HEALTH IMPACT OF HEATWAVE AND PREPAREDNESS MEASURES

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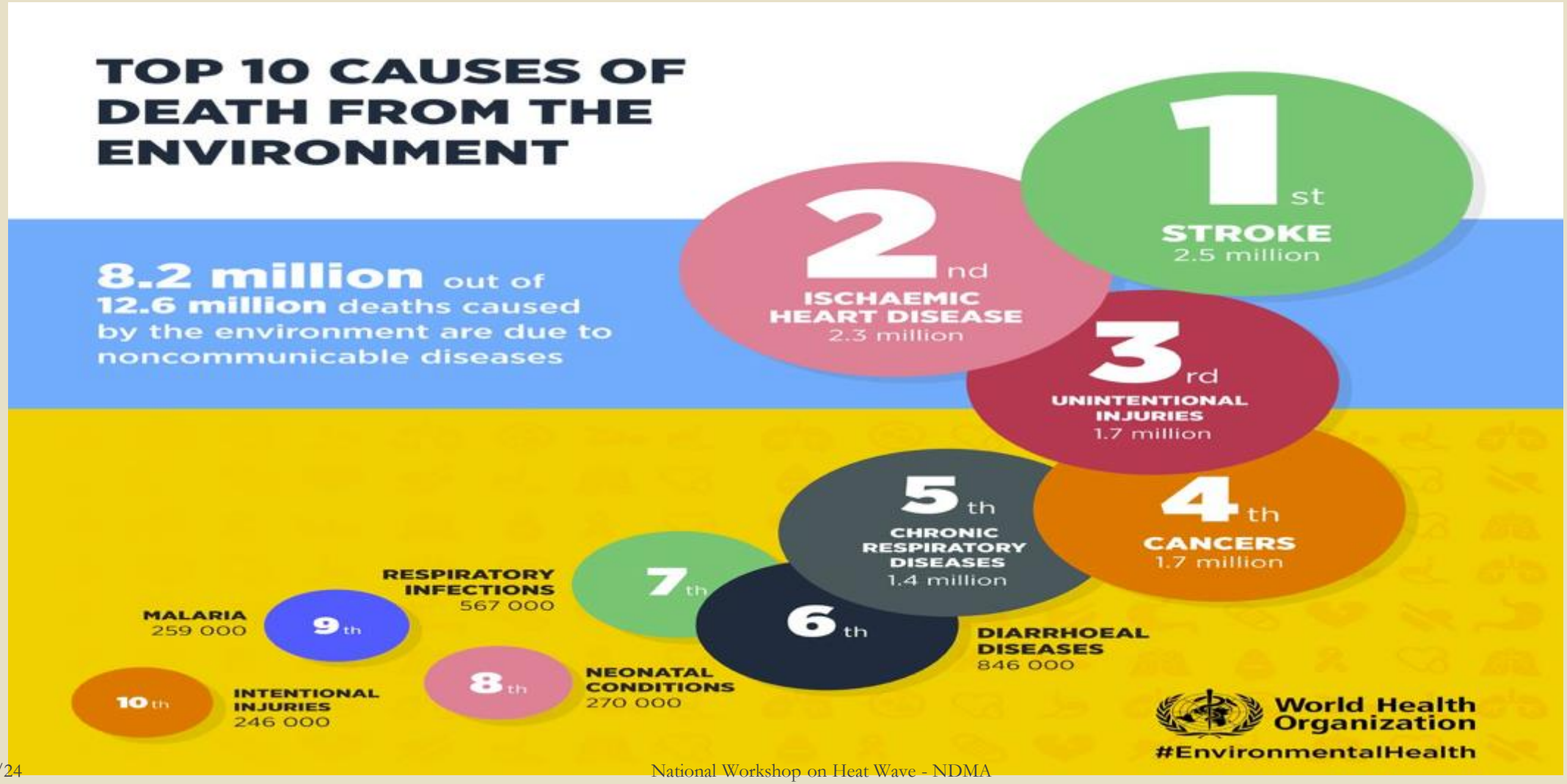
Outline of presentation

- **Epidemiology of Climate Change and Health**
- **Scientific evidence available for health impact of heat**
  - **Global evidence**
  - **Indian Evidence**
- **Preparedness measures**
- **Take home message**

Burden is high and hidden

Why we should be worried about the environmental risks?



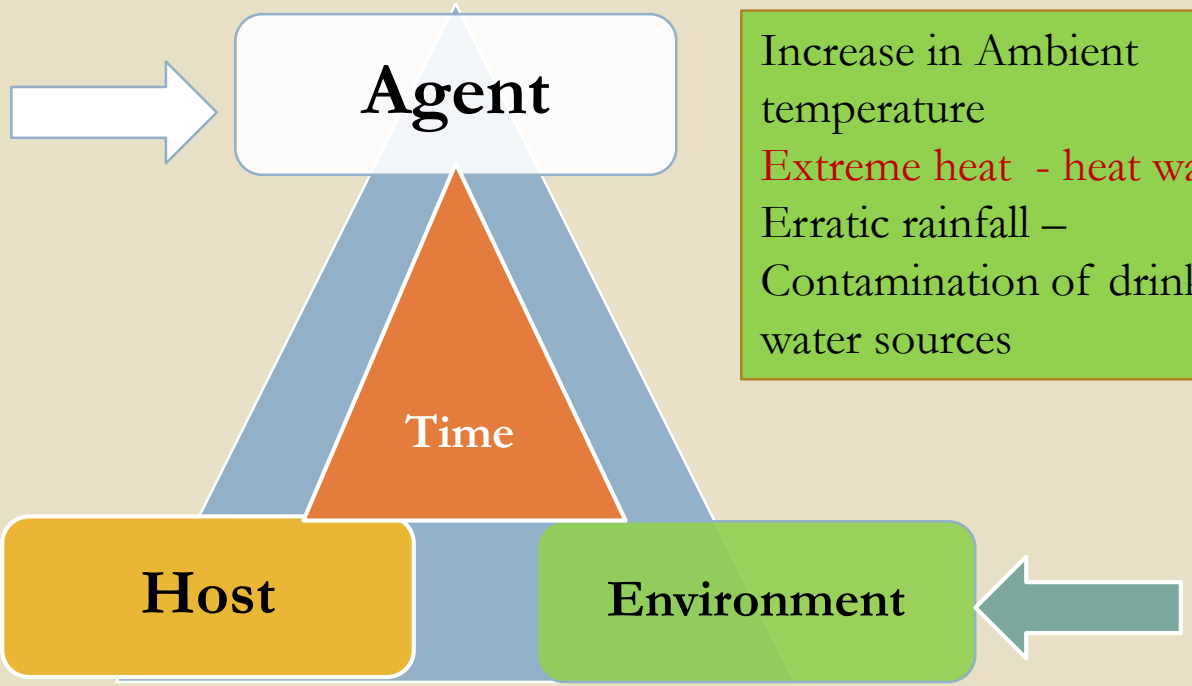
Indicators of climate change

- **Temperature, Humidity**
- **Sea level**
- **Ocean heat content**
- **Extreme weather**
- **Species migrating upward and poleward**
- **Sea surface temperature**

