دانشگاه علوم پزشکی تهران
دانشکده بهداشت
دپارتمان سلامت در حوادث و بلایا

Review of hospital action against climate change (Global Warming)

By:
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Outline

دانشگاه علوم پزشکی تهران
دانشکده بهداشت
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1. Backgrounds Information
2. Development & Concepts of Adaptive Hospitals
3. Systematic Literature Review
4. Discussion & Conclusion

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Introduction

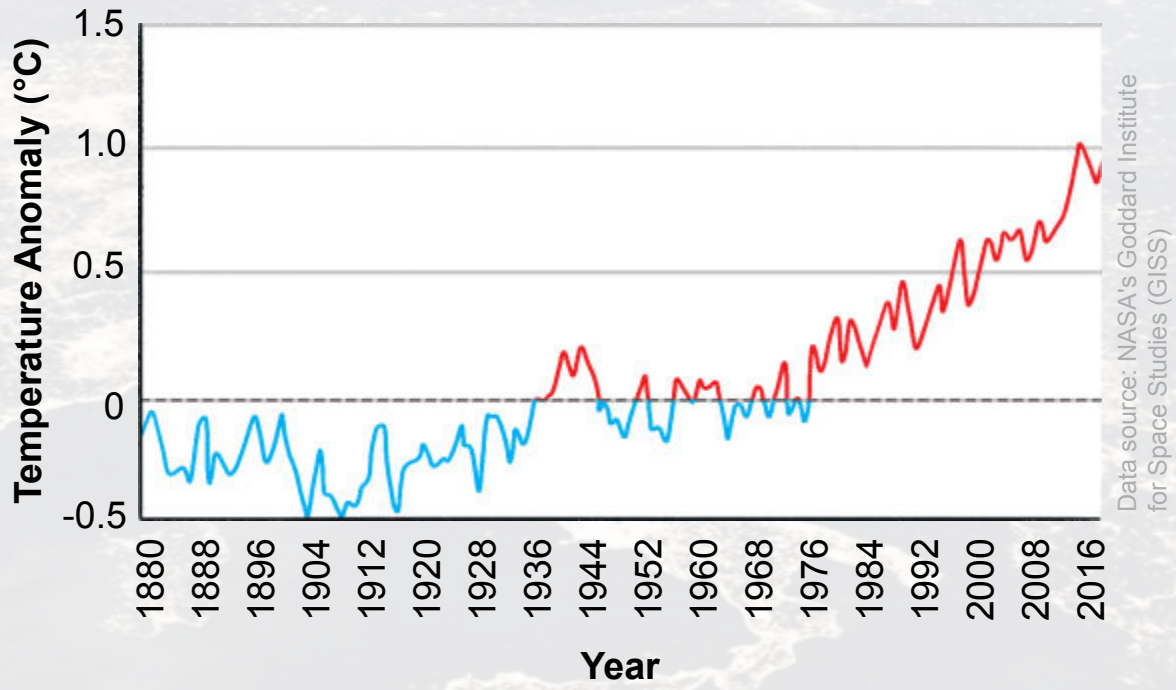
What Is Climate Change?

The United Nations Framework Convention on Climate Change (UNFCCC): Climate change means a change that is directly or indirectly attributed to human activities, that changes the composition of the world's atmosphere and, in addition, natural climate variability that Observed over comparable time periods.

Since 1880, scientists have kept thermometer-based records of the global surface temperature.

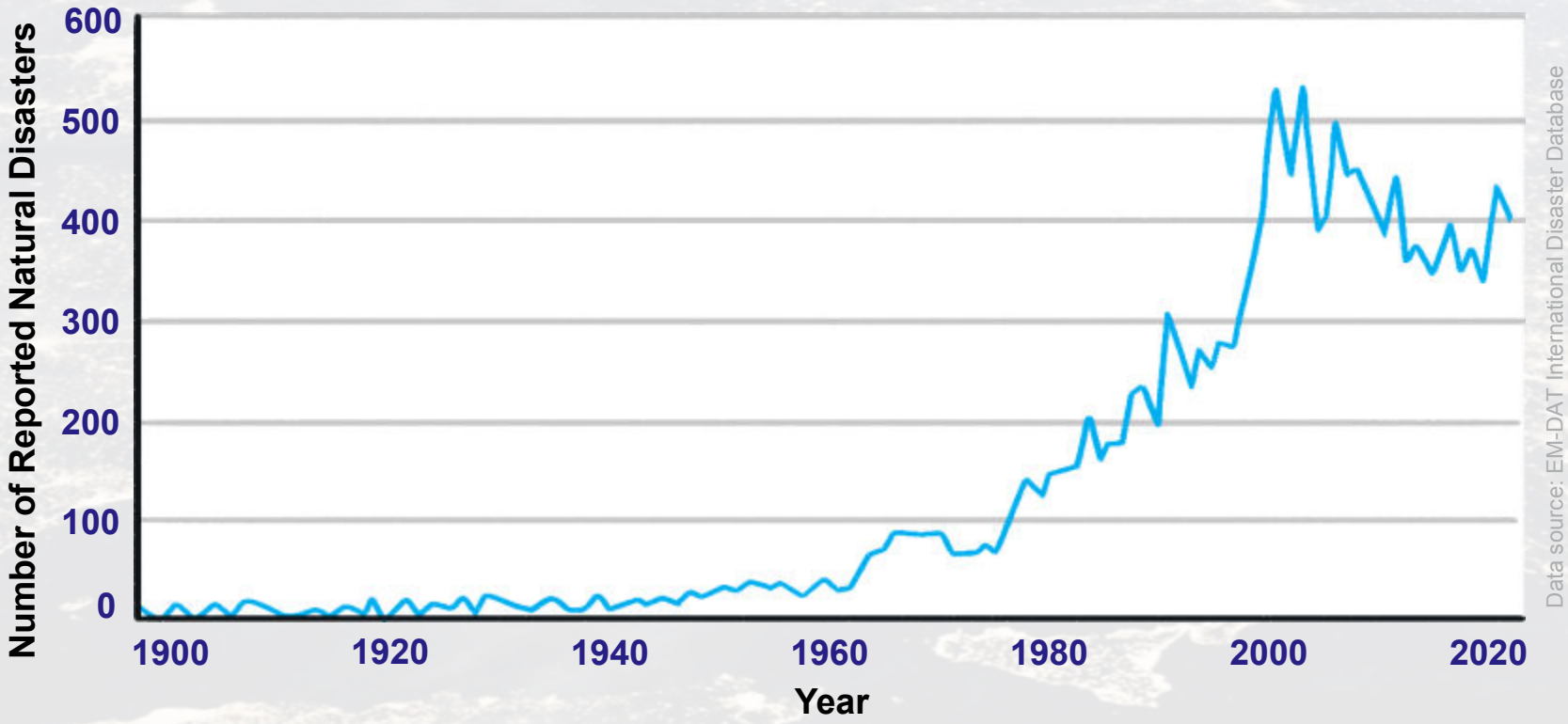
What is happening to the global temperature?

The planet is becoming warmer; the climate is changing.



Why Is Climate Change a Problem?

