LA TROBE UNIVERSITY

CLIMATE CHANGE AND VALUE-BASED CARE

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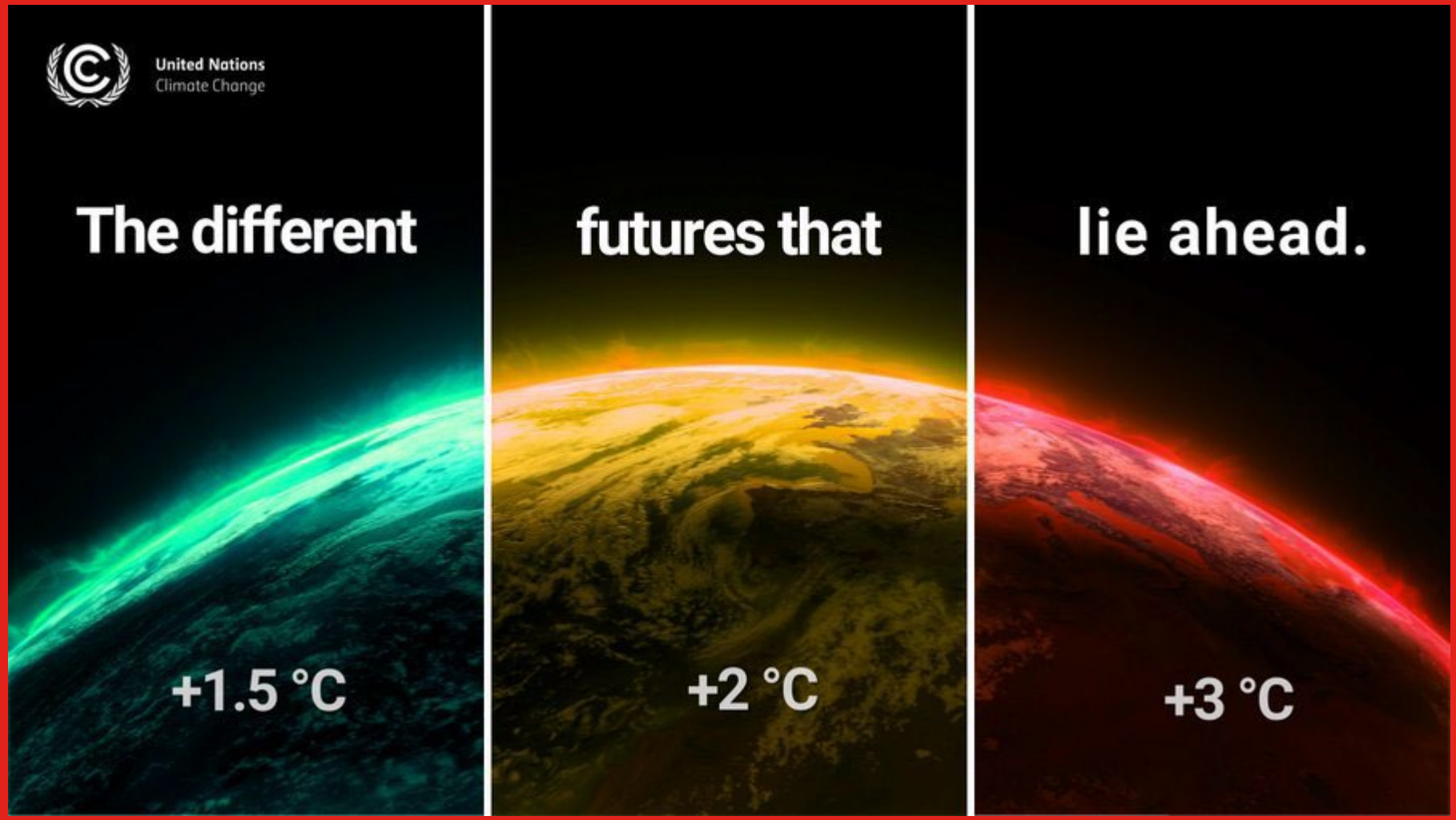
OUTLINE

- Climate change and health
  - ✓ Health impacts of climate change
  - ✓ Health system's contribution to climate change
- Health strategies in responding to climate change crisis
  - ✓ Mitigation
  - ✓ Adaptation
  - ✓ Resilience
- Building climate resilient health systems
- Public health competency in climate change