- **Glaciers**
- **Sea ice**
- **Snow cover**

Epidemiology of Climate Change and health

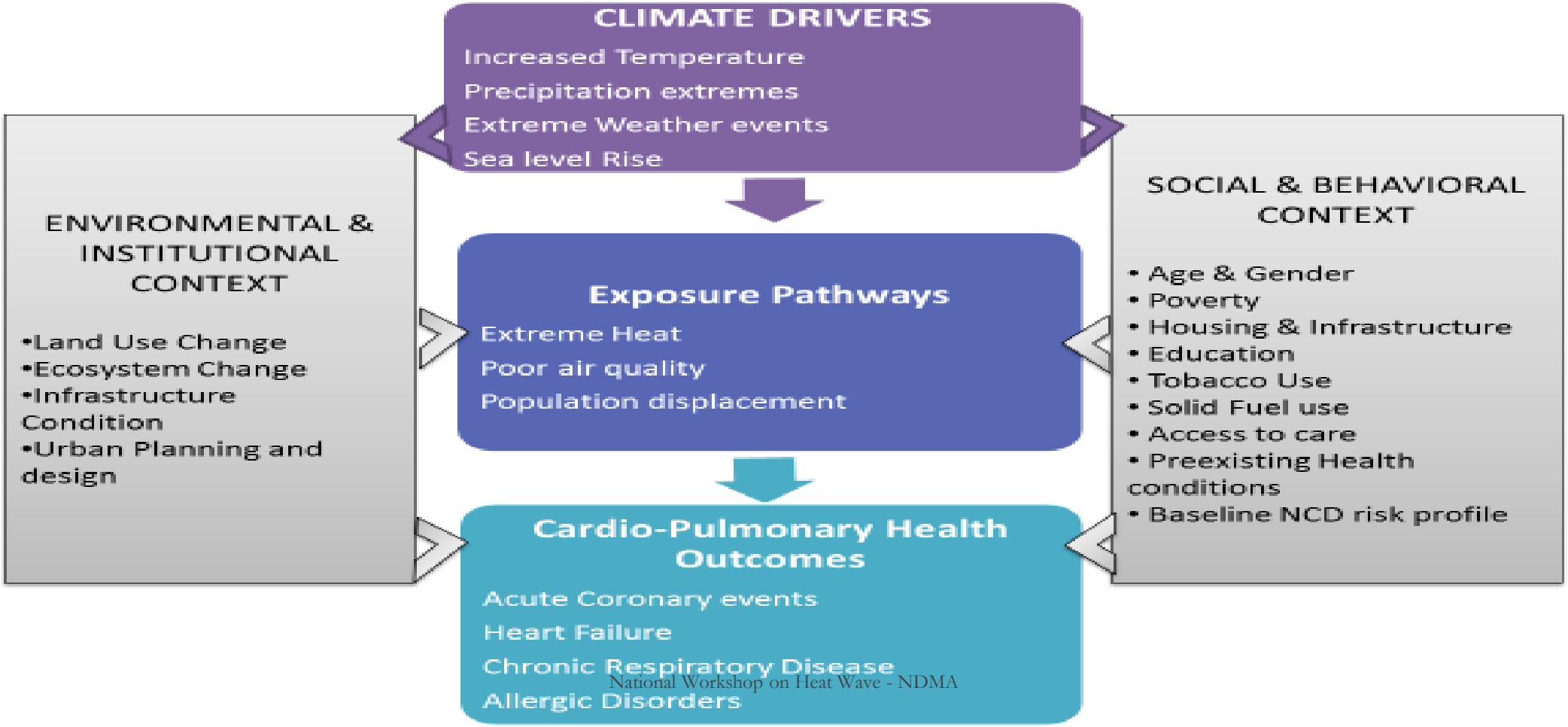
Influences on pathogen maturation and multiplication, on vector organism density and behaviour (such as the mosquito)



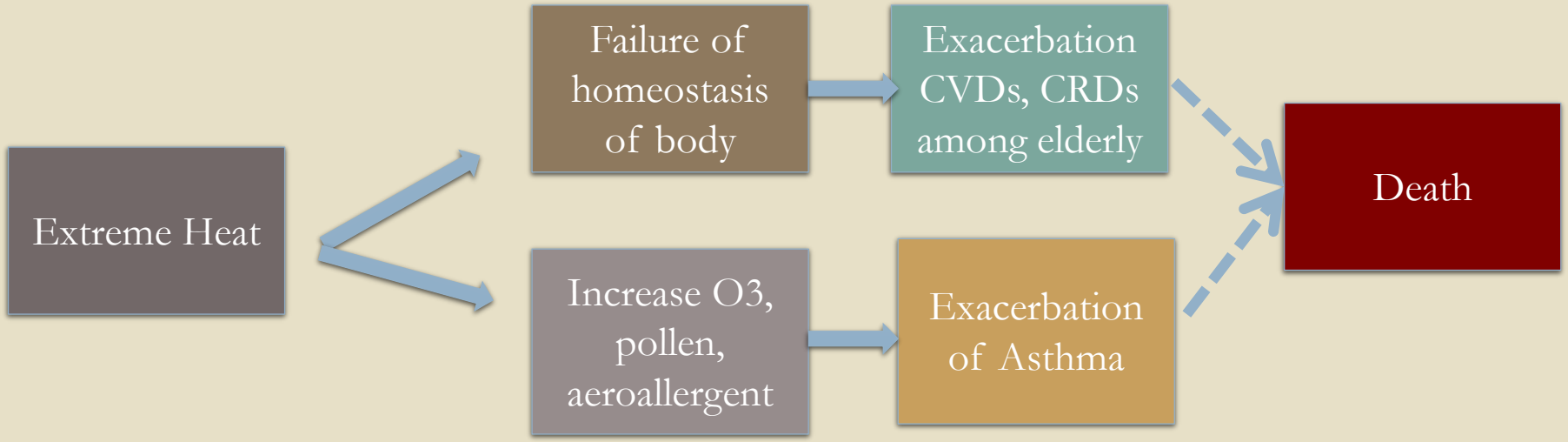
Increase in Ambient temperature
Extreme heat - heat waves
Erratic rainfall –
Contamination of drinking water sources

Human Behaviour – Crowding displacement, migration
Human nutrition - Undernutrition