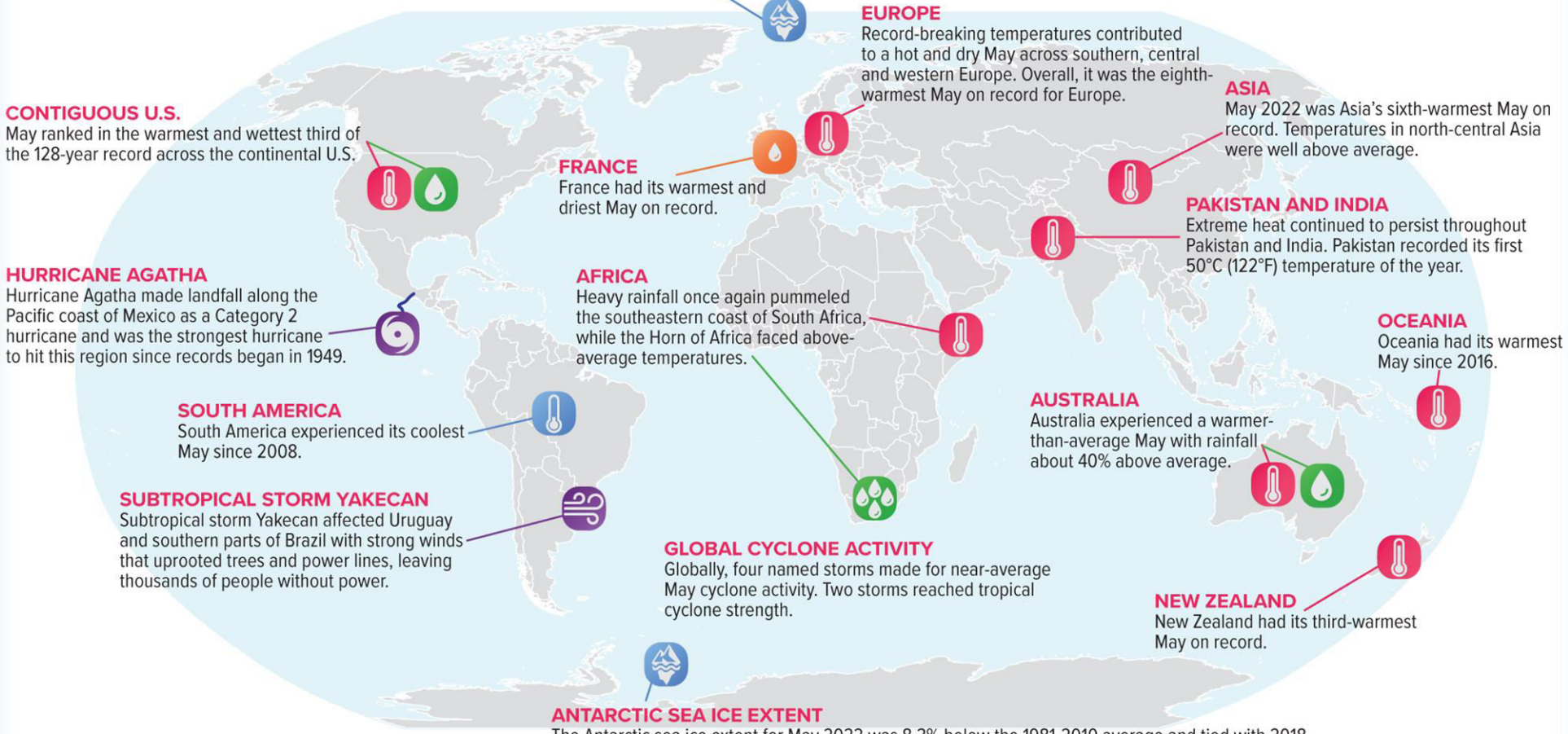
Climate change disrupts weather patterns and causes extreme weather events to become more common. These include hurricane activity, droughts and floods. As the global temperature has increased, so has the number of reported natural disasters.



Selected Significant Climate Anomalies and Events: May 2022

GLOBAL AVERAGE TEMPERATURE

May 2022 average global surface temperature was the ninth highest for May since global records began in 1880.



ARCTIC SEA ICE EXTENT

The May 2022 Arctic sea ice extent was 3.1% below the 1981-2010 average and the 14th-smallest May sea ice extent on record.

EUROPE

Record-breaking temperatures contributed to a hot and dry May across southern, central and western Europe. Overall, it was the eighth-warmest May on record for Europe.

CONTIGUOUS U.S.

May ranked in the warmest and wettest third of the 128-year record across the continental U.S.

FRANCE

France had its warmest and driest May on record.

ASIA

May 2022 was Asia's sixth-warmest May on record. Temperatures in north-central Asia were well above average.

PAKISTAN AND INDIA

Extreme heat continued to persist throughout Pakistan and India. Pakistan recorded its first 50°C (122°F) temperature of the year.

HURRICANE AGATHA

Hurricane Agatha made landfall along the Pacific coast of Mexico as a Category 2 hurricane and was the strongest hurricane to hit this region since records began in 1949.

AFRICA

Heavy rainfall once again pummeled the southeastern coast of South Africa, while the Horn of Africa faced above-average temperatures.

OCEANIA

Oceania had its warmest May since 2016.

SOUTH AMERICA

South America experienced its coolest May since 2008.

AUSTRALIA

Australia experienced a warmer-than-average May with rainfall about 40% above average.

SUBTROPICAL STORM YAKECAN

Subtropical storm Yakecan affected Uruguay and southern parts of Brazil with strong winds that uprooted trees and power lines, leaving thousands of people without power.

GLOBAL CYCLONE ACTIVITY

Globally, four named storms made for near-average May cyclone activity. Two storms reached tropical cyclone strength.

NEW ZEALAND

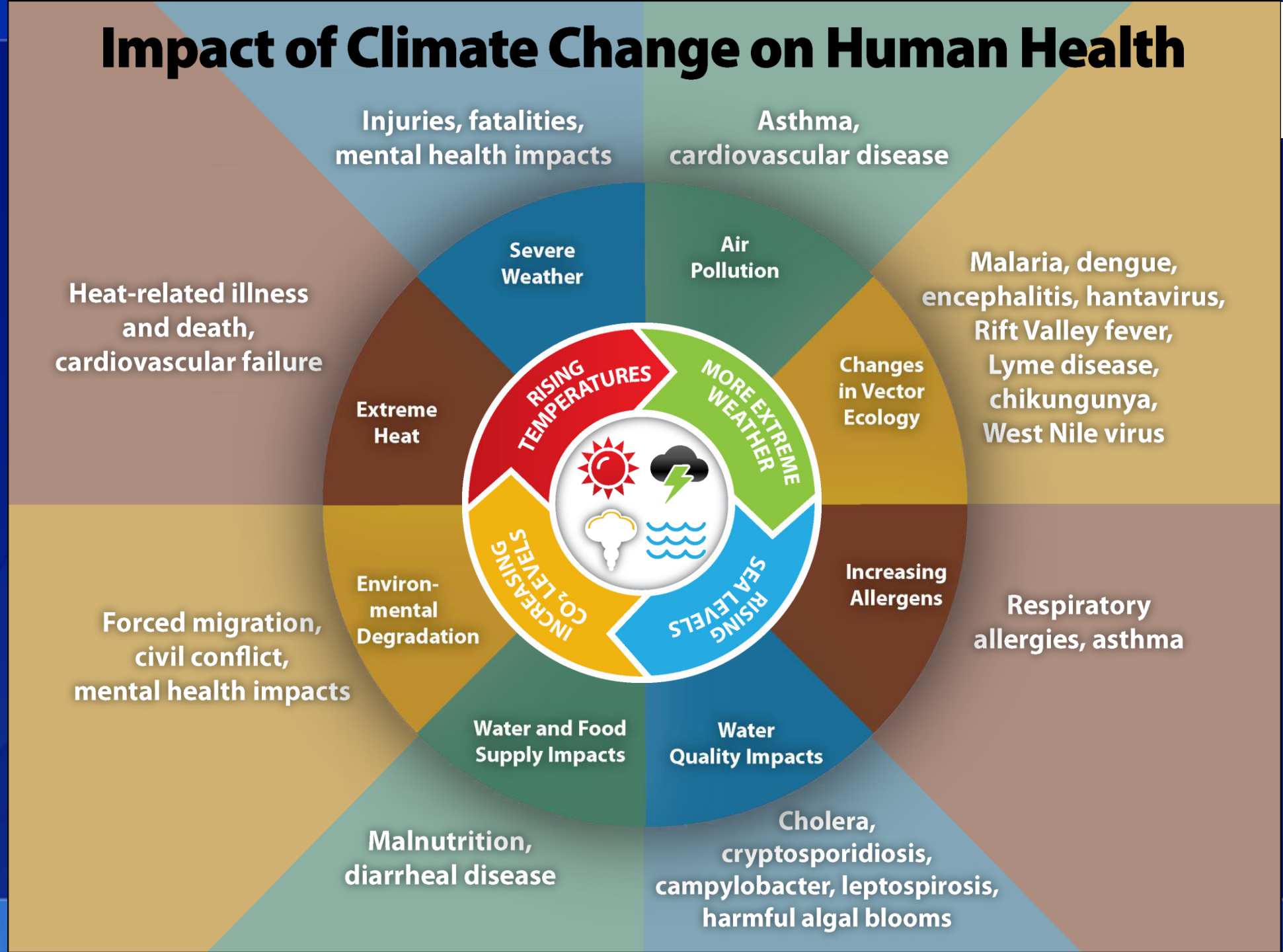
New Zealand had its third-warmest May on record.