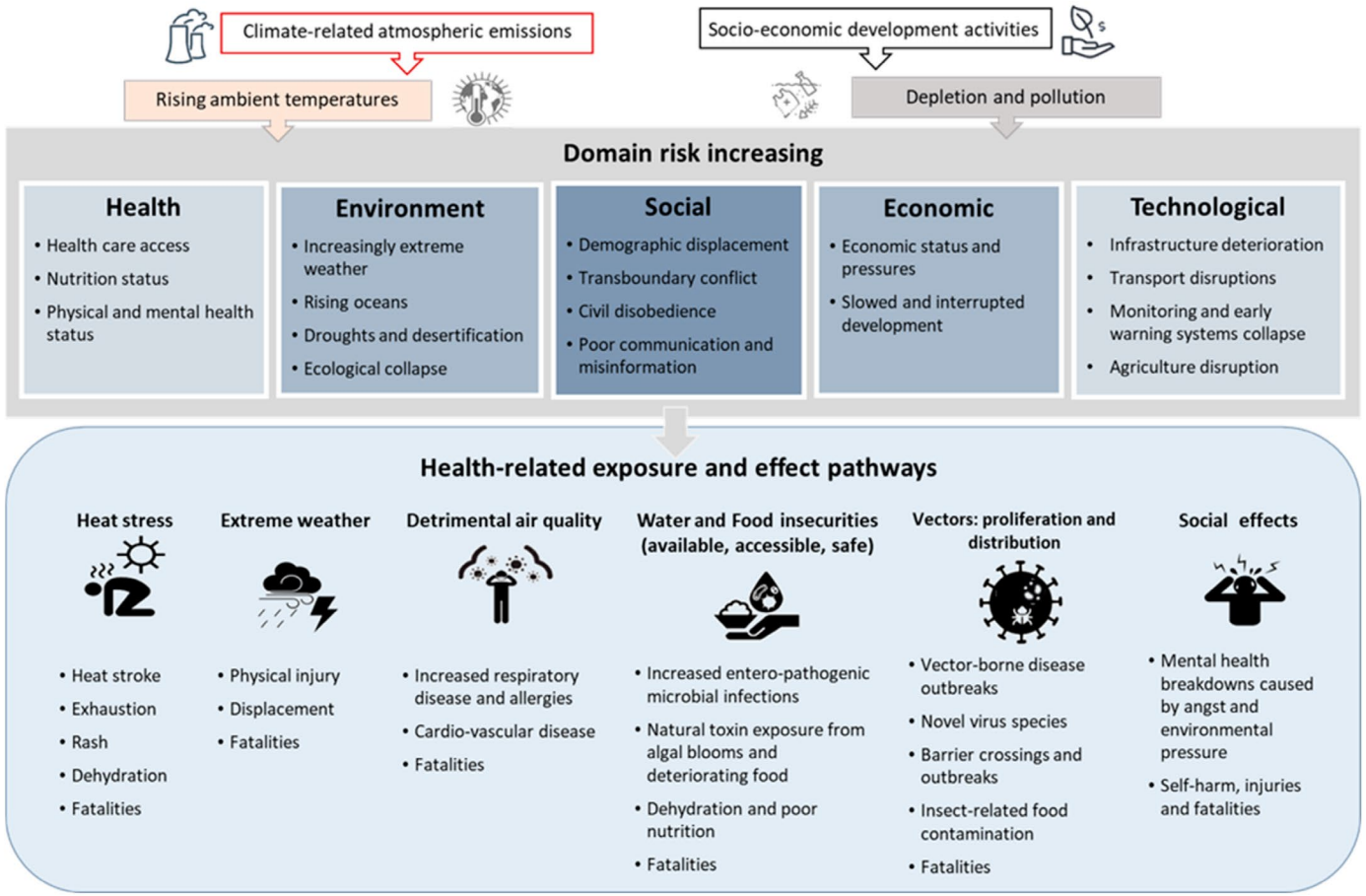
CLIMATE CHANGE AND HEALTH



https://www.un.org/en/climatechange/science/climate-issues/degrees-matter

HEALTH IMPACTS OF CLIMATE CHANGE

- Extreme weather events
- Changing environments
- Incremental and accumulative impacts

