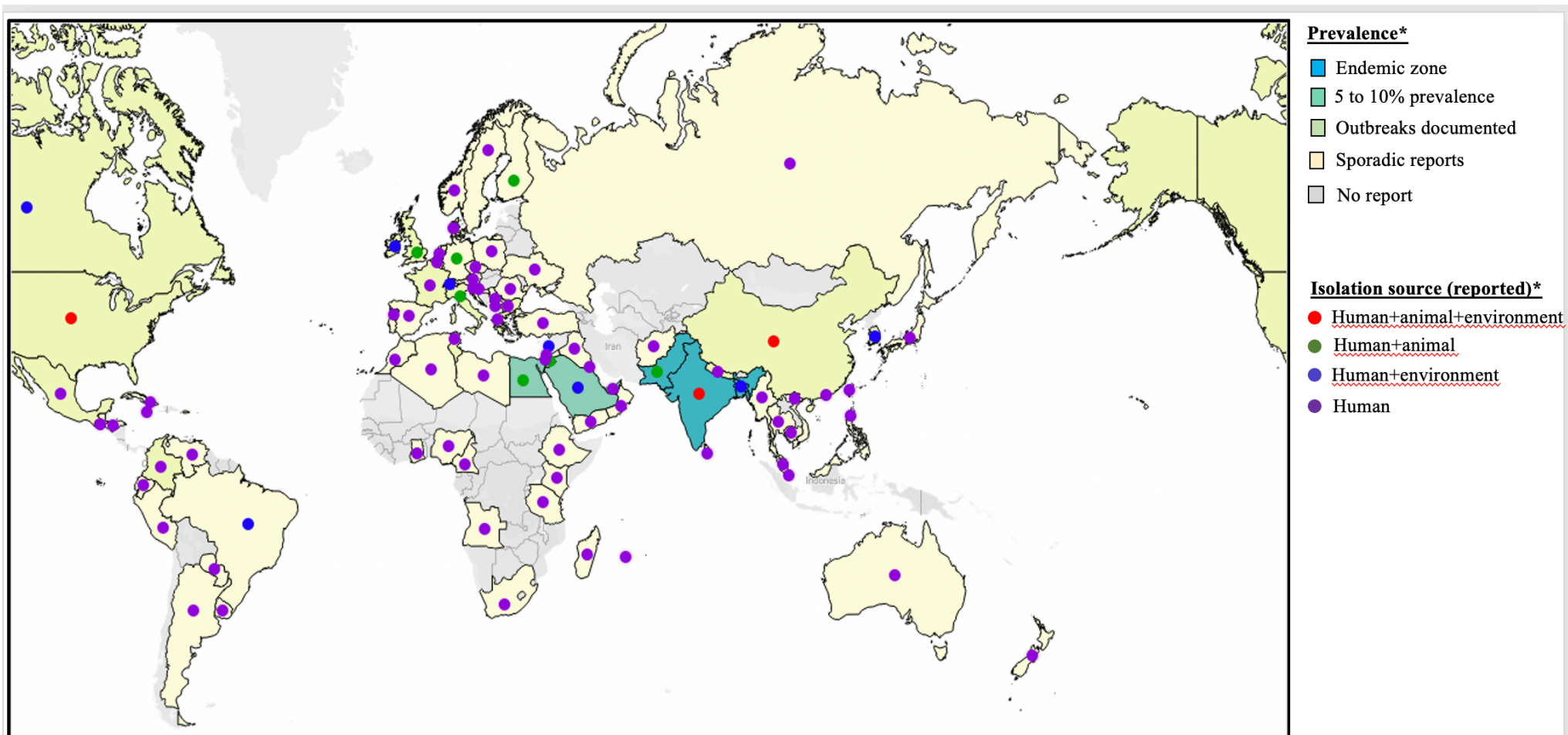
[Surveillance of antimicrobial resistance](#)

Anthropological and socioeconomic factors contributing to global antimicrobial resistance: a univariate and multivariable analysis