ANTARCTIC SEA ICE EXTENT

The Antarctic sea ice extent for May 2022 was 8.3% below the 1981-2010 average and tied with 2018 for the fifth-smallest May extent on record.

Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: http://www.ncdc.noaa.gov/sotc

Impact of Climate Change on Human Health



Introduction

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Summary for Policymakers of IPCC Special Report on Global Warming

- The Intergovernmental Panel on Climate Change (IPCC) report warned that the world is set to reach the 1.5℃ level within the next two decades and said that only the most drastic cuts in carbon emissions from now would help prevent an environmental disaster.

- There is a 93% likelihood of at least one year between 2022-2026 becoming the warmest on record and dislodging 2016 from the top ranking.

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Report of the Global Climate Action Summit (GCAS)

- By 2030, More than 6,000 cities, states and regions, and 2,000 companies, have made quantifiable commitments to reducing emissions to achieve the Paris Agreement.

- The report covers Brazil, China, India, Indonesia, Japan, Mexico, the Russian Federation, South Africa, the US and the EU, which collectively were responsible for 68% of global emissions.

Ref: Kuramochi T , Lui S , Höhne N , et al . *Global climate action from cities, regions and businesses: impact of individual actors and cooperative initiatives on global and national emissions. 2019 edition. NewClimate Institute, data-driven lab, PBL, German development Institute/Deutsches Institut für Entwicklungspolitik (die), Blavatnik school of government, University of Oxford, 2019. Available:* https://newclimate.org/2019/09/18/global-climate-action-from-cities-regions-and-businesses-2019

Introduction

- Healthcare is among the 'heavy-emitting' sectors.
- The global healthcare sector had a climate footprint of equivalent to 4.4% of global net emissions.
- If the health sector were a country, it would be the fifth-largest emitter on the planet.
- Australian healthcare sector accounts for 7% of total national emissions and 10% of the United States national CO2e emissions. Data was not available for many low- and middle-income countries.
- Due to their unique activities, more stringent code requirements, and 24/7 operations, hospitals are highly energy-intensive, using 2.5 times more energy per square foot than an office building

Ref:

- Dhillon VS , Kaur D , Hospital G . And climate change: their interrelationship and the way forward. J Clin Diagn Res JCDR 2015;9:LE01–5.
- Gerwig K. Greening Health Care: How Hospitals Can Heal the Planet. Oxford University Press, 2014.
- Williams A , MacNaughton P , et al . Building evidence for health: green buildings, current science, and future challenges. Annu Rev Public Health.

The environmental footprint of health care: a global assessment

Manfred Lenzen, Arunima Malik, Mengyu Li, Jacob Fry, Helga Weisz, Peter-Paul Pichler, Leonardo Suveges Moreira Chaves, Anthony Capon, David Pencheon

Summary

Background Health-care services are necessary for sustaining and improving human wellbeing, yet they have an environmental footprint that contributes to environment-related threats to human health. Previous studies have quantified the carbon emissions resulting from health care at a global level. We aimed to provide a global assessment of the wide-ranging environmental impacts of this sector.

Methods In this multiregional input-output analysis, we evaluated the contribution of health-care sectors in driving environmental damage that in turn puts human health at risk. Using a global supply-chain database containing detailed information on health-care sectors, we quantified the direct and indirect supply-chain environmental damage driven by the demand for health care. We focused on seven environmental stressors with known adverse feedback cycles: greenhouse gas emissions, particulate matter, air pollutants (nitrogen oxides and sulphur dioxide), malaria risk, reactive nitrogen in water, and scarce water use.

Findings Health care causes global environmental impacts that, depending on which indicator is considered, range between 1% and 5% of total global impacts, and are more than 5% for some national impacts.

Interpretation Enhancing health-care expenditure to mitigate negative health effects of environmental damage is often promoted by health-care practitioners. However, global supply chains that feed into the enhanced activity of health-care sectors in turn initiate adverse feedback cycles by increasing the environmental impact of health care, thus counteracting the mission of health care.

Funding Australian Research Council, National eResearch Collaboration Tools and Resources project.

Lancet Planet Health 2020; 4: e271–79

Integrated Sustainability Analysis, School of Physics (Prof M Lenzen PhD, A Malik PhD, M Li PhD, J Fry PhD, L S M Chaves PhD), Discipline of Accounting, Sydney Business School (A Malik) and School of Public Health (Prof A Capon PhD), University of Sydney, Sydney, NSW, Australia; Research Institute for Humanity and Nature, Kyoto, Japan (J Fry); Social Metabolism and Impacts, Potsdam Institute for Climate Impact Research, Member of the Leibniz Association, Potsdam, Germany (Prof H Weisz PhD, P-P Pichler PhD); Department of Cultural History & Theory and Department of Social Sciences, Humboldt University Berlin, Berlin, Germany (Prof H Weisz); Departamento de

Findings suggest that the environmental impact of health care is not confined to greenhouse gas emissions as previously studied. particulate matter, nitrogen oxides and Sulphur dioxide emissions, malaria risk, nitrogen to water and scarce water use.

Introduction

- Hospitals play a critical role in reducing health impacts of climate change by :

(1) treating illnesses and injuries,

(2) being prepared for climate-induced disasters,

(3) effectively engage the community on adaptation activities ,and

(4) stepping up to minimize healthcare carbon emissions.

Ref:

- Louis VR , Phalkey RK. *Health impacts in a changing climate – an overview. Eur Phys J Spec Top 2016;225:429–41.*doi:10.1140/epjst/e2016-60073-9
- Karliner J , Slotterback S , Boyd R , et al . Health Care's Climate Footprint. Health Care Without Harm and ARUP 2019.

Introduction

- There are mitigation measures which hospitals can take to slow the warming trend.
- Low-carbon health services including hospital design which allow natural lighting, policies that prioritize renewable energy transition, rainwater harvesting, provision of facilities for cycling or walking and minimize healthcare waste management and refusing single-use plastics with green procurement policy.
- However, at this critical time, mitigating emissions is no longer optional; furthermore, specific adaptation actions such as preparedness for the impacts of climate change to lessen health burden are necessary to face climate–health threats.

- Ref: FitzGerald GJ , Capon A , Aitken P . Resilient health systems: preparing for climate disasters and other emergencies. Med J Aust 2019;210:304–5.doi:10.5694/mja2.50115

Introduction

Case Study 1: Low-Carbon Building—India

- Kohinoor hospital in mumbai is committed to reducing its environmental impact while reducing costs to patients.
- The hospital opened in 2009 and, relies on low-energy light bulbs, uses photovoltaic power to heat its water, harvests rain-water, and treats its own sewage to reduce water use.
- Kohinoor hospital also installed high-efficiency air-conditioning plant, resulting in decreasing energy use intensity of 166 kwh/m2 /year (53 kBtu/ ft2/year).

Case Study 2: Low-Carbon Building—Rwanda

- Butaro hospital reduces its energy consumption by using natural ventilation, along with high-volume, low-speed fans.
- local materials from the nearby Virunga mountains were also used to decrease carbon footprint and contribute to the local economy. the overall approach saving uS$2 million while producing over 4,000 jobs.

Introduction

Case Study 3: Energy Efficiency—South Africa

- Victoria hospital launched campaign “switch it off.” cleaners and housekeepers in this 180-bed secondary facility seek to ensure that unused lights and hospital equipment are switched off.
- This project resulted in saving of uS$8,400 annually and boosted the morale of the cleaners and housekeepers, making them feel more recognized within the hospital.