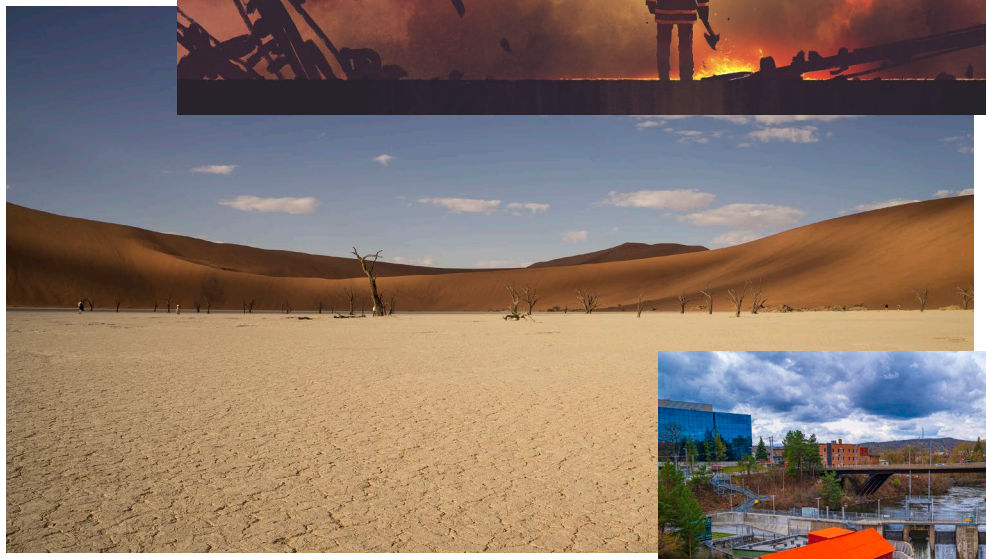


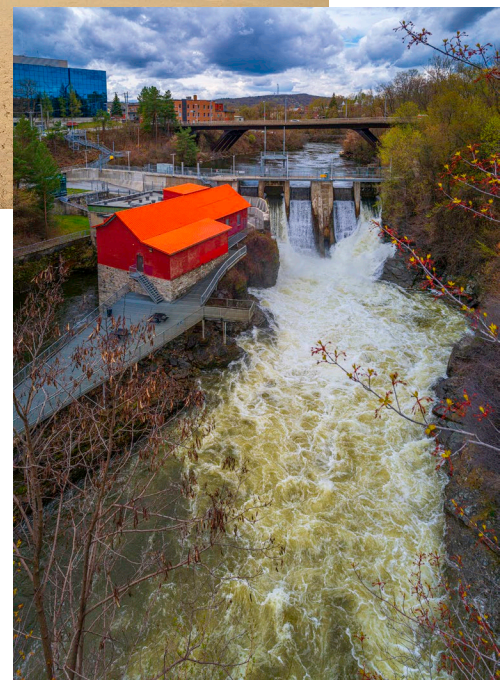
Jagals P, Ebi K. Core Competencies for Health Workers to Deal with Climate and Environmental Change. Int J Environ Res Public Health. 2021 Apr 7;18(8):3849. doi: 10.3390/ijerph18083849.

Table. Climate-Sensitive Exposures and Outcomes

Exposure	Health outcome	Exposure-outcome relationship
High ambient temperature	Preterm birth	Relative risk of 1.05 per 1 °C (33.8 °F)
High ambient temperature	Cardiovascular disease-related mortality	Relative risk of 1.02 per 1 °C (33.8 °F)
High ambient temperature	Schizophrenia morbidity	Relative risk of 1.07 for days with maximum temperatures in the 99th percentile relative to median temperature
Ambient temperature	Arboviral disease (eg, dengue, West Nile)	Increased transmission in temperature ranges with highest vectorial and pathogen performance
Airborne allergenic pollen (eg, ragweed, oak)	Allergic respiratory disease	Exposure to ragweed pollen concentrations averaging 71 grains/m^3/d for 19 d causes lower respiratory symptoms in 50% of exposed children
Small particles from wildfire smoke (wildfire-specific $PM_{2.5}$)	Same-day all-cause mortality	Relative risk of 1.015 per 10-µg/m^3 increase in wildfire-specific $PM_{2.5}$

Ebi, K. L., & Hess, J. J. (2024). Introduction to JAMA Climate Change and Health Series. JAMA, 331(5), 436-437. https://doi.org/10.1001/jama.2023.25878





OTHER IMPACTS - ANTIBIOTIC RESISTANCE?

- Extensive studies into rational use of antibiotics
  - ✓ Reduced antibiotic prescriptions
  - ✓ Increased antibiotic resistance
- Why?
  - ✓ Could climate change be associated with increased antibiotic resistance?

OUR OWN STUDY IN CHINA

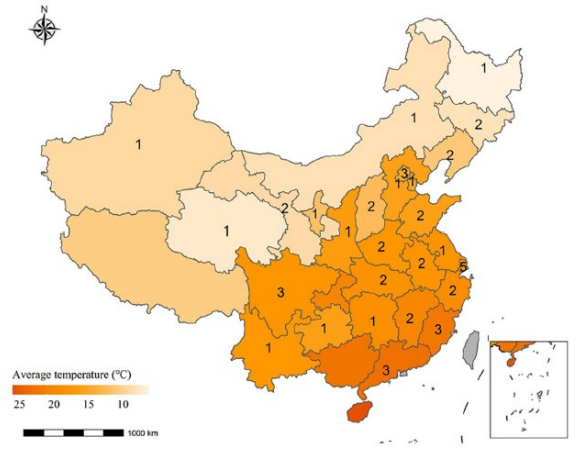


Fig. 1: Map with average ambient temperature. The numbers indicate the number of participating hospitals in 2019 in the China Antimicrobial Surveillance Network (CHINET) from each province or autonomous region.