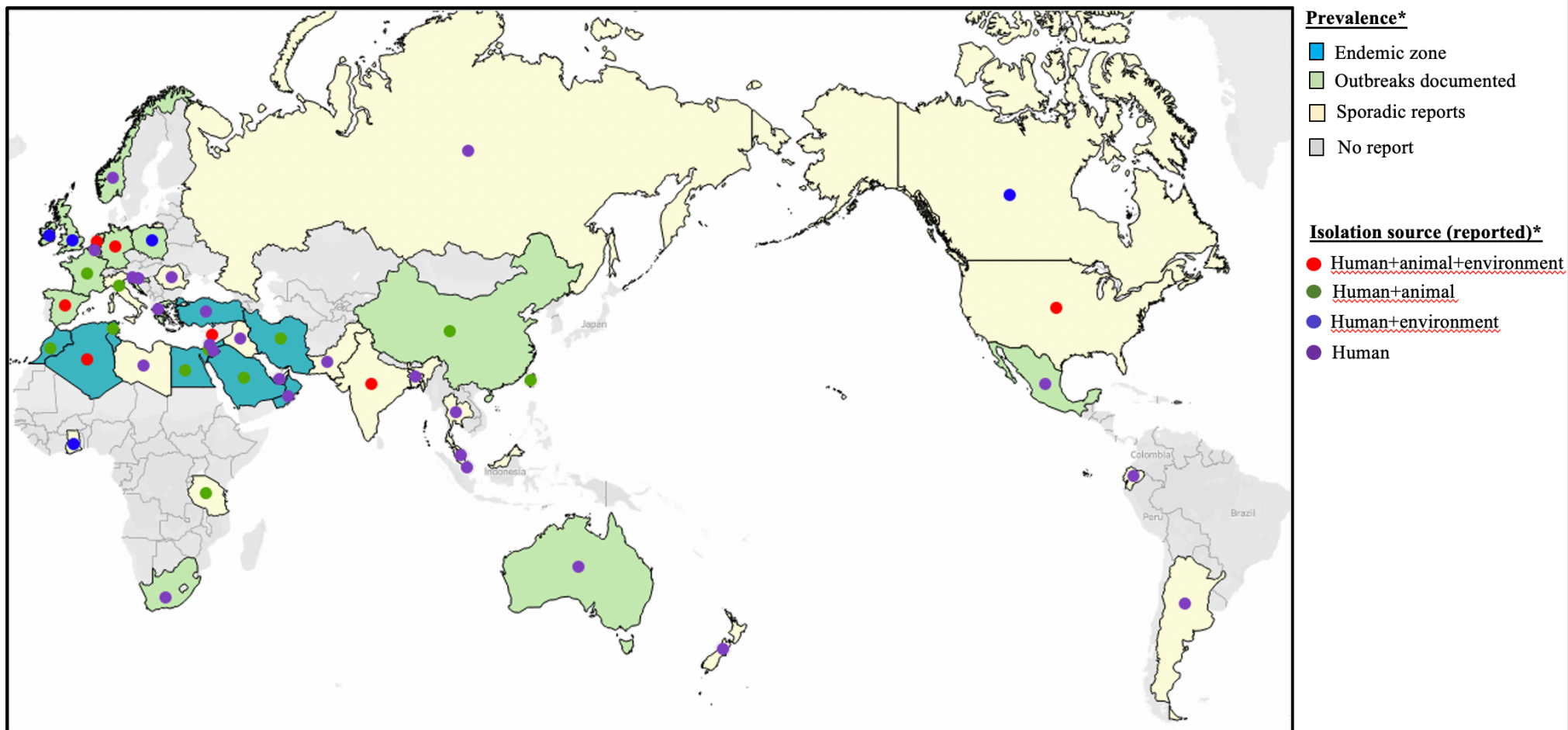


Peter Collignon, John J Beggs, Timothy R Walsh, Sumanth Gandra, Ramanan Laxminarayan





Global distribution of NDM producers.



Global distribution of OXA-48 producers.