Case Study 4: Renewable Energy—Uganda

- Uganda health centers with solar PV for lighting improved their night services, and were better able to handle emergencies due to more reliable electricity.

Introduction

Case Study 5: Anesthetic Gas Waste—Brazil

- In 2012, Sao Paulo's albert Einstein hospital conducted a study that identified that N2o contributed to more than 50 percent of the emissions it was tracking. Research shows that these gases accumulate in the atmosphere and contribute to climate change.
- The hospital created an interdisciplinary team to increase awareness of the issue, and reduced its use of N2o for anesthetic procedures by 23 percent.

Introduction

Case Study 6: Low-Carbon Waste Management—Nepal

- Bir hospital in Kathmandu uses new methods to reduce waste further, including a biogas system that turns food waste into biogas is generating electricity for cooking in the hospital kitchen.

Introduction

Case Study 7: Low-Carbon Food—Taiwan

- Tzu chi hospital, Taiwan is a Buddhist hospital that provides vegetarian food only.
- The hospital's cafeteria is supplied by an organic farm within the compound which is also used as horticultural therapy for patients with mental health challenges.
- The hospital calculates during the period of 2010–2014 they saved over 2,000 tons of carbon emissions through serving over 2 million vegetarian meals in their cafeteria and food court.

Introduction

• Due to the environmental impact of the hospital's, a large number of tools to improve innovation and have green hospitals around the world, especially the United States, the United Kingdom, Australia have been designed.

Examples of relevant tools and guidelines

- The "Global Green and Healthy Hospitals (GGHH)" and "Healthy Hospitals, Healthy Planet, Healthy People" are two independent guidelines focusing on climate change, which have been published by the World Health Organization (WHO) and the Health Care Without Harm institute, respectively.

Introduction

Examples of relevant tools and guidelines

- The "Leadership in Energy and Environmental Design," or LEED program, has been introduced by The United States Green Building Council (USGBC) in order to decrease environmental consequences during constructing and to turn hospitals into sustainable structures.

Examples of relevant tools and guidelines

- Moreover, the Pan American Health Organization (PAHO) has developed the "Smart Hospital Toolkit" as a useful guideline for hospital to lowering carbon emissions.

Examples of relevant tools and guidelines

- The Green Building Council of Australia (GBCA) has published rating tools including "Green star Health Care" support sustainable construction for healthcare centers.

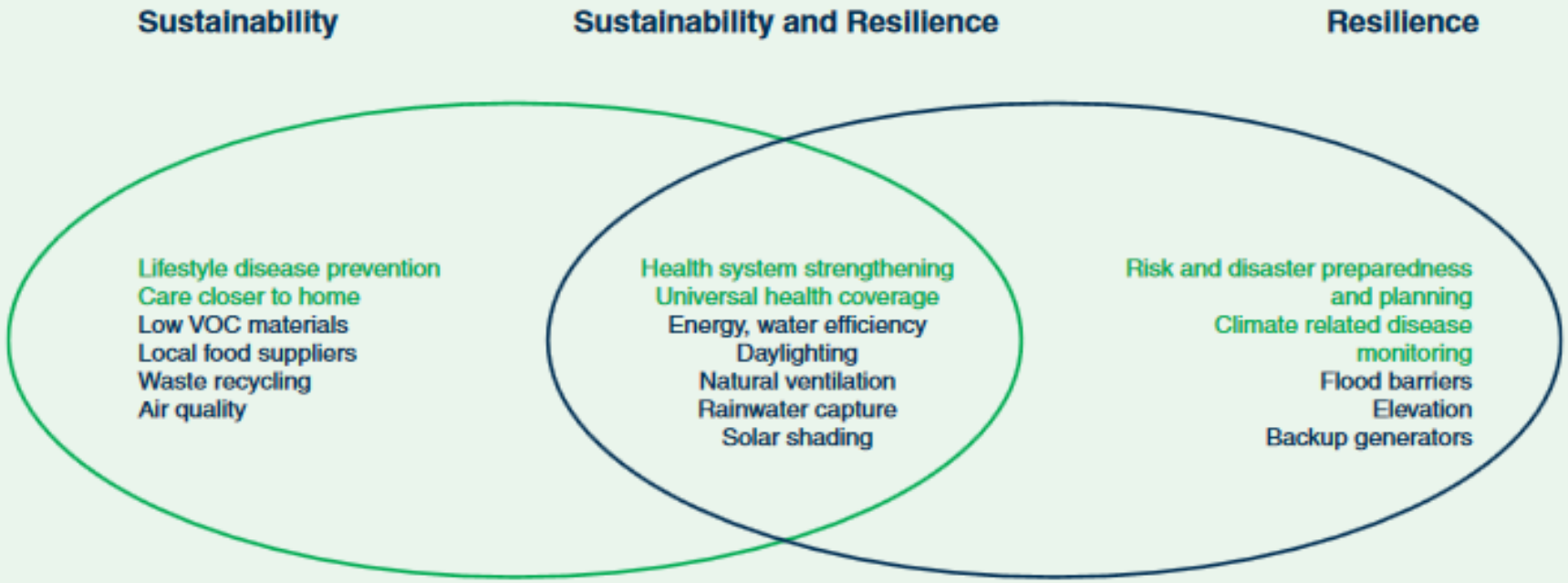
Examples of relevant tools and guidelines

- The Building Research Establishment's Environmental Assessment Method (BREEAM) has suggested strategies for hospitals in the UK to minimize the emission of greenhouse gases.

World Bank has provided a low-carbon solution in the health sector: "Climate-Smart Healthcare" .

Box 4: Climate-Smart Healthcare: The Intersection of Low-Carbon Healthcare and Resilience

The IPCC identified key risks from climate change that include flood impacts and landslides due to extreme precipitation, impacts on water availability, wildfire impacts, and heat-related mortality.[42] All significantly impact health in the communities where they occur. As first responders, hospitals and health centers need to be resilient to these impacts and remain operational during and immediately following these events to safely shelter patients in place and provide needed medical care to communities and responders.[43] As hospitals and health systems explore opportunities for low carbon healthcare, they are finding significant overlap between mitigation or "sustainability" measures and climate change resilience interventions. Accordingly, we propose a new term that captures both sides of climate-health impact and response equation: "climate-smart healthcare."



Source: Health Care Without Harm/World Bank.

Examples of relevant tools and guidelines

- In recent years, hospitals around the world have taken an approach to take actions that are safe not only for patients but also for their surrounding environment.
- Despite all the guidance provided, hospitals need more radical measures to confront climate change.
- The present study was conducted to examine the components affecting hospitals' measures to confront climate change and to provide strategies in this regard.

Springer Link

Review article | Published: 09 June 2022

Climate adaptive hospital: A systematic review of determinants and actions

Alireza Mashallahi, Ali Ardalan, Amir Nejati & Abbas Ostadtaghizadeh

Journal of Environmental Health Science and Engineering (2022) | Cite this article

23 Accesses | Metrics

Abstract

Introduction

Climate change is among the most renowned concerns of the current century, endangering the lives of millions of people worldwide. To comply with the United Nations Climate Change Conference (COP21), hospitals should be on track to reduce greenhouse gas emissions. Although hospitals contribute to climate change by emitting greenhouse gases, they are also affected by the health consequences of climate change. Despite all the guidance provided, hospitals need more radical measures to confront climate change. The current study was carried out to examine the components of hospitals' adaptation to climate change and to review measures to confront climate change in hospitals.

General Objectives:

- Determining strategies and programs for hospitals to deal with climate change (global warming)
- Determining the indicators, components of the hospitals measures to deal with climate change (global warming)
- Development of action framework for hospitals to deal with climate change (global warming)

I- Systematic Literature Review: Data Sources

- External databases:
  - PubMed
  - Web of Science
  - Scopus
  - EMBASE
- Internal databases:
  - Magiran
  - Iran-doc
  - SID

I- Systematic Literature Review: Search Strategy

(Adapt* OR Adopt* OR mitigat* OR Cop* OR resilien* OR accomudat* OR Adjust* OR Acclimat* OR Compatibl* OR "risk reduction" OR cease OR tackle OR address OR fight OR strateg* OR implementation OR action OR effort OR attempt OR policy OR framework OR plan OR approach OR response OR model)

AND (Climate change OR Global Warming)

AND (hospital* OR healthcar* OR "health care" OR (health AND care*) OR (Tertiary AND Care*)).