Variables	Description
DDDs	National total antibiotic consumption measured in defined daily doses per day per 100 population by year
CPI	National Corruption Perceptions Index by year
Population density	Provincial population per square kilometer by year
GDP	Provincial GDP (in current Chinese currency value) per capita, log-scale transformed, by year
Health facility	Provincial health facility density per 10,000 population by year
Physician	Provincial physician density per 10,000 population by year
Hospital bed	Provincial hospital bed density per 10,000 population by year
Humidity	Annual average humidity of major cities in each province (%)
Rainfall	Annual average rainfall of major cities in each province (mm)

Table 3: **Control variables used for statistical analysis.**

- 49 hospitals in China Antimicrobial Surveillance Network (CHINET) since 2005.
- Confounding factors
  - ✓ Sociodemographic profiles
  - ✓ Economic status
  - ✓ Medical services
  - ✓ Environmental factors

Li, W., Liu, C., Ho, H. C., Shi, L., Zeng, Y., Yang, X., ... & Yang, L. (2023). Association between antibiotic resistance and increasing ambient temperature in China: An ecological study with nationwide panel data. *The Lancet Regional Health–Western Pacific*, *30*.

AMBIENT TEMPERATURE AND ANTIBIOTIC RESISTANCE

- Prevalence of CRKP and CRPA increased with higher ambient temperature ($p < 0.001$), but not CRAB ($p = 0.44$)
  - ✓ Unit (1 ◦C) increase 1.14-fold for CRKP prevalence
  - ✓ Unit (1 ◦C) increase 1.06-fold for CRPA prevalence

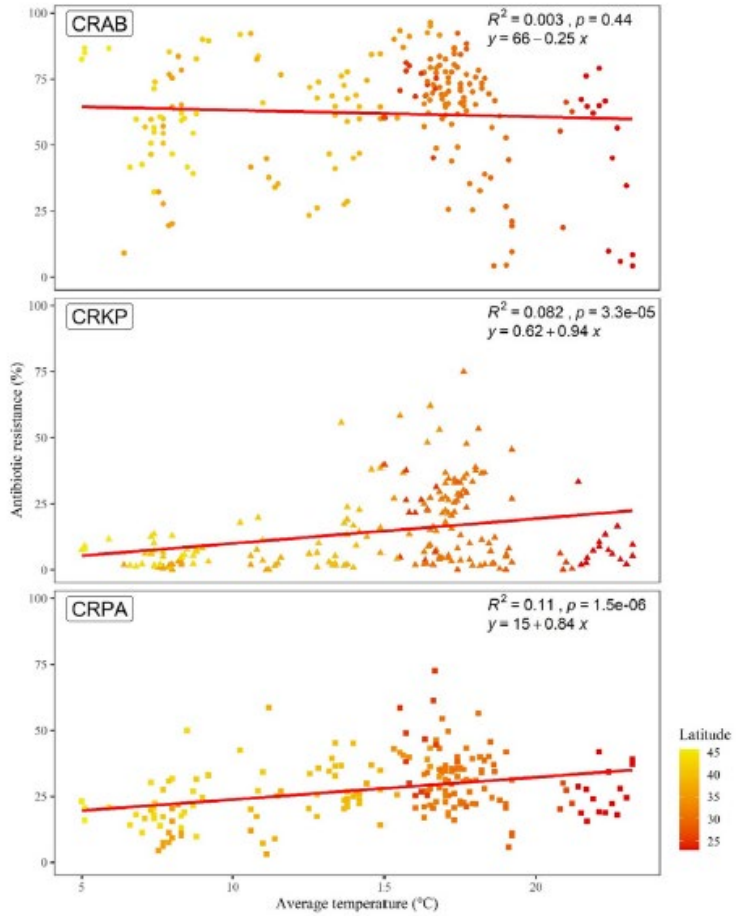


Fig. 3: Unadjusted linear trend line estimating the linear relationship between annual average ambient temperature and antibiotic resistance. Each point represents a province colored by latitude. The three pathogens were represented as geometric shapes.

Li, W., Liu, C., Ho, H. C., Shi, L., Zeng, Y., Yang, X., ... & Yang, L. (2023). Association between antibiotic resistance and increasing ambient temperature in China: An ecological study with nationwide panel data. *The Lancet Regional Health–Western Pacific*, *30*.

ACCUMULATIVE EFFECTS OF AMBIENT TEMPERATURE

- The four-year sum in year-by-year changes in ambient temperature had the greatest effect: RR = 1.09 (p = 0.016, 95%-CI [1.02–1.18]) for CRPA

- Average ambient temperature remained a significant stable predictor of antibiotic resistance for CRKP prevalence and CRPA prevalence