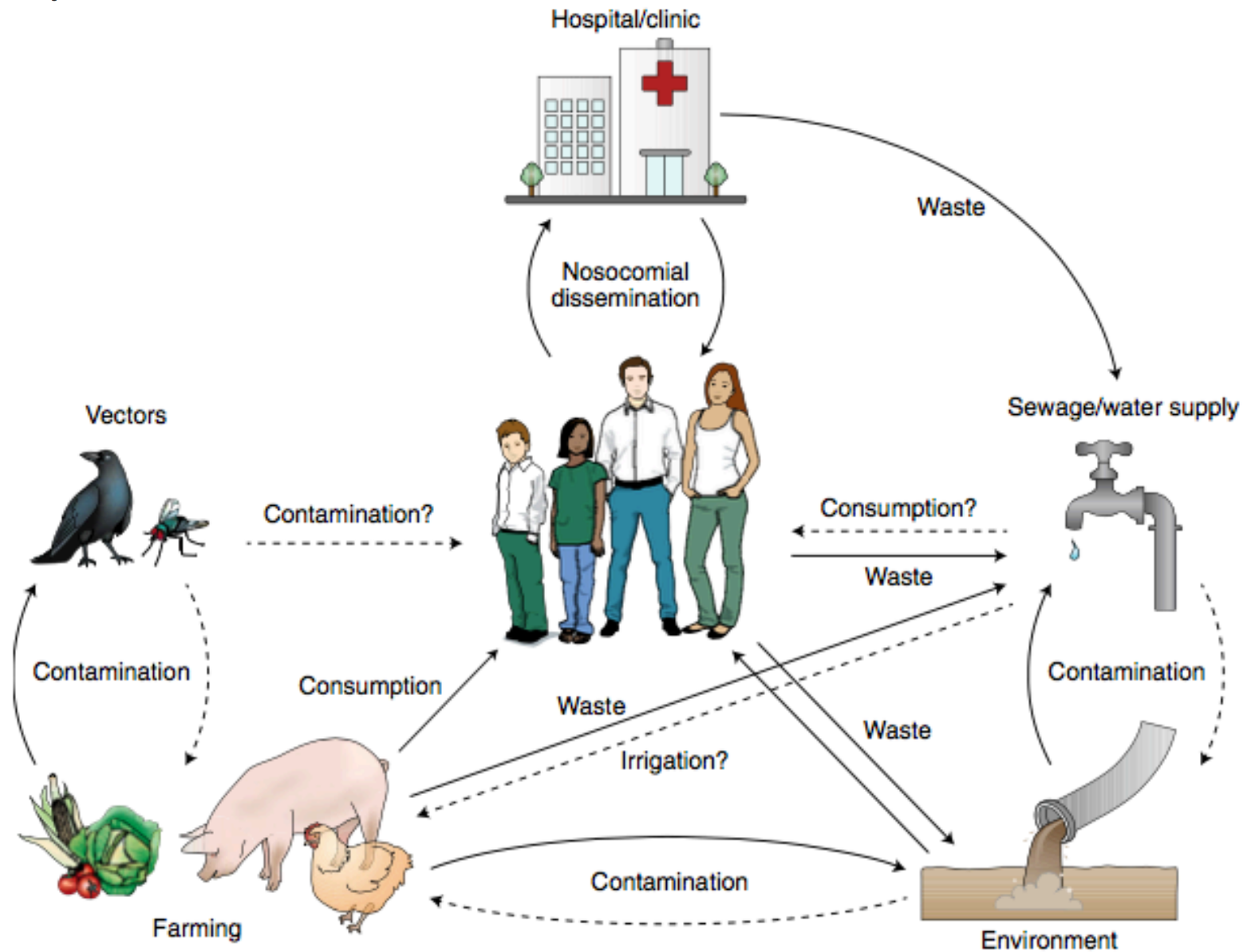


Global distribution of OXA-181 and OXA-232 producers.

A one-health approach to antimicrobial resistance

Widespread use of antibiotics in animals either as growth promoters or for metaphylaxis may drive the spread of clinically relevant drug resistance genes and pathogens. New work uncovers drug resistance gene patterns from livestock across European farms and finds a correlation with agricultural antibiotic use.