I- Systematic Literature Review: Eligibility Criteria (Included Studies)

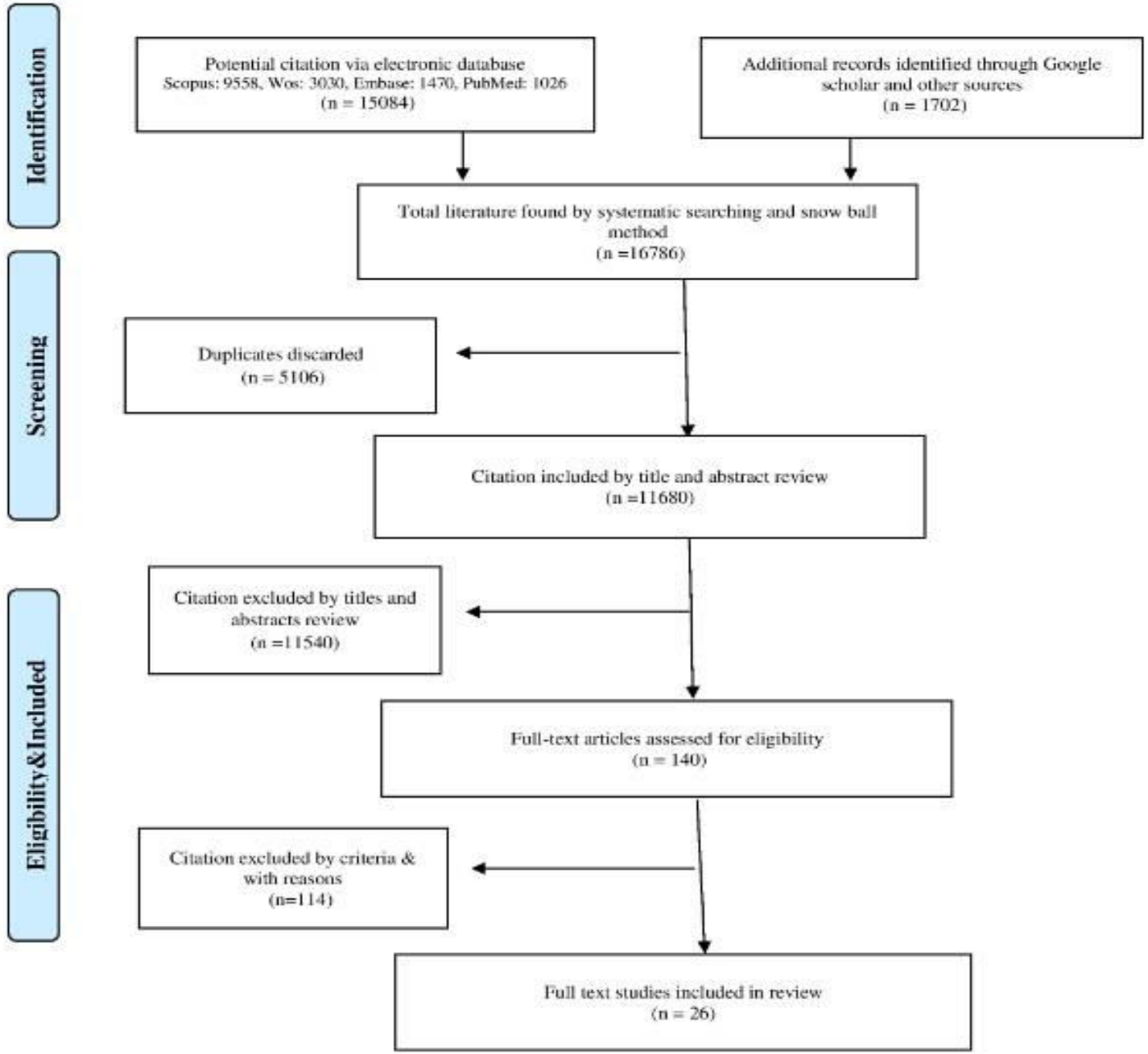
1. Papers published in scientific journals or books, Quidlines, instructions, and projects, gray literature related to the research question
2. It is possible to access the full text of the articles and be in Persian or English
3. The studies published until June1 2020, were included in the study.

I- Systematic Literature Review: Eligibility Criteria (Excluded Studies)

1. Studies irrelevant to the research topic (Studies related to other disasters, other than climate change (for example: earthquake).
2. Studies that were in any language rather than English or Persian

I- Systematic Literature Review: Data Extraction & Quality Assessment

1. Removal of duplicated papers using EndNote® software
2. Scanning the titles and abstracts of the remaining papers to identify relevant literature
3. Extracting data by two independent reviewers
4. Descriptive and Analytical assessment
5. Quality analysis



First author	year	Study location	Methodology	Type	Study objective	Quality appraisal
Bharara et al. [21]	(2018)	India	Cross-sectional study	Original article	To become a climate-friendly green hospital according to seven instructions from the WHO on the climate change issue	JBI = 6/8
Agar [22]	(2015)	Australia	Narrative literature review	Original article	To explore the existing scope of "Green" or eco-dialysis methods	JBI = 8/11
Tomson [23]	(2015)	UK	Narrative literature review	Original article	To reduce the carbon footprint of hospital-based care	JBI = 8/11
McGain and Naylor [24]	(2014)	Australia	Systematic review	Original article	To determine the amount of research done on hospital environmental sustainability as well as major concerns that arise for research, policy, and practice	JBI = 10/11
Charlesworth et al. [25]	(2018)	Australia	Expert opinion	Original article	To operationalize environmental sustainability Initiatives in health organizations	JBI = 5/6
Linstadt, et al. [26]	(2020)	USA	Narrative literature review	Original article	To encourage and educate emergency personnel to take action by offering a roadmap to a sustainable health system and a method for establishing a climate-smart emergency department	JBI = 9/11
Aslan and Yıldız [27]	(2019)	Turkey	case report	Original article	To establish how many green applications are implemented in hospitals in Konya, Turkey	JBI = 7/8
Pencheon [28]	(2015)	UK	case report	Original article	To making health care more sustainable	JBI = 5/8
Cook et al. [29]	(2019)	USA	Expert opinion	Original article	To do Climate Actions by nurses: Opportunities to lead national efforts	JBI = 5/6
Guetter et al. [30]	(2019)	Brazil	Narrative literature review	Original article	To decrease the waste of operating rooms and the effect of the approaches on the environment	JBI = 9/11
Jamieson and Wicks [31]	(2015)	Australia	Narrative literature review	Original article	To review environmental sustainability in healthcare systems and to highlight the demand for a policy framework for taking action	JBI = 8/11
Weisz et al. [32]	(2020)	Austria	Cross-sectional study	Original article	To calculate the carbon footprints of health care professionals from Austria and to decompose the emissions of hospitals to a greater extent	JBI = 7/8