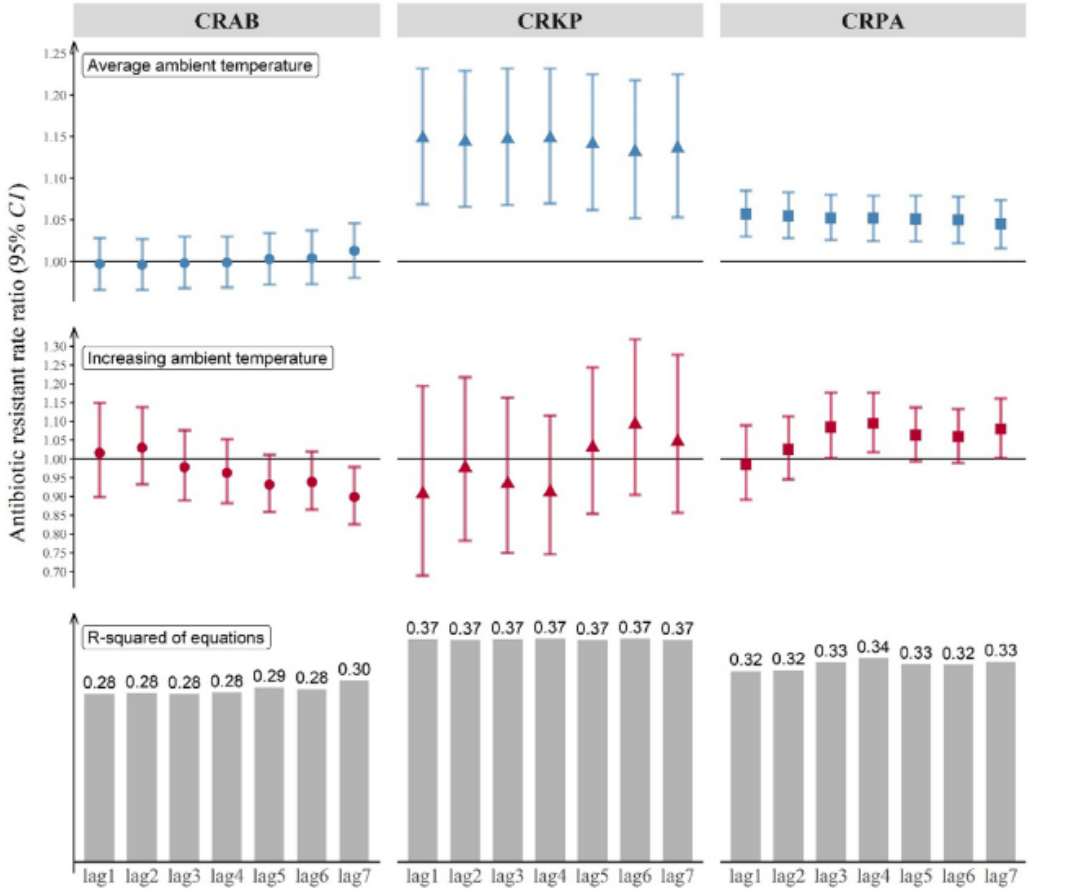


Fig. 5: Rate ratios of antibiotic resistance for the three target species (CRAB, CRKP, CRPA) when average ambient temperature and changes in average ambient temperature jumped by 1 °C. The bars represent the R-squared of the equations.

REGIONAL EFFECTS

- Positive associations between ambient temperature and the prevalence of antibiotic resistance remained significant for CRAB, CRKP and CRPA in northern China, for CRKP and CRPA in winter, and for CRKP in summer

- Negative associations between ambient temperature and the prevalence of CRAB and CRKP were found in southern China

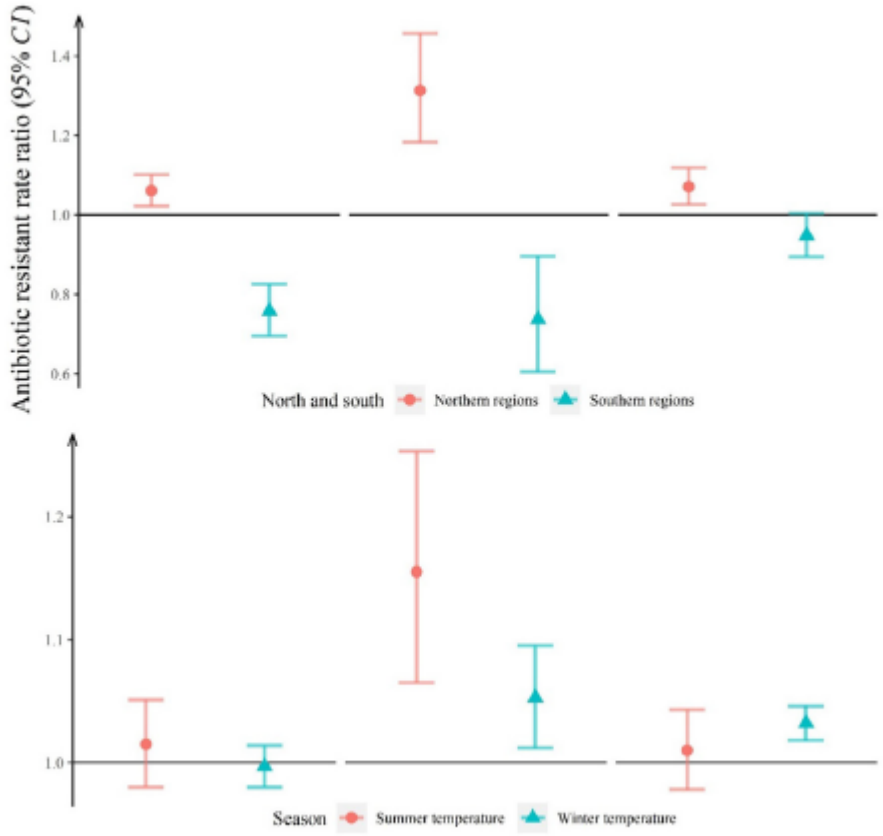


Fig. 4: Rate ratios of antibiotic resistance associated with ambient temperature: results of sub-group modelling.