Possible pathways of linkages of Climate change and Cardiopulmonary diseases



Possible pathways of linkages of heat wave and Cardiopulmonary diseases



Vulnerabilities for Heat wave impact

Social

Economical

Geographical

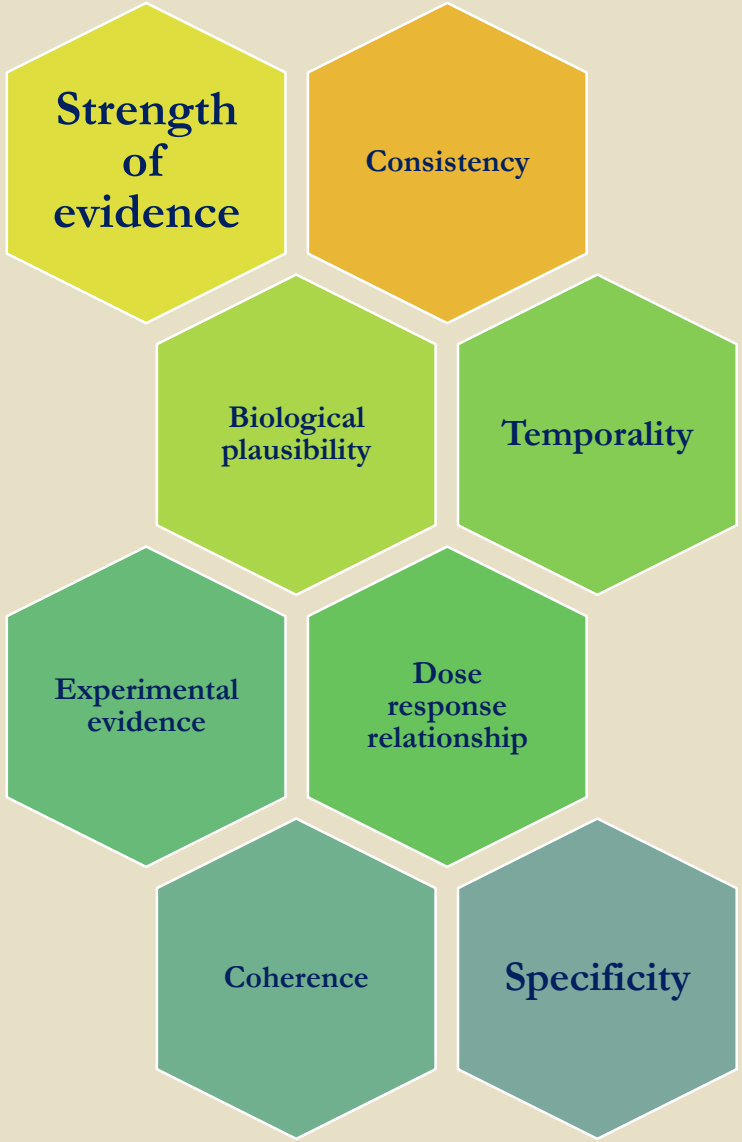
Political

Biological

GLOBAL EVIDENCE : IMPACT OF HEATWAVE ON HEALTH

Bradford Hill's Criteria for Causation

Complexity of interaction of environmental risk and health outcomes make generating evidence very challenging



Heat waves and all cause mortality

- 6.5% increase in New York during heat wave[1]
  - Higher among age 15 – 64 years by 37% in Australia[2]
- 2.8% increase for each 0.56°C increase in heat wave intensity[1]
- 4.2% increase for each extra day a heat wave lasted[1]
- Higher in mediterian region[3]
- Higher among[4]
  - Confined to bed (5.5 times)
  - Lived alone (2.3 times),
  - Lived on the top floor of a building (4.7 times)

1. ***Anderson B et al, 2011, 2. Nitshcke Monica et al, 2011***
2. ***Baccini M et al, 2008***
3. ***Semenza Jan et al, 1996***

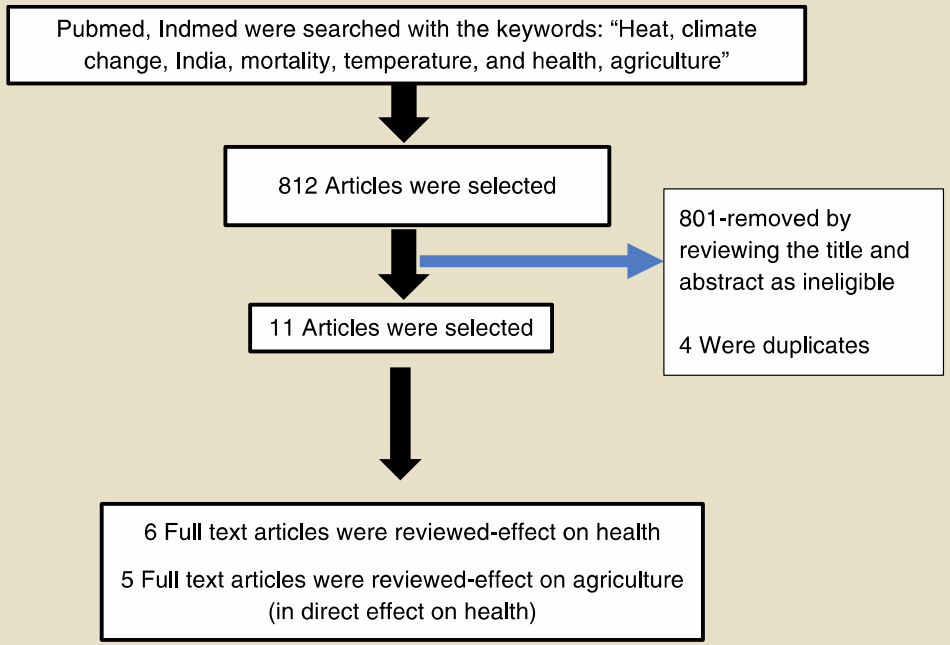
Heat waves and cause specific mortality

- Korea – Three times increase Cerebro-vascular disease related mortality[1]
- China - Increase mortality due to cardio-vascular (1.01 times) and respiratory (1.14 times)[2]

1. Lima et al, 2012
2. Liqun Liu et al, 2011

INDIAN EVIDENCE : IMPACT OF HEATWAVE ON HEALTH

Heatwave and mortality



Box 1: Definition of heat wave in India (15).