Sahamir and Zakaria [33]	(2014)	Malaysia	Literature review	Original article	To analyze the criteria for green assessment for public hospitals in Malaysia	JBI = 9/11
Holmner et al. [34]	(2012)	Sweden	Narrative literature review	Original article	To review and discuss the literature regarding the possible role of health information technology, namely eHealth, in the adaptation and mitigation of climate change	JBI = 8/11
Kumari and Kumar [35]	(2020)	India	Narrative literature review	Original article	To detect the parameters influencing the design quality of green hospitals as well as their future designs	JBI = 9/11
Prada et al. [36]	(2020)	Romania	case report	Original article	To put an emphasis on greenhouse gas emission reduction by devising new strategies for dealing with global warming. The new proposed solutions are related to the energy efficiency of the hospitals in the Eastern part of Europe	JBI = 6/8
Danilov et al. [37]	(2020)	Russia	Literature review	Conference Paper	To concentrate on green healthcare system designs, deeply investigated	JBI = 8/11
Satoshi et al. [38]	(2010)	Japan	Cross-sectional study	Report	To Follow up on the voluntary action plan for global warming in hospitals	JBI = 5/8
Chapman and Chapman [39]	(2011)	Canada	Expert opinion	Viewpoint	To discuss opportunities for giving critical care to decrease the corresponding environmental effects and change the framework	JBI = 5/6
Bouley et al. [12]	(2017)	World bank	Literature review	Guideline	To design resilience and low-carbon approaches for healthcare systems	JBI = 8/11
PAHO [16]	(2017)	Pan American Health Organization	Literature review	Guideline	To help health systems develop a policy framework on smart health equipment	JBI = 9/11
GHHA[14]	(2015)	USA	Literature review	Guideline	To develop a thorough list of subjects related to environmental health for healthcare systems throughout the globe	JBI = 8/11
World Health Organization [13]	(2016)	WHO	Literature review	Guideline	To address the climate change issue in the health sector	JBI = 9/11
Kubba [15]	(2009)	USA	Literature review	Guideline	To promote a greener, more resilient, and prosperous future for health care	JBI = 8/11
Schroeder et al. [40]	(2012)	UK and the USA	Text	book	To promote sustainable healthcare	JBI = 4/6
Nieto-Cerezo [41]	(2019)	UK	Text	book	To design innovative climate change adaptation plans for Hospitals	JBI = 5/6

I- Systematic Literature Review: Descriptive results

- Most of them were from the United States (19%), Australia (15%), the United Kingdom (15%), India (7%), and the rest of the studies were from Russia, Canada, Turkey, Japan, Malaysia, Romania, Austria, and Sweden.
- The studies included 16 original research papers, a conference paper, five guidelines, two books, a report, and a viewpoint. Literature review was an essential part of all of the studies method.

Finally, 13 components were extracted and divided into two general areas of "adaptation" and "mitigation":

1. water management
2. wastewater management
3. energy management
4. waste management
5. green buildings
6. food
7. transportation
8. green purchasing policy
9. material & resource management
10. chemicals, and toxins management
11. technology
12. sustainable care models
13. leadership

I- Systematic Literature Review: Thematic results

- The "Climate Change Mitigation" defines as "human intervention to reduce human influence on the climate system" area included:

water and waste water management,

reducing energy consumption,

reducing hospital waste,

transportation and reducing fossil fuel consumption,

chemicals management,

cooperation in legislation and implementation of mitigation-related laws.

I- Systematic Literature Review: Thematic results

- The "Climate Change Adaptation" defines as "increasing resilience to climatic hazards; risk transfer; reducing vulnerability; preparedness and response and recovery; and risk modification " area included:
- capacity building,
- technology development and transfer,
- financial affairs,
- education and research,
- monitoring and evaluation.

Domain	Subdomain	Macro-Actions
Water consumption management	Water resources conservation and saving	Implement a training program for staff and patients
		Apply high-tech equipment to achieve maximum water consumption
		Monitoring consumption and consumption costs
		Green space management
		Regular control to prevent possible leaks
	Water supply	Having water supply resources in the hospital
		Sustainable access to clean water
	Runoff and stormwater management	Use a rainwater harvesting system

Domain	Subdomain	Macro-Actions
Wastewater treatment	Separate wastewater, collection, and treatment	Separate wastewater and sewage of different wards of the hospital
		Hospital wastewater physical treatment
	Hospital wastewater treatment, disinfection, and filtration	Wastewater recycling in the hospital before entering the municipal wastewater
		Use efficient filters to remove contamination
	Recycling	Use efficient technologies for sewage conversion

Domain	Subdomain	Macro-Actions
Waste management	Waste minimization	Implement "zero waste" policies in hospital
		Frequent inspections
	Harvesting	Storage
		Proper waste segregation
	Recycling	Converting waste to fertilizers or composts instead of burning them
	Waste disposal	Training and increasing the awareness of staff
		Implement national regulations, and the WHO and CDC advises

Domain	Subdomain	Macro-Actions
Energy management	Reduce energy consumption	Training programs for employees to modify their consumption pattern
		Use low-power high-efficiency equipment (class A)
	Energy audit	Frequent inspection over consumption
	Alternative sources of energy supply	Use renewables in hospital
	Energy efficiency	Promote and smarten lighting systems
		Improve thermal conditions of the building
		Improve insulation conditions of the building
		Improve ventilation conditions in the hospital
		Improve refrigerant management

Domain	Subdomain	Macro-Actions
Materials and resources management	Improve chemicals management	Use non-toxic materials
		Hospital gas management
		Reduce the use of pesticides
		Reduce hospital disinfectants
		Reduce environmental pollutants
		Lab materials management
		Medicine management

Domain	Subdomain	Macro-Actions
Transportation	Human resources	Increase active travels
		The approach to reducing unessential travels
	Vehicles	Optimize fuel consumption and low-carbon transport
	Road	Hospital access routes

Domain	Subdomain	Macro-Actions
Nutrition in hospital	Improve sustainable food procedures	Modify food consumption pattern
		Increase food security
Domain	**Subdomain**	**Macro-Actions**
Hospital purchases	green purchase policy	showing production methods and observing ethical rules from production to packaging and final disposal
		modify products purchase pattern

Domain	Subdomain	Macro-Actions
Use of technology	Use of e-Health	Use Health Information Technology
		Care, educate, and treat patients remotely (Tele-Medicine)
	Improve modern technologies	
Domain	**Subdomain**	**Macro-Actions**
Financial affairs	Funding countermeasures	Financial support and economic incentives
	Financial planning	Improve insurance mechanisms

Domain	Subdomain	Macro-Actions
Monitoring, evaluation, assessment	Risk assessment	Identify regional hazards of hospital
		Regional health information database supported in hospital
	Develop early warning systems in hospital	Improve and strengthen syndromic surveillance
Sustainable care models	Changing care models	Training physicians and staff
		Training patients