Li, W., Liu, C., Ho, H. C., Shi, L., Zeng, Y., Yang, X., ... & Yang, L. (2023). Association between antibiotic resistance and increasing ambient temperature in China: An ecological study with nationwide panel data. *The Lancet Regional Health–Western Pacific*, *30*.

CONTRIBUTION OF HEALTH SYSTEMS TO CLIMATE CHANGE

- Energy consumption
- Waste generation
- Chemical use
- Transportation
- Land use

CARBON EMISSIONS OF HEALTH SYSTEMS

- Equates to fifth-largest emission country (Karliner et al., 2020).
- Pharmaceutical sector is more emission-intensive than automotive industry (Weisz et al., 2020).
- Average share of the healthcare sector in carbon emissions exceeds 5% (Weisz et al., 2020)
- Vast majority of emissions come from the healthcare supply chain
  - ✓ 82% in the US (Matthew J. Eckelman et al., 2020)

MANAGE HEALTH

ADDRESS THE CAUSES OF THE CAUSES

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HEALTH STRATEGIES IN RESPONDING TO CLIMATE CHANGE CRISIS

HEALTH STRATEGIES IN RESPONDING TO CLIMATE CHANGE CRISIS

MITIGATION

ADAPTATION

RESILIENCE

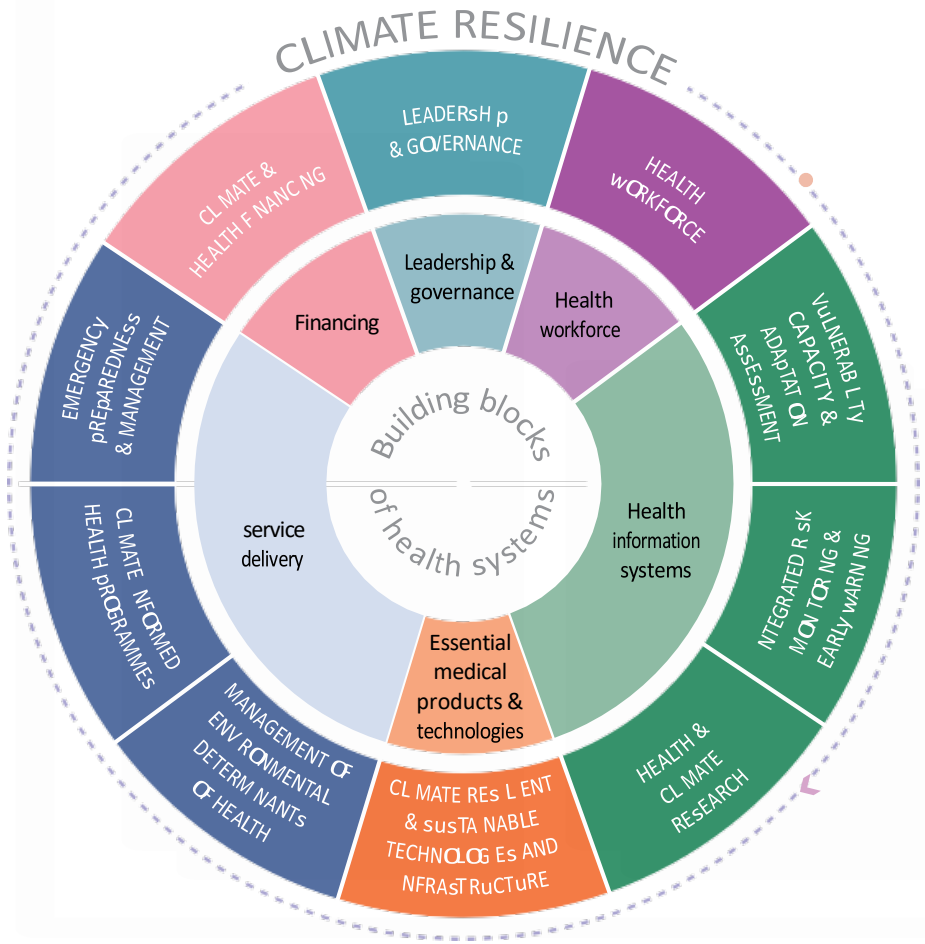
MITIGATION

- Improving housing conditions
- Enhancing community environment
- Optimising service planning and delivery
- Fostering cross-sector collaborations

ADAPTATION

- Resilient Infrastructure
- Renewable Energy Integration
- Green Spaces
- Community Engagement
- Healthcare Preparedness
- Policy Support
- International Cooperation
- Education and Awareness

RESILIENCE



- Service delivery
- Health workforce
- Health information systems
- Essential medicines
- Financing
- Leadership/governance

WHO. (2022). Measuring the climate resilience of health systems.