Heat wave:

A heat wave is if the maximum temperature of a station reached at least 40°C or more for plains, 37°C or more for coastal stations and at least 30°C or more for hilly regions. The following criteria is used to declare a heat wave:

1. Based on departure from the normal

– Heat wave: departure from normal is 4.5°C–6.4°C

– Severe heat wave: departure from normal is >6.4°C

2. Based on actual maximum temperature (for plains only)

– Heat wave: when actual maximum temperature ≥45°C

– Severe heat wave: when actual maximum temperature ≥47°C

(To declare a heat wave the above readings must be recorded in two meteorological stations on 2 consecutive days)

Source: Salve HR* Parthasarathy R, Krishnan A, Pattanaik DR Impact of ambient air temperature on human health in India Rev Environ Health 2018; 1- 4

Heatwave and Morbidity in India

DE GRUYTER Rev Environ Health 2018; aop

Mini Review

Harshal R. Salve*, Raghavan Parthasarathy, Anand Krishnan and D.R. Pattanaik

Impact of ambient air temperature on human health in India

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Abstract: A systematic search was carried out in the databases of Pubmed, Indmed and Mausam for articles on the effect of ambient temperature on health. Relevant data were extracted using a standard data abstraction form by two authors independently. The overall effects of ambient air temperature are reported as odds ratio (OR) and 95% confidence intervals (CIs) on mortality. Of 812 records identified, only seven were included in the final review as per pre-defined criteria. An increase in the all-cause mortality rate of 41% are reported during a heat wave in India. Risk ratios for all-cause mortality was in the range of 1.7–2.1. The dose-response relationship of ambient temperature and all-cause mortality and cardiovascular diseases are been reported. Current evidence on the effect of ambient temperature and health is sufficient to initiate an integrated response from policy makers, climate scientists and public health practitioners in India. Continued advocacy and generation of more robust evidence is needed.

Keywords: air pollution; climate change; epidemiology; heat; public health.

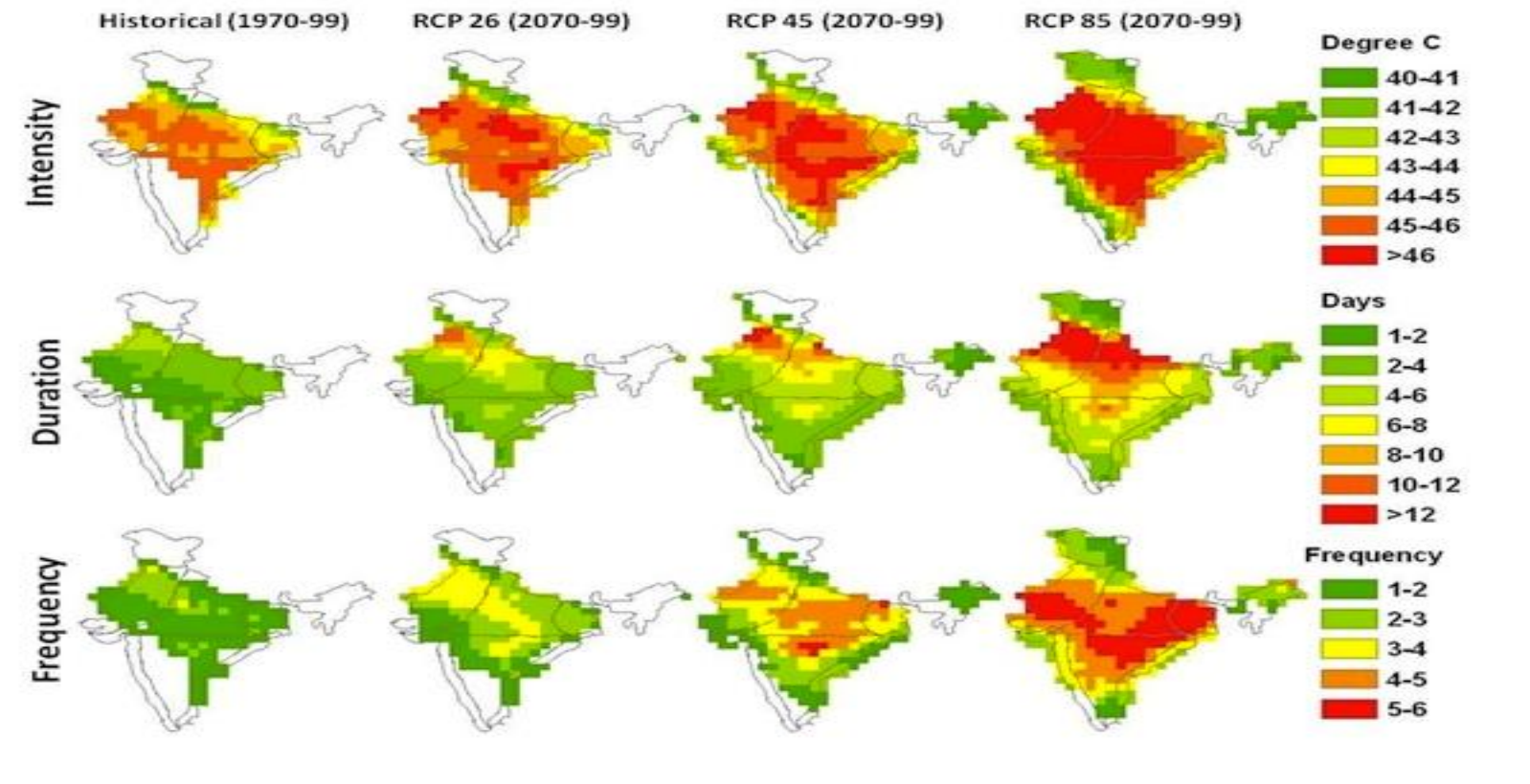
Introduction

resulting crop failure, tropical cyclones and flooding has been increasing in recent years, consistent with the climate change (2). The increasing trend in the occurrence of heat waves, an effect of climate change, is regarded to be among the inevitable natural disasters (3–5). These trends, which exhibit significant regional variability, are expected to continue in future as climate change becomes more pronounced (6). The latest assessment (AR5) by the Intergovernmental Panel on Climate Change finds that health risks related to temperature extremes are more likely to increase in the future (7). Climate models project that the frequency and intensity of heat waves are set to increase irrespective of emission scenarios up to the year 2040, globally (8).

As per the recent report of the Indian Meteorological Department (IMD) report on the annual climate summary in India (Figure 1), the annual mean land surface air temperature anomalies averaged throughout India was 0.59°C (9). The figure also shows that, the annual mean land surface air temperature anomaly average throughout the country as a whole in 2009 was 0.93°C and that was the warmest year in the past century. And another significant finding was that all the 7 warmest years in the country including 2009 occurred during the recent decade (2001–2009) making the decade the warmest in a century. A national assessment conducted by the Indian government on climate change projects increasing temperatures

Source: Salve HR* Parthasarathy R, Krishnan A, Pattanaik DR Impact of ambient air temperature on human health in India Rev Environ Health 2018; 1- 4

Estimation of heatwaves in India



Gulrez Azhar et al, Heat Wave Vulnerability Mapping for India Int J Environ Res Public Health; 2017

Heat vulnerable districts

HVI Category	Number (%) of Districts
Very high	**10 (1.56)**
High	**97 (15.16)**
High normal	213 (33.28)
Low normal	225 (35.16)
Low	75 (11.72)
Very low	20 (3.13)