Timothy R. Walsh



Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study

Yi-Yun Liu*, Yang Wang*, Timothy R Walsh, Ling-Xian Yi, Rong Zhang, James Spencer, Yohei Doi, Guobao Tian, Baolet Dong, Xianhui Huang, Lin-Feng Yu, Danxia Gu, Hongwei Ren, Xiaojie Chen, Luchao Lv, Dandan He, Hongwei Zhou, Zisen Liang, Jian-Hua Liu, Jianzhong Shen



Anthropogenic and environmental factors associated with high incidence of *mcr-1* carriage in humans across China

Yingbo Shen^{1,11}, Hongwei Zhou^{2,11}, Jiao Xu³, Yongqiang Wang¹, Qijing Zhang⁴, Timothy R. Walsh⁵, Bing Shao¹, Congming Wu¹, Yanyan Hu², Lu Yang¹, Zhangqi Shen¹, Zuowei Wu⁴, Qiaoling Sun², Yanran Ou¹, Yueling Wang⁶, Shaolin Wang¹, Yongning Wu⁷, Chang Cai⁸, Juan Li⁹, Jianzhong Shen^{1,10*}, Rong Zhang^{2*} and Yang Wang^{1,10*}

Comprehensive resistome analysis reveals the prevalence of NDM and MCR-1 in Chinese poultry production

Yang Wang^{1†}, Rongmin Zhang^{1†}, Jiyun Li¹, Zuowei Wu², Wenjuan Yin¹, Stefan Schwarz^{3,4}, Jonathan M. Tyrrell⁵, Yongjun Zheng⁶, Shaolin Wang¹, Zhangqi Shen¹, Zhihai Liu⁷, Jianye Liu⁷, Lei Lei⁷, Mei Li^{5,7}, Qidi Zhang⁸, Congming Wu¹, Qijing Zhang², Yongning Wu⁹, Timothy R. Walsh^{5*} and Jianzhong Shen^{1*}

Emergence of plasmid-mediated high-level tigecycline resistance genes in animals and humans

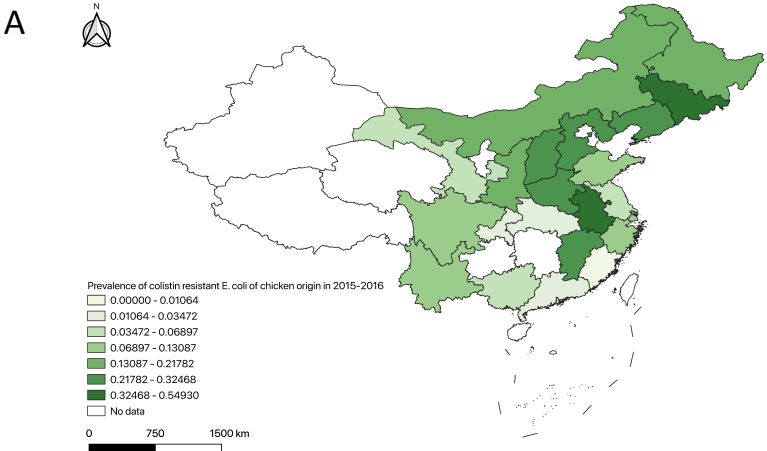
Tao He¹⁰, Ran Wang¹⁰, Dejun Liu^{2,9}, Timothy R. Walsh^{2,3}, Rong Zhang⁴, Yuan Lv⁵, Yuebin Ke⁶, Quanjiang Ji¹⁰, Ruicheng Wei¹, Zhihai Liu², Yingbo Shen², Gang Wang¹, Lichang Sun¹, Lei Lei¹⁰, Ziquan Lv⁶, Yun Li⁵, Maoda Pang¹, Liyuan Wang⁵, Qiaoling Sun⁴, Yulin Fu², Huangwei Song², Yuxin Hao², Zhangqi Shen², Shaolin Wang¹⁰, Gongxiang Chen⁴, Congming Wu², Jianzhong Shen^{2,8*} and Yang Wang^{10,8*}