CLIMATE RESILIENT HEALTH SYSTEMS

- A primary care dominant system performs better in population health than a hospital dominated one
- Hospitals contribute more to greenhouse gas emissions than primary care
  - ✓ 32% of CO_2 emissions in healthcare, compared to 18% from ambulatory care in Austria (Weisz et al., 2020)

Weisz, U., Pichler, P.-P., Jaccard, I. S., Haas, W., Matej, S., Bachner, F., Nowak, P., & Weisz, H. (2020). Carbon emission trends and sustainability options in Austrian health care. Resources, Conservation and Recycling, 160, 104862. https://doi.org/https://doi.org/10.1016/j.resconrec.2020.104862

PUBLIC HEALTH COMPETENCY IN CLIMATE CHANGE

ARE HEALTHCARE WORKERS PREPARED?

Open access Protocol

BMJ Open

Health professionals in a changing climate: protocol for a scoping review

Lianping Yang,[1] Chaojie Liu,[2] Jeremy Hess,[3] Dung Phung,[4] Cunrui Huang[1]

To cite: Yang L, Liu C, Hess J, *et al*. Health professionals in a changing climate: protocol for a scoping review. *BMJ Open* 2019;**9**:e024451. doi:10.1136/bmjopen-2018-024451

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2018-024451).

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ABSTRACT

Introduction Climate change will impose significant health impacts. Although we know health professionals should play a critical role in protecting human health from climate change, their preparedness to engage with these issues worldwide is unclear. This study aims to map the range and nature of existing evidence regarding health professionals' knowledge, attitudes, perceptions and practices regarding climate change and health impacts and the challenges they face, and identify knowledge gaps to guide future development of research, policy and practices.

Methods and analysis We will perform a scoping review based on the six-stage framework proposed by Arksey and O'Malley. Our study includes peer-reviewed literature focusing on any aspect of health professionals' work regarding climate change and health since 2002 and indexed in MEDLINE/Pubmed, Web of Science, Scopus or Embase. Identified papers will be described and assessed. Thematic analysis will be applied to evaluate and categorise the study findings.

Implications and dissemination This is the first scoping review of health professionals' activities to anticipate and prepare for health impacts attributable to climate change.

Strengths and limitations of this study

- The systematic scoping review will fill an important research gap, as evidence regarding health professionals' engagement and preparedness is beginning to accumulate but has not yet been collated and centrally assessed.
- This review will search multidisciplinary databases covering medicine, health, society and the environment in order to ensure a comprehensive assessment of the literature.
- No restrictions will be applied on study type, design, location or health professional role.
- As we aim to synthesise all the different aspects with regard to climate change and health professionals, identified literature will not be excluded based on quality assessment, though the type of study and the strength of available evidence will be noted in the review.
- As full-text review will not apply to the small number of publications in a language other than English and Chinese, the review report may be biased.

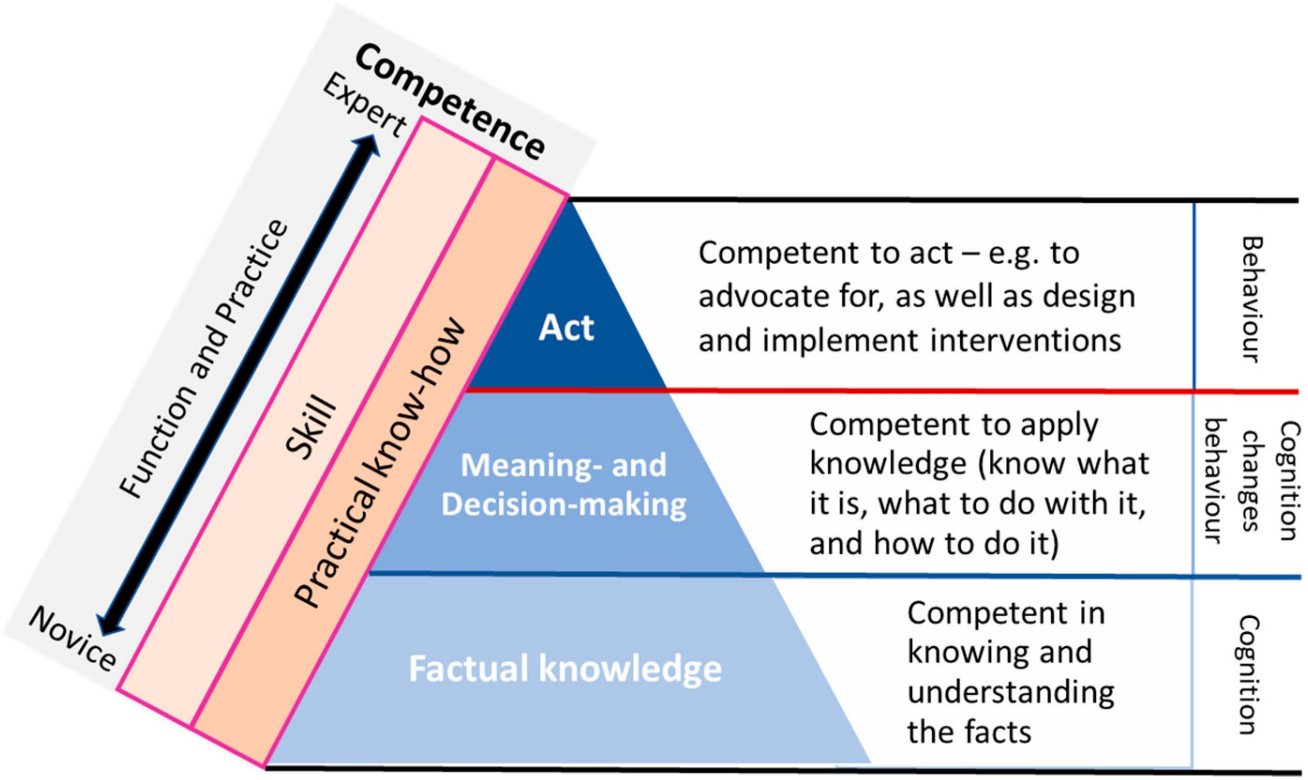
Table 2. Perceived impacts of climate change from medical, public health and nursing students.