Gulrez Azhar et al, Heat Wave Vulnerability Mapping for India Int J Environ Res Public Health; 2017

Heatwave and mortality

- Mortality increase by 11% when mean daily temperature crosses 40^{o} C[1]
- The maximum effect is on day 2 of maximum temperature[1]
- Mortality due to non-communicable diseases increases by 1.57 times during heatwave[2]
- Men suffers more (1.38 times) than female[3]

1 Desai V K et al, 2001-2012
2Ingole V et al(56), 2003-2012
3.Azhar et al(57), 2010

Ahmedabad Study

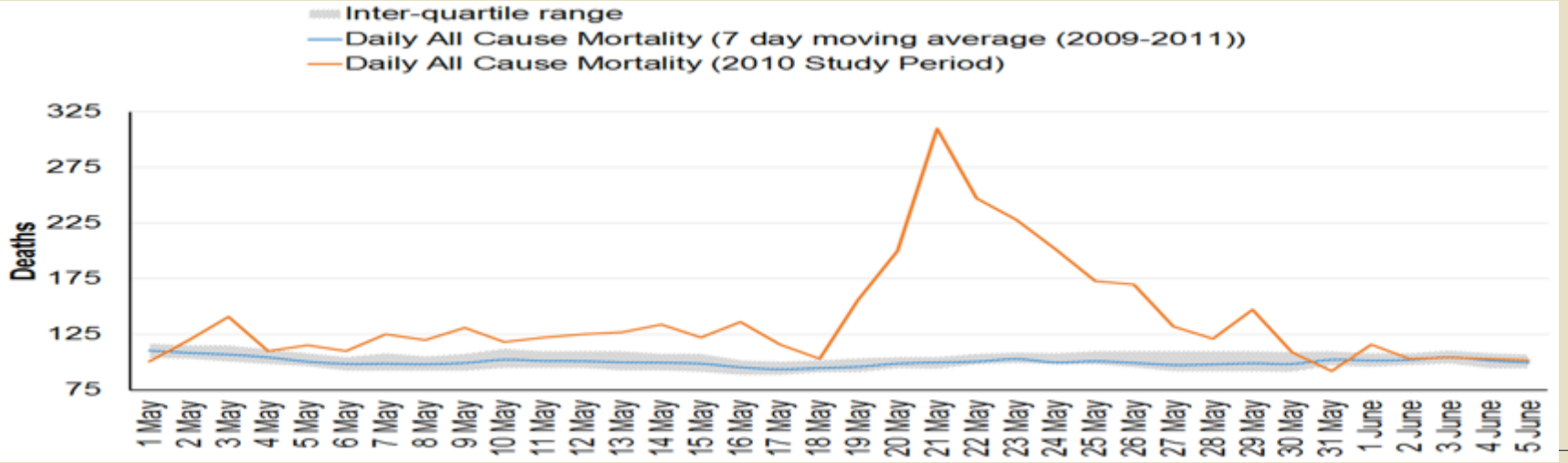
OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Heat-Related Mortality in India: Excess All-Cause Mortality Associated with the 2010 Ahmedabad Heat Wave

Gulrez Shah Azhar, Dileep Mavalankar, Amruta Nori-Sarma, Ajit Rajiva, Priya Dutta, Anjali Jaiswal, Perry Sheffield,

43.1% increase in all cause mortality during heat wave



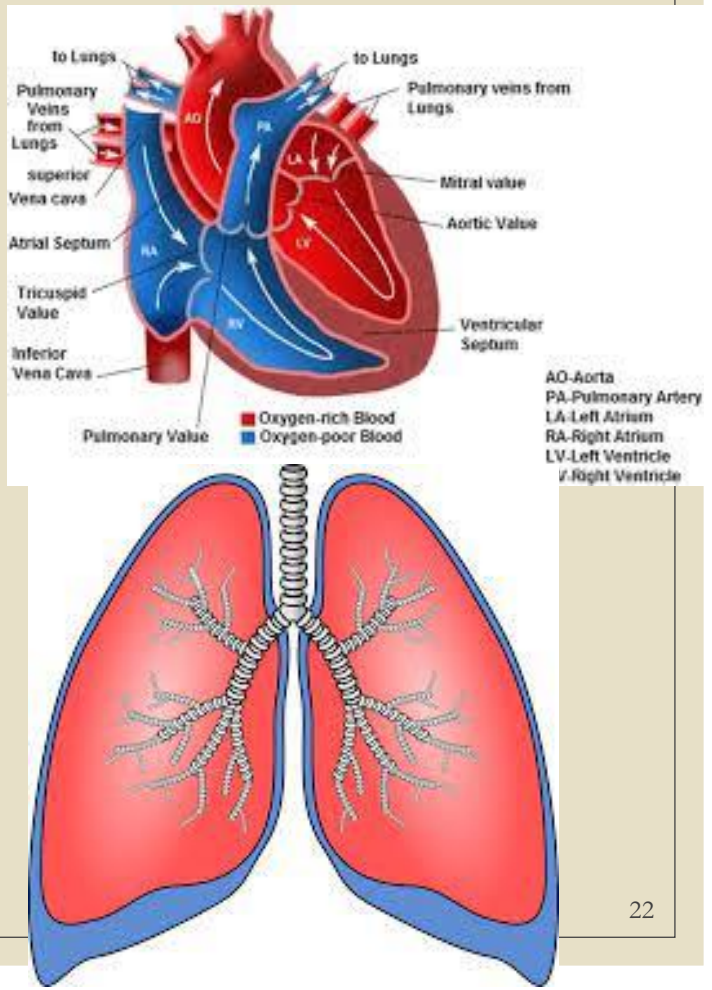
Ambient temperature and cause specific mortality

- **Deaths due to hot days -**
- **Acute myocardial infarction, stroke, acute renal failure, asthma and chronic ischemic heart disease)**
- **(RR = 1.57; CI: 1.18–2.10)**

Scarcity of studies on cause specific mortality

What are cardio-pulmonary diseases (CPDs)?