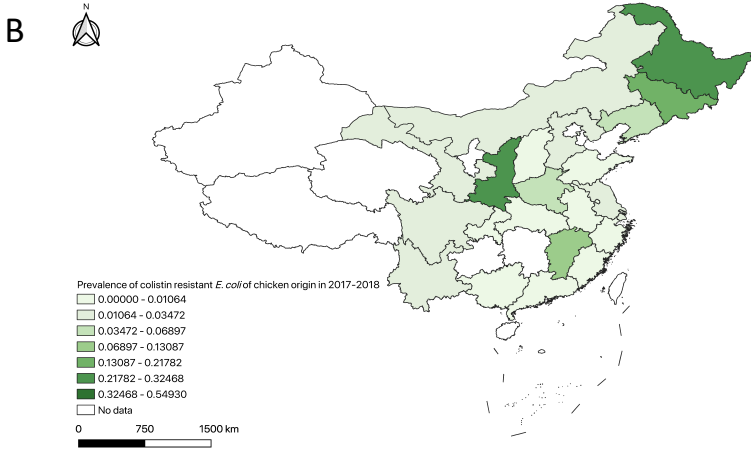
Changes in colistin resistance and *mcr-1* abundance in *Escherichia coli* of animal and human origins following the ban of colistin-positive additives in China: an epidemiological comparative study

Yang Wang*, Chunyan Xu*, Rong Zhang*, Yiqiang Chen*, Yingbo Shen*, Fupin Hu*, Dejun Liu, Jiayue Lu, Yan Guo, Xi Xia, Junyao Jiang, Xueyang Wang, Yulin Fu, Lu Yang, Jiayin Wang, Juan Li, Chang Cai, Dandan Yin, Jie Che, Run Fan, Yongqiang Wang, Yan Qing, Yi Li, Kang Liao, Hui Chen, Mingxiang Zou, Liang Liang, Jin Tang, Zhangqi Shen, Shaolin Wang, Xiaorong Yang, Congming Wu, Shixin Xu, Timothy R Walsh, Jianzhong Shen

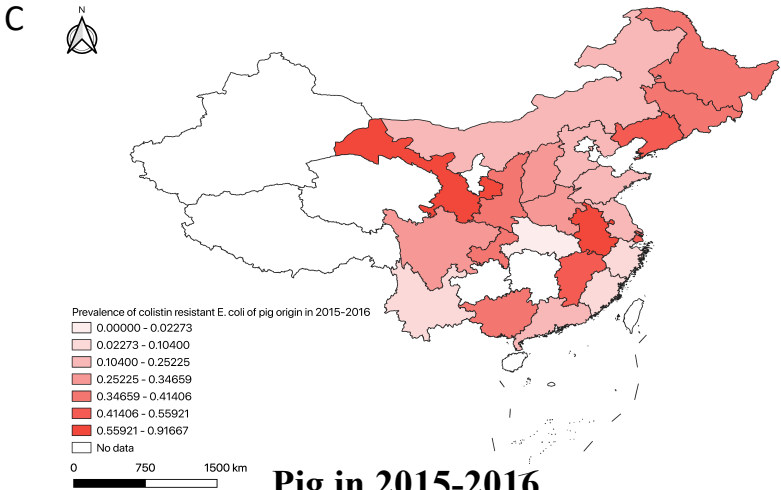
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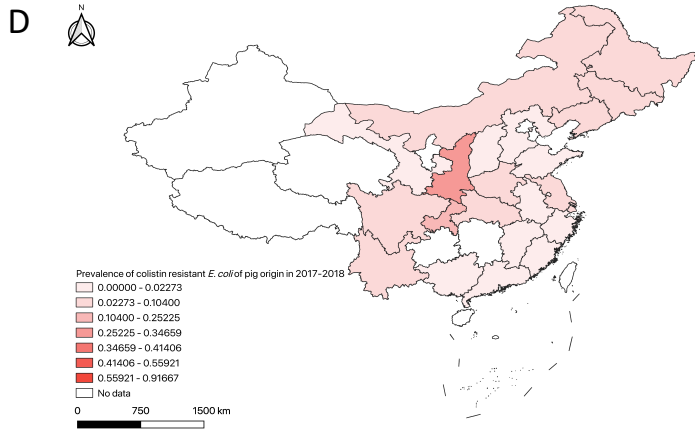
Chicken in 2015-2016