Perceived Impacts of Climate Change	Medical (n = 644)		Public Health (n = 430)		Nursing (n = 313)		All (n = 1387)		p
	n	(%)	n	(%)	n	(%)	n	(%)	
Climate change is controllable	418	64.9	321	74.7	196	62.6	935	67.4	<0.01
Overall, climate change is bad	546	84.8	359	83.5	253	80.8	1158	83.5	0.30
Climate change is bad for human health	575	89.3	381	88.6	266	85.0	1222	88.1	0.15
Climate change will be serious in my local community	576	89.4	368	85.6	282	90.1	1226	88.4	0.09
Climate change will be serious in China	619	96.1	413	96.1	298	95.2	1330	95.9	0.79
Climate change will be serious in the world	609	94.6	410	95.4	299	95.5	1318	95.0	0.76
Health consequences of climate change									
Air quality-related illness	604	93.8	413	96.1	299	95.5	1316	94.9	0.22
Heat-related illness	596	92.6	407	94.9	283	90.4	1286	92.8	0.07
Disruption of health services by extreme weather events	585	90.8	396	92.1	282	90.1	1263	91.1	0.62
Cold-related illness	570	88.5	385	89.5	276	88.2	1231	88.8	0.82
Flooding-related displacement	550	85.5	375	87.4	259	82.8	1184	85.5	0.20
Illness related with shortage of water supply	556	86.5	352	82.2	269	86.2	1177	85.1	0.13
Vector-borne infectious disease	541	84.0	359	83.9	249	79.8	1149	83.0	0.23
Water-borne infectious disease	544	84.6	328	76.6	249	79.6	1121	81.0	<0.01
Other health impacts of climatic change	479	76.4	348	82.1	234	76.0	1061	78.1	0.06
Food-borne disease	472	73.4	250	58.1	226	72.2	948	68.4	<0.01
Mental health conditions	443	68.8	255	59.3	185	59.1	883	63.7	<0.01
Malnutrition	282	43.9	141	32.8	117	37.4	540	39.0	<0.01
Total score (Mean ± SD)	9.70 ± 2.39		9.36 ± 2.20		9.36 ± 2.27		9.52 ± 2.31		0.03

Yang L, Liao W, Liu CJ, Zhang N, Zhong S, Huang C (2018). Associations between Knowledge of the Causes and Perceived Impacts of Climate Change: A Cross-Sectional Survey of Medical, Public Health and Nursing Students in Universities in China. Int. J. Environ. Res. Public Health 15, 2650; doi:10.3390/ijerph15122650

CLIMATE COMPETENCY FRAMEWORK

- Climate and environment sciences
- Drivers of climate change
- Evidence, projections and assessments
- Iterative risk management
- Mitigation, adaptation and health co-benefits
- Collective strategies



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WHAT NEXT?

WHO FRAMEWORK FOR CLIMATE-RESILIENCE

- Climate-transformative leadership and governance
- Climate-smart health workforce
- Assessments of climate and health risks and greenhouse gas emissions
- Integrated risks monitoring, early warning, and greenhouse gas emissions tracking
- Health and climate research
- Climate resilient and low carbon infrastructures, technologies, and supply chain
- Management of environmental determinants of health
- Climate-informed health programs
- Climate-related emergency preparedness and management
- Sustainable climate and health financing

WHO. (2023c). Operational framework for building climate resilient and low carbon health systems. World Health Organization. Retrieved 16 Feb 2024 from https://www.who.int/publications/i/item/9789240081888

FURTHER WHO DOCUMENTS

- Six steps in vulnerability assessment
  https://www.who.int/publications/i/item/9789240036383
- Communicating on climate change and health
  https://www.who.int/publications/i/item/9789240090224

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