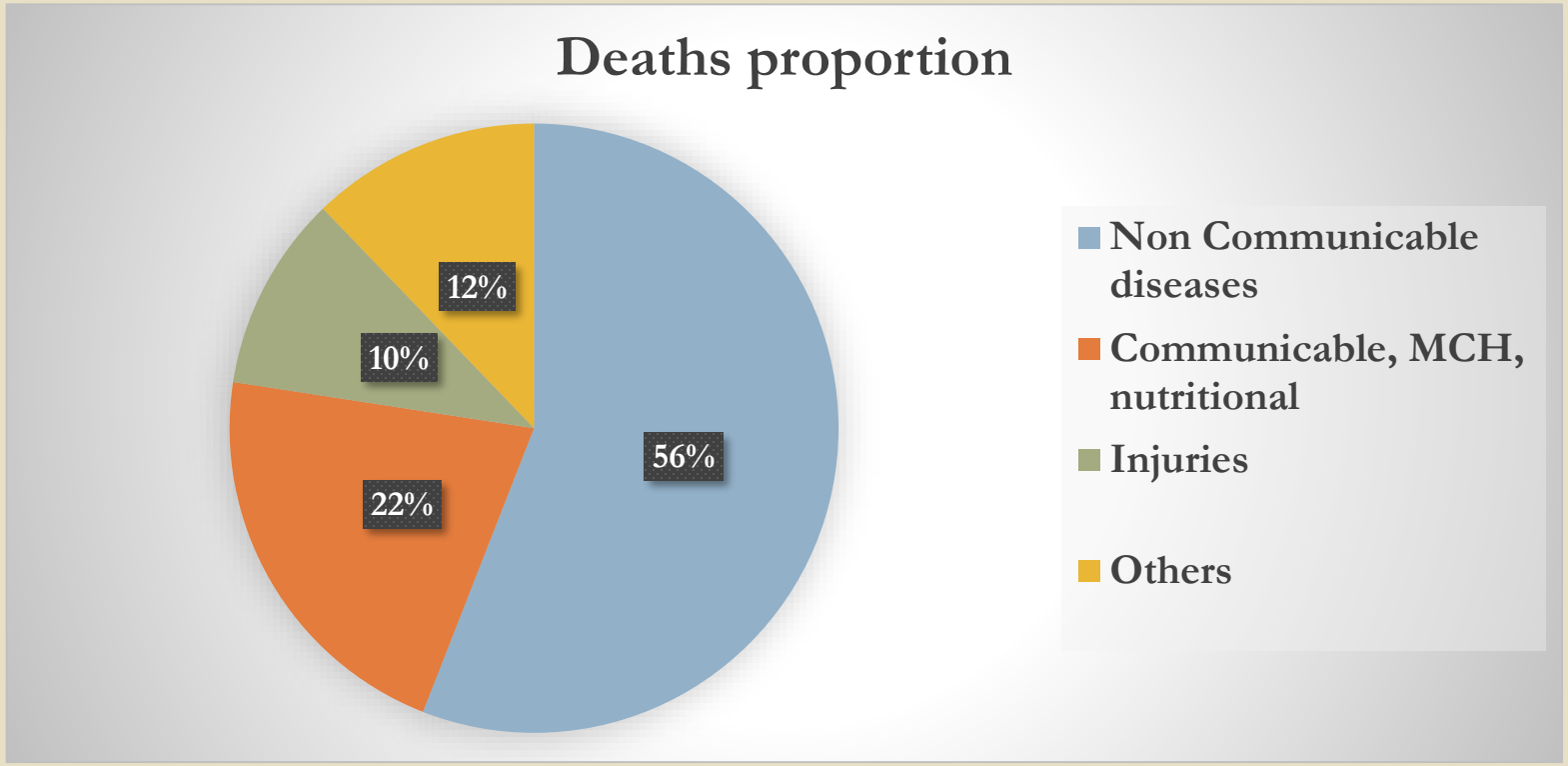
Cardiac diseases	Pulmonary diseases
Ischemic heart diseases (IHD) Valvular heart disease Pericardial diseases Hypertensive heart diseases Rheumatic heart disease Circulatory diseases	Chronic obstructive pulmonary diseases (COPD) Asthma Acute asthmatic attacks Allergy exacerbation Interstitial Lung diseases Lung Cancer



Burden of Cardio-pulmonary diseases - India

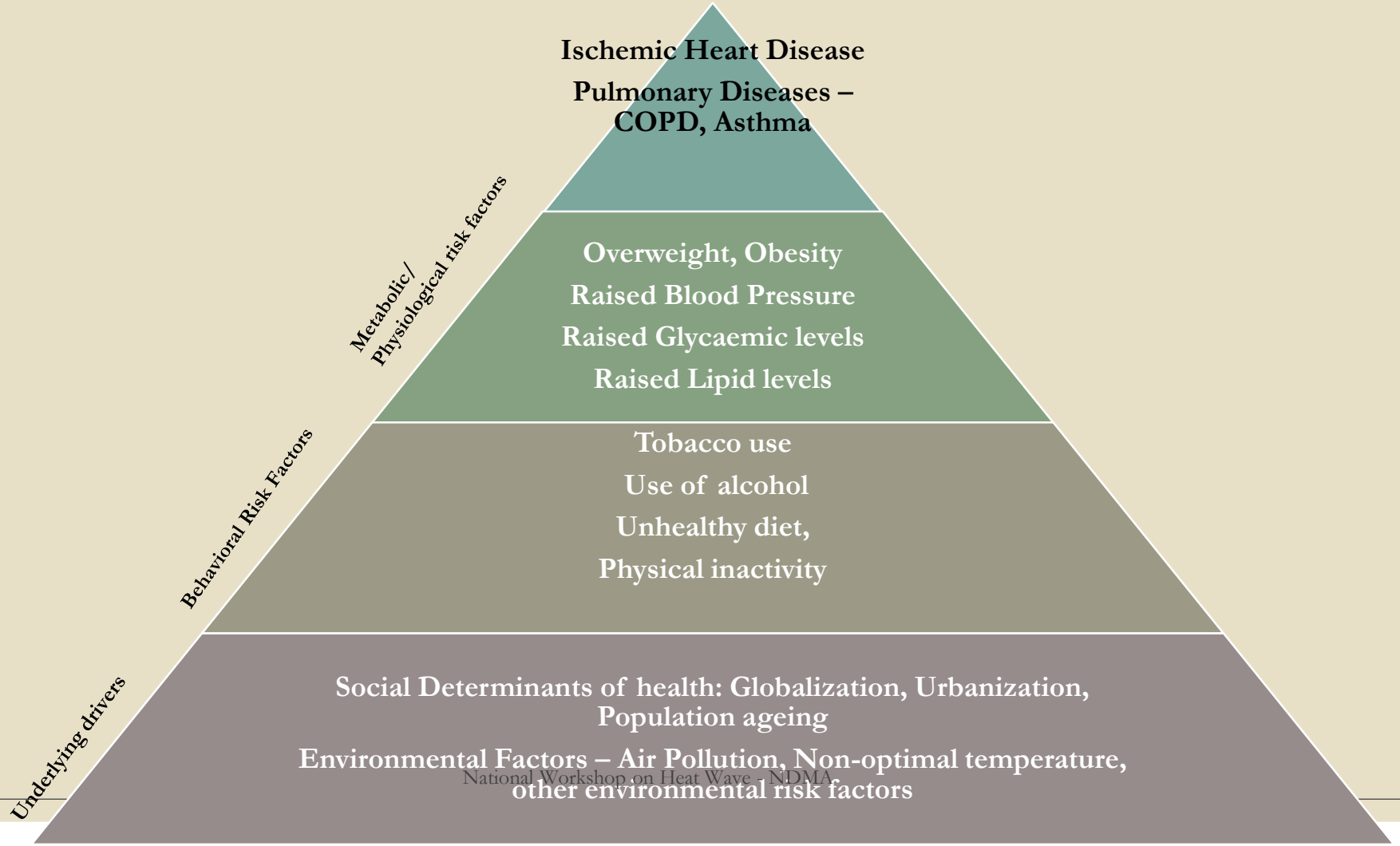
Causes of DALY Lost (1990)	Causes of DALY Lost (2016)
Diarrheal Diseases	Ischemic heart Diseases
Lower respiratory infection	COPD
Neonatal pre term	Diarrheal Diseases
Tuberculosis	Lower respiratory infection
Measles	Cerebro-vascular diseases