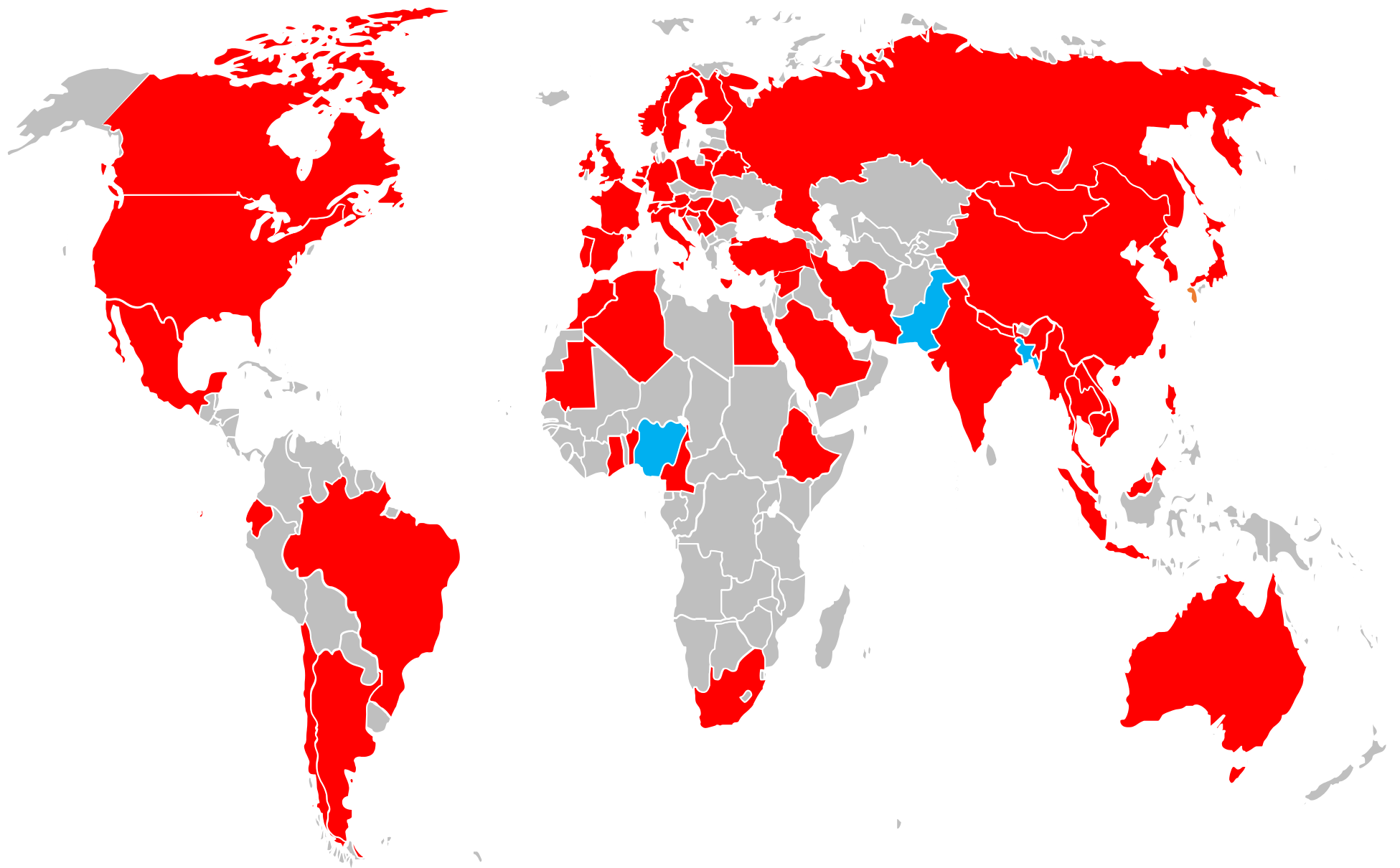
Chicken in 2017-2018



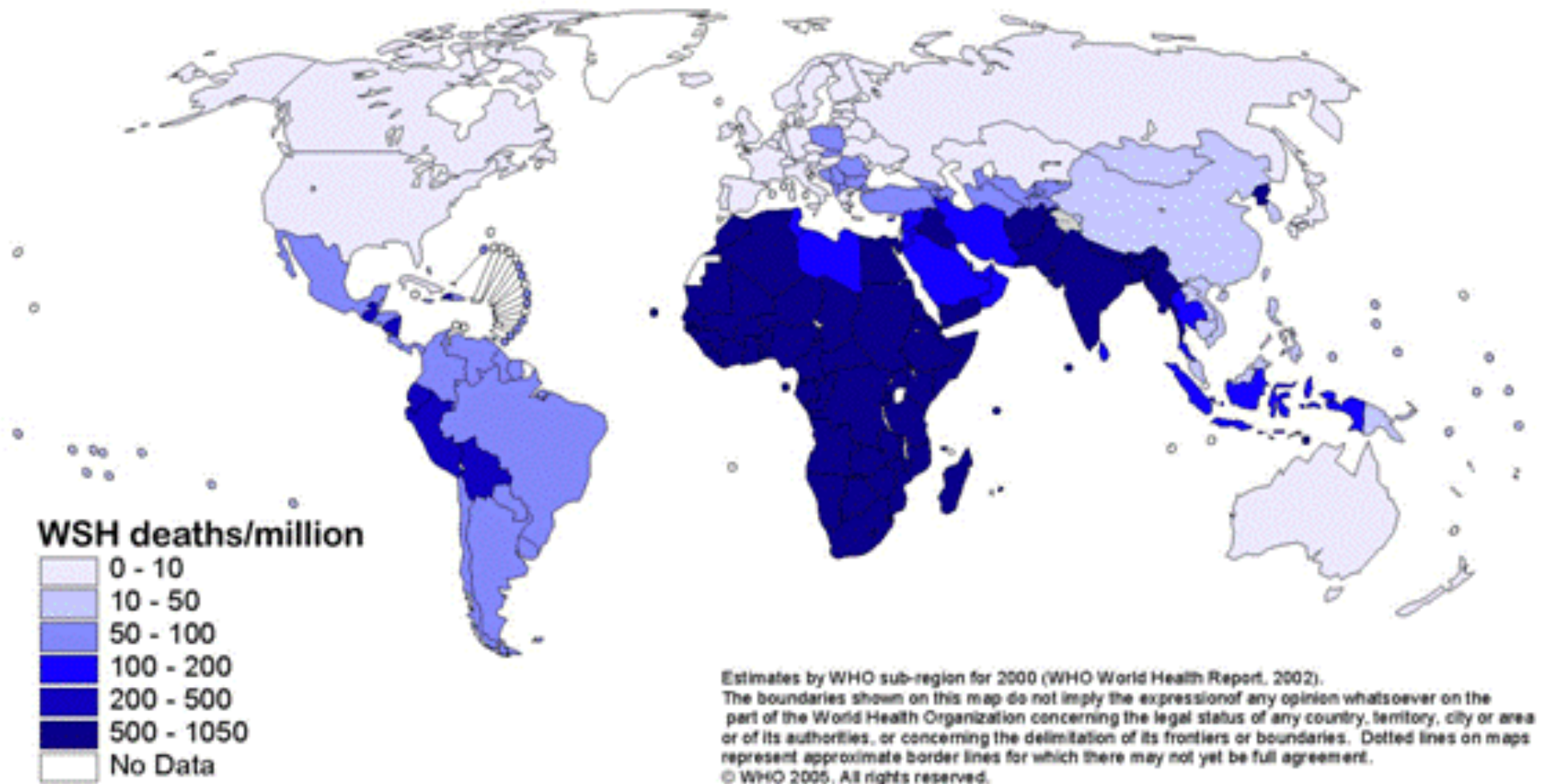
Pig in 2015-2016



Pig in 2017-2018



Deaths from unsafe water, sanitation and hygiene

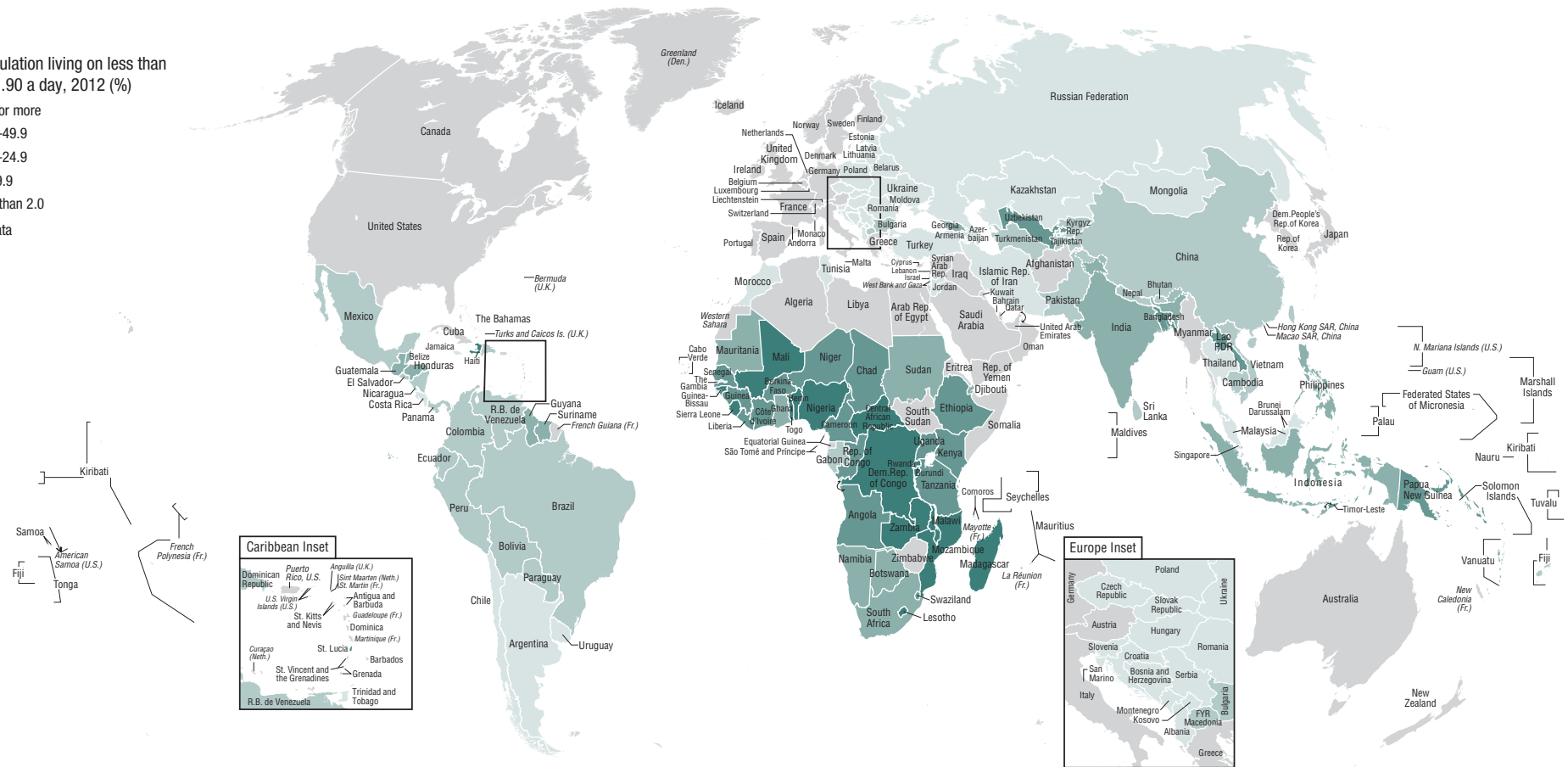
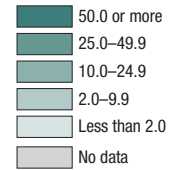


Source: The World Health Organization. "Deaths from unsafe water, sanitation, and hygiene."

<http://www.who.int/heli/risks/water/en/wshmap.pdf>.

Poverty

Share of population living on less than
2011 PPP \$1.90 a day, 2012 (%)



IBRD 41450

<http://databank.worldbank.org/data/download/site-content/wdi/maps/maps-wdi-2016-sec-1-poverty.pdf>





Acknowledgements

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