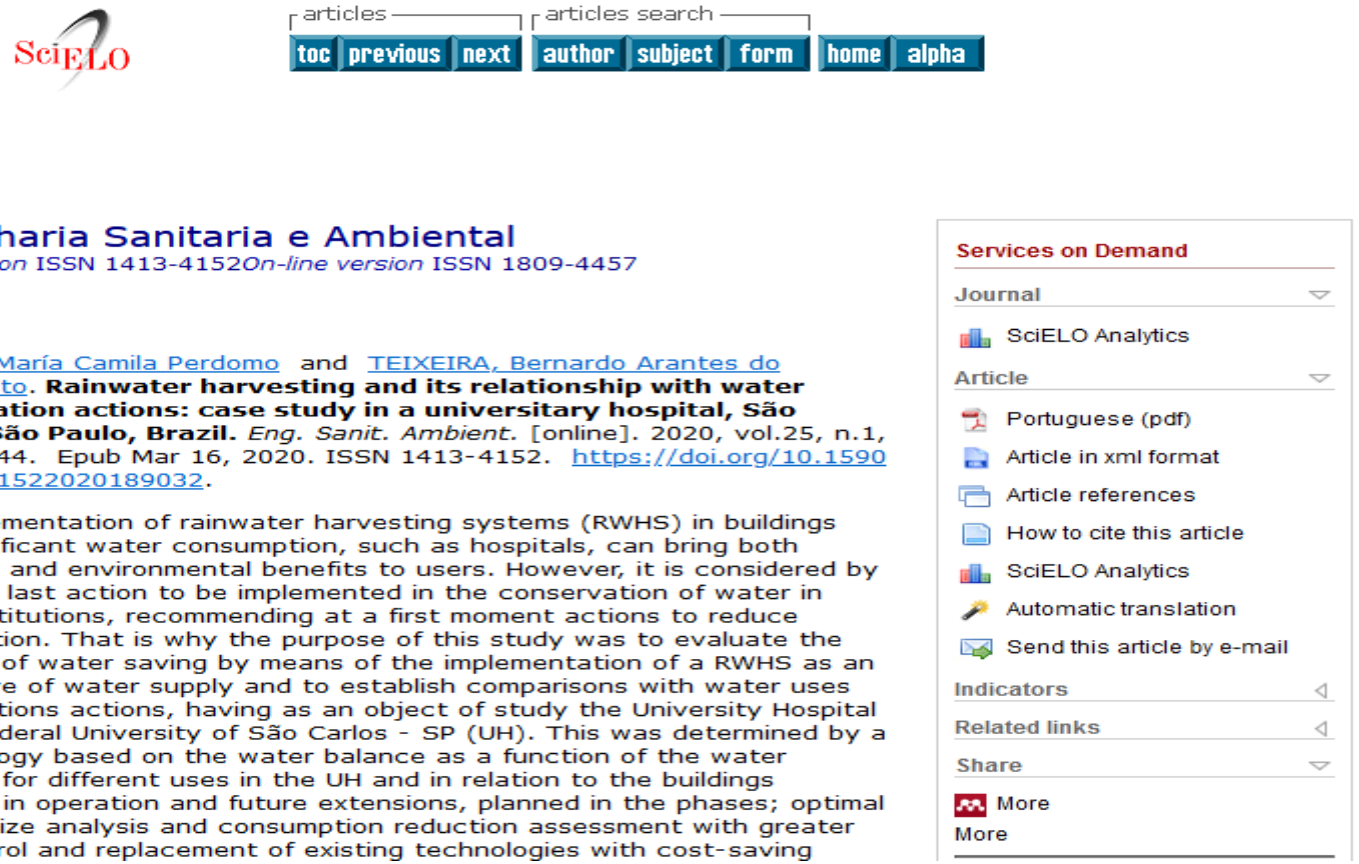
Domain	Subdomain	Macro-Actions
Management and leadership	Organizing	Joining hospitals in Global Environmental Protection Network
		Active incidents and accidents reporting system
		Surveillance over hospital accreditation standards and integration climate measures in it
		Establishing a hospital resilience committee
		Decision support system for managers in emergency conditions
	Command	Incident command system (ICS) for rapid response to emergency cases
	Coordination	Interaction with collaborative and supportive organizations and institutions
		the relationship between hospital officials with society, media, and NGOs, and the involvement of local authorities
	Logistic management	Supply chain management
		Information management
	Planning	disasters planning
		instant response
		evacuation

Domain	Subdomain	Macro-Actions
	improve human resources	training staff
		practice to increase staff's preparedness
		forming database for the hospital's staff
		volunteer management
	improve safety	establish an emergency committee in the hospital
	optimize and improve systems	optimize and enhance the power system
		optimize and improve the water and sewage system
		optimize and improve fuel system
		optimize and improve heating, ventilation, and air conditioning (HVAC)
		optimize and improve the firefighting system
		optimize and improve IT and communicational systems

Domain	Subdomain	Macro-Actions
Hospital structure	design	design building regulations and design green carbon-free hospital
	hospital structure	building a reinforced structure
	hospital location	select an appropriate site for the hospital building
	pollution prevention	design a bylaw and implement pollution reduction principles when constructing the hospital

Climate change mitigation strategies for hospitals

- In terms of water management, a report prepared by the United Nations predicts that by the end of 2030, water shortage in arid and semi-arid regions will lead to the migration of 24 to 700 million people.
- Lack of proper management and planning regarding water use may lead to irreparable damage in the future.
- Therefore, several solutions have been proposed for maintaining and controlling water reserves in hospitals as one of the largest water consumers.
- Applying these simple but practical solutions can markedly help to improve resilience in water management in hospitals.



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Engenharia Sanitaria e Ambiental
Print version ISSN 1413-4152*On-line version* ISSN 1809-4457

Abstract

GAITAN, María Camila Perdomo and TEIXEIRA, Bernardo Arantes do Nascimento. **Rainwater harvesting and its relationship with water conservation actions: case study in a universitary hospital, São Carlos, São Paulo, Brazil.** *Eng. Sanit. Ambient.* [online]. 2020, vol.25, n.1, pp.133-144. Epub Mar 16, 2020. ISSN 1413-4152. https://doi.org/10.1590/s1413-41522020189032.

The implementation of rainwater harvesting systems (RWHS) in buildings with significant water consumption, such as hospitals, can bring both economic and environmental benefits to users. However, it is considered by some the last action to be implemented in the conservation of water in these institutions, recommending at a first moment actions to reduce consumption. That is why the purpose of this study was to evaluate the potential of water saving by means of the implementation of a RWHS as an alternative of water supply and to establish comparisons with water uses conservations actions, having as an object of study the University Hospital of the Federal University of São Carlos - SP (UH). This was determined by a methodology based on the water balance as a function of the water demands for different uses in the UH and in relation to the buildings currently in operation and future extensions, planned in the phases; optimal storage size analysis and consumption reduction assessment with greater loss control and replacement of existing technologies with cost-saving

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- Gaitan et al. (2020) conducted a case study in Sao Paulo, Brazil to examine the impact of water conservation measures in a university hospital.
- They found that a combination of the above measures, such as rainwater harvesting systems (RWHS) along with water conservation programs, can save between 71% of current consumption, which are considered to be significant levels and reflect the needs of strategic water management with financial, environmental and social benefits.

Journal of Environmental Protection and Ecology 17, No 2, 772–780 (2016)

Environmental management

WATER MANAGEMENT IN THE HOSPITALS IN TRABZON PROVINCE

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Abstract. There is a high demand of water in hospitals and wastewater can pose danger. However, water should be provided without interruption. In other words, water should be professionally managed in hospitals. Survey methodology was used to collect data for this study in which the knowledge and opinions of the managers of 23 private and public hospitals in Trabzon province of Turkey on water management were analysed. It was found out that the managers do not know either the daily water requirement of water in hospitals or the exact number of the items and places related to water consumption such as faucets, toilets, urinals and shower stalls; many of the documents that show in-building water supply networks are not available; there are not any technical staff for water-related problems in 8 hospitals; there have been water cuts in 13 hospitals in the last year and problems in providing water in the time of water cuts. It turned out that the hospital managers in Trabzon should be informed about water management and awareness should be raised in this regard. Moreover, water management issue should be tackled in green hospital context and relevant statutory obligations should be imposed.

Keywords: hospital, water management, Trabzon, drinking water, waste water.

- They showed that only a few hospitals collected wastewater through separate systems. Meanwhile, only 14 of the 23 surveyed hospital managers stated that wastewater management was one of their top priorities.
- According to their findings, they concluded that it was quite essential to train hospital managers on this subject.

Climate change mitigation strategies for hospitals

- In terms of waste management, hospitals are among the main polluters of the environment due to the production of pharmaceutical, chemical, radioactive, and infectious waste material.
- Several studies have focused on inefficient measures concerning hospital waste management. Some of these insufficient measures include improper source separation, insufficient use of colored and coded waste bags, illegal methods of waste collection, unsafe storage of infectious waste, unskilled manpower, insufficient financial resources, and poor supervision over waste disposal centers.
- Hospitals should have comprehensive programs for sustainable management of their waste and achieving zero waste.

- Despite their preference for reusable surgical instruments, only 20% preferred the reusable devices available to them.

Climate change mitigation strategies for hospitals

- In terms of energy management, hospitals are one of the largest centers of energy consumption due to their constant operation.
- The adoption of energy-saving techniques has a vital effect on lowering greenhouse gas emissions.

Towards zero energy hospital buildings: a polyclinic building as case study.

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Abstract. The need for (nearly) Zero Energy Buildings (nZEBs) becomes increasingly important due to climate change and increasing energy prices. Considering that, on average the existing hospitals use 3.5 times more energy than the nZEB requirement, reaching zero energy a very challenging task. However, monitoring hospitals' energy flows together with a holistic view on building functions and occupancy can contribute to achieving potential energy savings, which is lacking in the current hospital buildings.
Therefore, in this study, the energy saving potentials of a polyclinic building of a hospital in the Netherlands was investigated through a holistic inspection of the building and its occupancy. The analysis is performed in order to investigate the building characteristics, energy supply and demand. It was found that the number of people present was considerably lower than the full capacity, with 30% average occupancy in the medical facilities and 70% for the administrative areas. The air supply of the current ventilation system was found to be constant irrespective of the number of people present in these rooms. Furthermore, a discrepancy of 30-50% was found between designed and installed lighting systems. The analysis of the polyclinic showed possible energy-saving measures with controlled ventilation rates and lighting according to the occupancy.