Burden of Cardio-pulmonary diseases - India

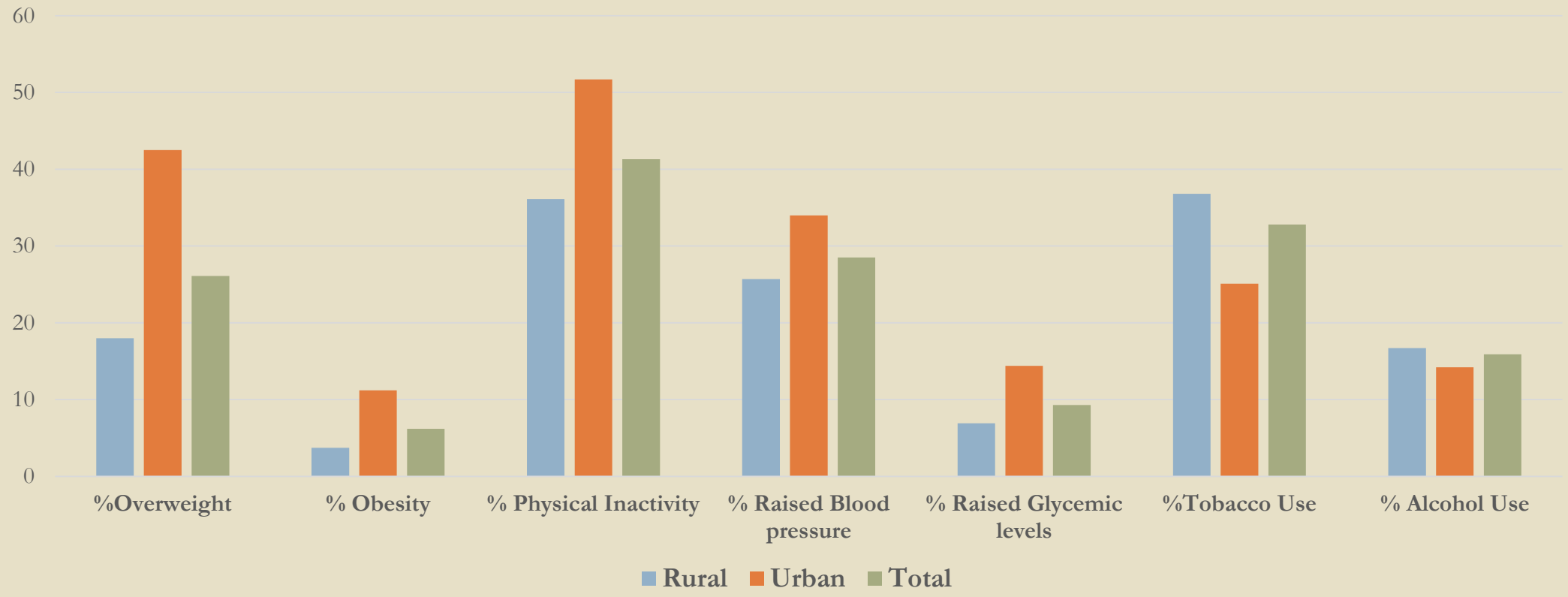


Major Non Communicable diseases – Heart disease, Diabetes, COPD, Asthma, Stroke, Cancer

Risk factors for Cardio-pulmonary diseases



Burden of CPD risk factors in India



Source: National NCD Monitoring Survey 2027-18

PREPAREDNESS MEASURES

Major domains for action

Guiding principles for preparedness

Multi-stakeholder engagement

Science based decision making

Communication

Working with national programmes

Community Participation

Advocacy and communication

Guiding principles	Specific actions	Important stakeholders	Assessment methods	Tools available
• Communication with specific messages to the right person • Multi-stakeholder engagement • Community participation	• Identification of stakeholders for advocacy and communication • Inclusion of agenda of climate change impact on CPD in state level meetings with political leadership and other policy makers • Inclusion of actions related to prevention of CPD in State and District level inter-Departmental co-ordination meeting and Program Implementation Plan • IEC/ awareness campaign for general population related to heat alerts, air pollution alerts • Inclusion of CPD related actions in State level Disaster management plan	• State level political leadership • Department of Health • Department of WCD • Department of PRI • Department of Water and Sanitation • Disaster management Authority • IMD	• Number of yearly meetings held • Number of IEC campaigned held	• IEC materials • Alerts generated by IMD • Early warning System

Situation assessment

Guiding principles	Specific actions	Important stakeholders	Assessment methods	Tools available

• Apply epidemiological principals
• Co-ordination with health Department
• Involvement of medical colleges
	• Mapping of human resource, material and financial resources
	• Assessment of health system
	• Burden assessment of cardiopulmonary diseases
	• Assessment of risk factors for CPD – tobacco consumption, dietary assessment, Indoor Air Pollution, Outdoor Air Pollution
	• Vulnerability assessment of population using -
	  ○ CPD risk factors
	  ○ Climatic conditions
	  ○ Demographic variables
		• State Program Officers of NPCDCS
		• NHM Officers
		• Medical colleges
		• IMD
		• Pollution Control Board
			• Annual Survey of risk factors assessment
			• Annual survey of health System Assessment
				• NFHS
				• SARA
				• Categorization of zones/ districts in the state as per vulnerability to climate change
				• (Annexure1)

Capacity Building and System Strengthening

Guiding principles	Specific actions	Important stakeholders	Assessment methods	Tools available
• Trained manpower is key to climate actions • Developing climate resilient health system	• Mapping of all manpower to be trained • Developing training manual • Developing standard algorithms for management of CPD • Ensuring availability of essential medicines at all levels of health systems • Health system preparedness for extreme weather events/ natural calamity	• State Program Officers of NPCDCS • NHM Officers • Medical colleges • District program managers	• Assessment of training sessions • Health system assessment survey	• Guidelines for management of CPD under NPCDCS • Essential drug and equipment lists at all levels of health care (Annexure 2)