- Enrico et al. (2019) conducted a study Towards zero energy hospital buildings in Netherlands in order to investigate the building characteristics, energy supply and demand.
- It was found that the number of people present was lower than the full capacity, with 30% average occupancy in the medical facilities and 70% for administrative areas. air supply of the current ventilation system was found to be constant irrespective of the number of people present in these rooms.

Climate change mitigation strategies for hospitals

- Regarding chemical, hospitals are one of the largest consumers of chemicals from chemotherapy for cancer treatment to disinfectants for sterilization. These chemicals potentially have detrimental effects on the environment.
- Hospital staff is at a greater risk due to continuous exposure to these substances.

American Journal of Hospice
& Palliative Medicine®
28(8) 536-538

DOI: 10.1177/1049909111405788
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Managing Unused Pharmaceuticals in a Hospice Setting: A Pilot Study

Joel Kreisberg, DC[1] and Connie Zheng, BS[1]

Abstract

With the escalating use of pharmaceuticals in health care, there has been increasing anxiety over the potential health risks associated with pharmaceutical waste accumulating in the environment. This research provided nurses in a hospice care facility in Concord, California, with education and training to offer patients a medication disposal service through the use of mail-back envelopes. Over the 6-month study period, 160 of the 400 distributed mailers were returned for disposal. The total weight of pharmaceuticals diverted for incineration was 107 pounds, with an average weight of 0.66 pounds per mailer. This study suggests that the mailer system and proper education of medical staff have the potential to improve medical waste management, but alternative approaches may be necessary to increase the rate of envelop return.

Keywords

hospice, waste, disposal, pharmaceuticals, pollution, education, nurses

- This research provided nurses in a hospice in California, with education and training to offer patients a medication disposal service through the use of mail-back envelopes.
- Over the 6-month study period, 160 of the 400 distributed mailers were returned for disposal. The total weight of pharmaceuticals diverted for incineration was 48.5344 kg, with an average weight of 300 gr per mailer.
- This study suggests that mailer system and proper education of medical staff have the potential to improve medical waste management.

Climate change mitigation strategies for hospitals

- Given that a large amount of greenhouse gas emissions in hospitals is due to transportation, there is a clear need to implement certain strategies to reduce greenhouse gas emissions.
- Hospital transportation management includes not only patient and staff transportation but also transportation related to the hospital's logistics department.

Climate change mitigation strategies for hospitals

- Bozoudis et al. (2020) studied the greenhouse gas emissions from the transportation activities of the Athens Military Hospital.
- They found that the transfer of patients in or out of the hospital had the largest share (85.92%) in the emission of greenhouse gases.
- After patient transportation, ambulance services, garbage disposal, hospital purchases, and staff transfer had the highest shares in greenhouse gas emissions with 7.52%, 3.65%, 2.43%, and 0.48% of the share, respectively.
- According to this study, calculation of greenhouse gas emissions is the starting point for planning to reduce greenhouse gas emissions in the transportation sector.

Climate change mitigation strategies for hospitals

- Regarding the green purchasing policy component, hospitals must follow the Sustainable Purchasing Guidelines that cover all ethical and environmental aspects from production to packaging, transportation, and final disposal.
- Green purchasing covers consumables products, electronic appliances, food, cleaning products, etc.
- One of the most important parameters for the successful implementation of the green purchasing policy is training the hospital staff, especially those working in the purchasing and procurement department

Climate change mitigation strategies for hospitals

- Regarding foods, hospitals serve millions of meals to patients and their families each year, hospital settings are ideal targets for encouraging healthy and sustainable dietary habits.
- The reduced intake of processed foods and red meat, the increased intake of fruits and vegetables can reduce the emission of greenhouse gases.

Journal of Health Services Research & Policy
2015, Vol. 20(1) 39–44

DOI: 10.1177/1355819614553017
jhsrp.rsmjournals.com

Comparison of the carbon footprint of different patient diets in a Spanish hospital

Rosario Vidal[1], Enrique Moliner[2], Andrej Pikula[3], Angel Mena-Nieto[4] and Agustín Ortega[5]

Abstract

Objectives: Mitigating climate change requires management strategies to reduce greenhouse gas emissions in any sector, including the health system. Carbon footprint calculations should play a key role in quantifying and communicating these emissions. Food is among the categories with low accuracy because the carbon footprint for food is still under development. We aimed to quantify the carbon footprint of different diets.

Methods: Average carbon footprint for a normal diet was based on detailed composition data in Juan Ramón Jiménez Hospital (Huelva, Spain). In addition, the carbon footprints of 17 other therapeutic diets were estimated using a streamlined variation of each diet published by Benidorm Clinical Hospital (Spain).

Results: The carbon footprint was calculated for 18 hospital diets for a variety of patients. The reference menu corresponds to the normal diet provided to patients who do not have special dietary requirements. This menu has a low carbon footprint of 5.083 CO_2 eq/day.

Conclusions: Hospital diets contribute to the carbon footprint of a hospital. The type of diet has a significant impact on the greenhouse gas emissions. A Mediterranean diet is associated with lower environmental impact than diets with more meat, in particular red meat.

Climate change adaptation strategies for hospitals

- leadership is an important component in hospitals, which is policy-making and planning to create a sustainable framework at all levels in the hospital.
- To achieve the goals of sustainable development in the fight against climate change, a question that arises is, "If the health sector does not take an effective measure and play the leadership role in this fight, are other sectors expected to do so?"

Climate change adaptation strategies for hospitals

- As for the building component, hospitals produce a significant amount of carbon footprint from the beginning of the construction process until their launch day.
- It is important to note that green building strategies are not only applicable to newly built hospitals but also can be applied to old buildings to renovate them to improve their performance in many ways.

Design of healthcare structures by green standards

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Abstract. Global warming is real, and the healthcare industry is both a contributor and a victim. Also, physical setting and, in particular, sustainable design practices can support patient recovery during hospitalization. In the context of this paper, focus areas for design of green healthcare structures have been explored in detail. Herein, we are laying focus on understanding architecturally justified approaches of interior lighting in a healthcare setting. This paper also discusses design strategies to improve indoor air quality in hospitals and the current international research to improve indoor air quality are reported. Other focus areas like greenhouse keeping, use of green interior materials and landscaping are discussed. Data for the review was extracted from published books and diverse online sources with the help of the Google search engine. It was found that healthcare structures, being resource intensive establishments, consume vast amounts of energy, water, and construction materials to provide high quality care. It was also found that healthcare institutions, by adopting sustainable measures are capable of reducing their environmental footprint to a bigger extent, boost the wellbeing of healthcare staff and aid patient recovery.

- It was also found healthcare institute by adopting sustainable measures are capable reducing their environmental foot print.

Climate change adaptation strategies for hospitals

- An essential part of the fight against climate change is Evaluation and monitoring health information. in this regard including:
- the vulnerability assessment of the affected population;
- continuous and systematic monitoring,
- evaluation of the effectiveness of adaptive interventions;
- use of Early Warning Systems to warn against the health effects of climate change and climatic anomalies;

Ref: Mousavi A, Ardalan A, Takian A, Ostadtaghizadeh A, Naddafi K, Bavani AM. Health system plan for implementation of Paris agreement on climate change (COP 21): a qualitative study in Iran. BMC public health. 2020 Dec;20(1):1-3.

Climate change strategies for hospitals

- Identifying the components and measures related to climate change will enable managers, decision-makers, and policymakers in the field of hospitals to achieve an acceptable level of measures to reduce the speed of climate change by allocating appropriate resources and funds to the measures.

Climate change strategies for hospitals

- Mitigating and adapting to climate change are complicated issues that need collaboration across all sectors.
- It should be noted that control measures (mitigation and adaptation) are flexible and sometimes even complement each other.


Thank you for
your attention