Monitoring, Surveillance and Research

Guiding principles	Specific actions	Important stakeholders	Assessment methods	Tools available
Monitoring is essential part of the any system	• Developing monitoring framework for implementation preventive and curative actions • Collaborating with IMD for integration of climate and health information e.g. SAFAR • Developing/ Strengthening surveillance mechanism with the help of medical institutes • Conducting operations /translational research for betterment of processes	• State Program Officers of NPCDCS • NHM Officers • Medical colleges • District program managers • IMD	Indicators for monitoring • Input • Process • Output	• Exiting monitoring mechanism of NPCDCS

Integration of CPD management during natural calamity

Guiding principles	Specific actions	Important stakeholders	Assessment methods	Tools available
• Preparedness is key • Community participation	• Developing SOPs for management of CPDs during emergency situation/ natural disasters (annexure 3) • Creation of emergency response team • Developing post emergency plan for ensuring service delivery for CPD	• State level health program officers • NDMA (State branch)	Annual assessment of health system for emergency response	• WHOs Package of Essential NCD interventions (WHO/PEN) • Guide for patients

Essential Medicines and technologies for Management of CPDs

Essential Medicines and Technologies list for management of cardio-pulmonary disorders at Primary Care level*

Medicines	Technologies
Thiazide diuretic	Thermometer
Calcium channel blocker (amlodipine)	Stethoscope
Beta-blocker	Blood pressure measurement device
Angiotensin converting enzyme inhibitor	Measurement tape
Statin	Weighing machine
Isosorbide dinitrate	Spacers for inhalers
Glyceryl trinitrate	Peak flow meter
Furosemide	Nebulizer
Salbutamol	Pulse oximeter
Amoxicillin	Blood cholesterol assay
Hydrocortisone (inj)	Lipid profile
Epinephrine	Serum creatinine assay
Heparin	Troponin test strips
Diazepam	Urine microalbuminuria test strips
Magnesium sulphate	Electrocardiograph
Promethazine	Defibrillator
Dextrose infusion	
Glucose injectable solution	
Prednisolone	
Beclomethasone (oral/inhaled)	
Aspirin	
Codeine	
Morphine	
Penicillin	
Erythromycin	
Sodium chloride infusion	
Oxygen	
Digoxin tablets/Inj	
Potassium chloride	
Antiarrhythmics	

SOPs for integration of CPD management heatwave response

SOPs for integration of CPD management during emergency response

Preparation phase

1.Identification of priority conditions for inclusion in emergency response.

2.Preparation of pre- emergency profile of CPD.

3.Assessment of Health Facility Preparedness.

4.Establishment of a health system co-ordination/contingency plan.

5.Ensuring Availability of Essential Medicines and Technologies.

6.Preparation of Individualized Emergency Plans.

SOPs for integration of CPD management during emergency response

Emergency Response Phase

1.Integrating CPDs in Initial Rapid Assessment.

2.Map CPD service provision.

3.Organize CPD services delivery with a focus on primary health care.

SOPs for integration of CPD management during emergency response

Post-emergency phase or in slow-onset emergencies

1.Debrief on lessons learnt from the crises.

2.Strengthen health system response.

3.Strengthen public health response to CPDs.

4.Monitoring and evaluation of Emergency Response to CPDs.

Situation analysis – Heat - wave related Vulnerability mapping

- **State/districts can be mapped into three area on the basis of vulnerability to development of CPD**

Indicator	High	Moderate	Low
Geographical location	Desert, Coastal region, major urban	Heavy rainfall or drought prone	Plain
Tobacco use (adults)	> 35 %	25 – 10 %	< 10 %
Health system	Good	Fair	Poor
Obesity prevalence	> 10	10 – 5	< 5
Heat waves episodes in preceding years	> 2	1	zero

Focus on IEC - What can be done to reduce impact of CC on health?

Focus on IEC - What can be done to reduce impact of CC on health?

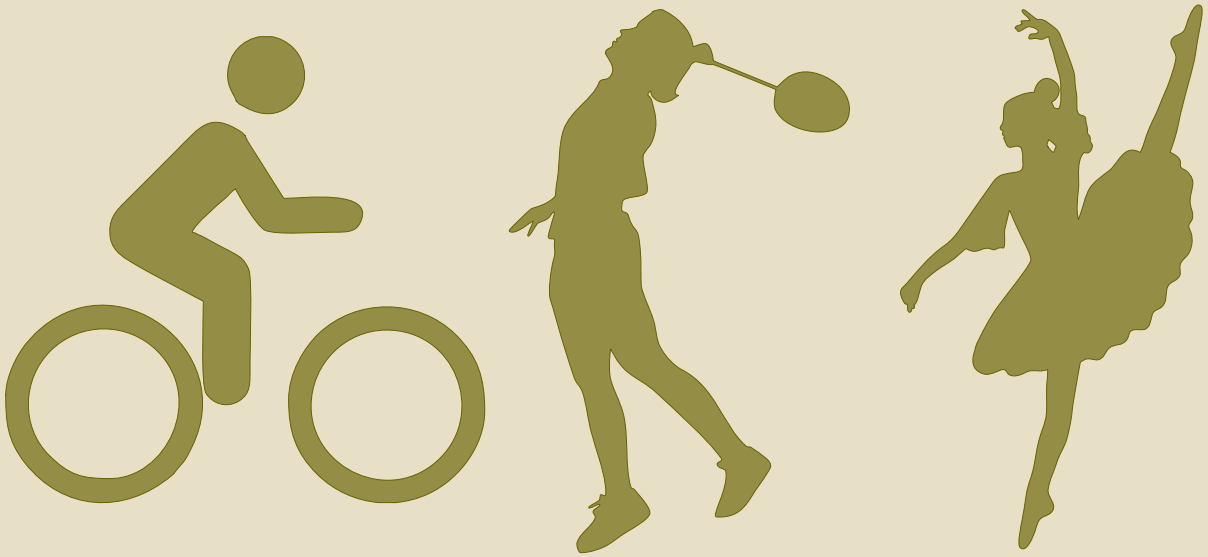
Use energy efficient appliances

Reduce, Reuse, Recycle

Plant trees

Avoid driving. Carpool, walk,cycle or use public transport

Focus on IEC - Measures for Prevention of CPDs



Promotion of Physical activity in day to day life
Reduce sedentary time

Balance nutrition in day to day life

Focus on IEC - Measures for Prevention of CPDs

Stop tobacco and alcohol use

Regular BP and blood sugar measurement

Focusing on community based good practices

Take home messages

- **Generating scientific evidences is crucial for policy making**
- **Data sharing with transparent mechanism is needed**
- **Prioritization based on vulnerability assessment - Geographical, social, economical**
- **Multistakeholder engagement is challenging for execution**
- **Compilation of good practices and dissemination**

Together wE Achieve More

THANK YOU

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