HLTH 6200

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Using One Health to Explore the Public Health Impact of Heat Islands

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Heat islands are urban areas that experience higher temperatures than their surrounding rural areas, posing a significant public health problem. This phenomenon is primarily caused by human activities and infrastructure that absorb and retain heat. According to the U.S. Environmental Protection Agency (EPA), urban areas can be 1-7°F hotter during the day and 2-5°F hotter at night compared to rural areas. The increased temperatures contribute to a range of health impacts, including heat-related illnesses and deaths, particularly among vulnerable populations such as the elderly, children, and individuals with pre-existing health conditions (EPA, 2021).

The magnitude of the problem is substantial. A study by the Centers for Disease Control and Prevention (CDC) highlights that extreme heat caused 24% of weather-related deaths in the United States, more than any other weather-related event (CDC, 2020). The urban heat island effect exacerbates these temperatures, leading to higher rates of heat-related illnesses, such as heat exhaustion and heatstroke, and increasing the prevalence of respiratory problems due to worsened air quality. Economically, the heat island effect leads to increased energy consumption for cooling, which in turn raises greenhouse gas emissions and contributes to climate change (American Lung Association, 2022). Higher costs for cooling, increased healthcare expenses due to heat-related conditions, and reduced productivity due to heat-related health issues are also significant burdens on society (National Institute of Environmental Health Sciences, 2021)

The consequences of heat islands at the population level are profound. There is an increased risk of heat stroke, respiratory problems, and sometimes death. Environmentally, higher temperatures lead to greater energy consumption, increased air pollution, and negative impacts on urban wildlife. The population most affected includes residents of low-income and minority communities who often live in areas with fewer green spaces and higher overall

temperatures (American Public Health Association, 2022). Additionally, people between the ages of 55 and 64 account for 19% of heat related deaths, far more than any other age group (CDC, 2022).

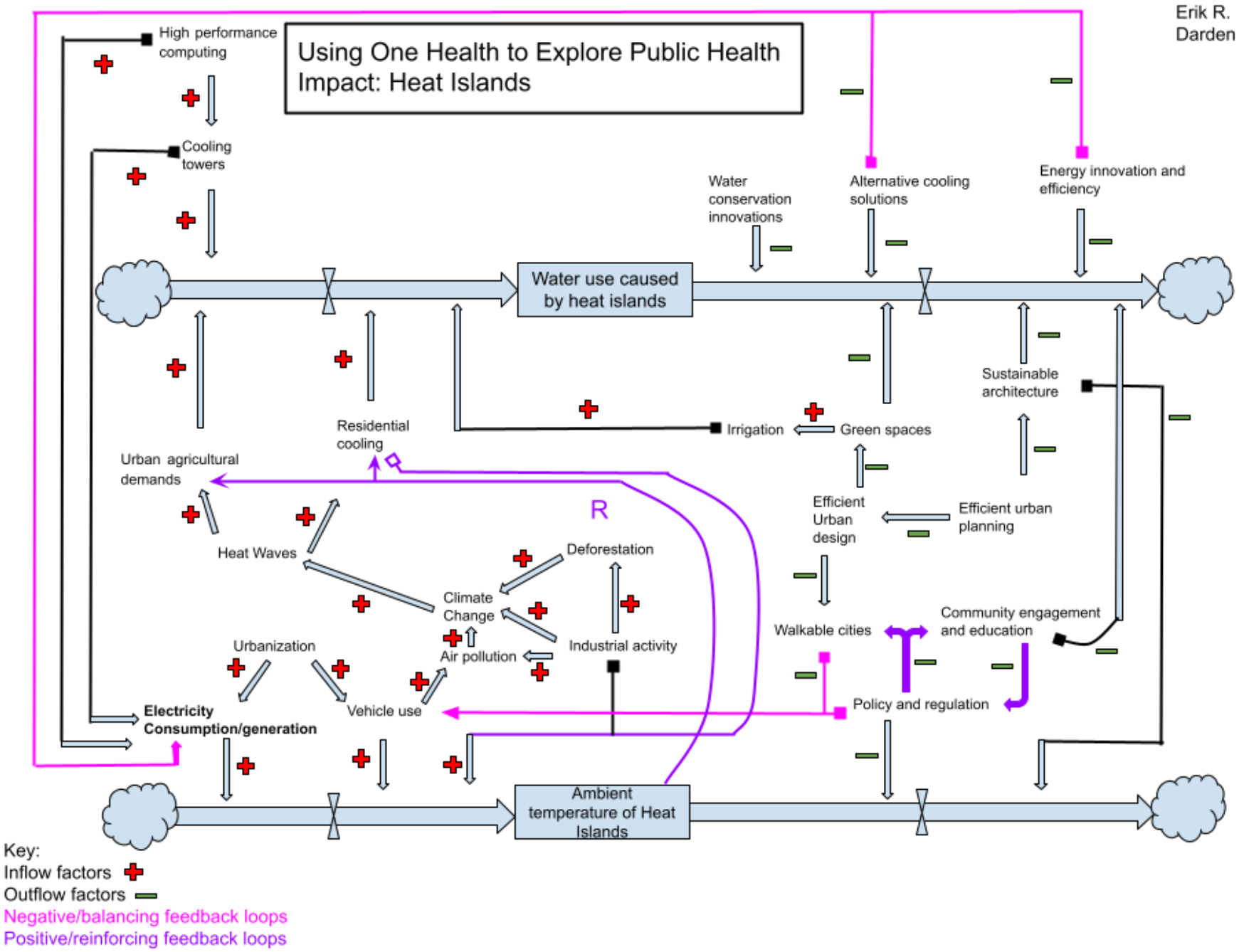
The financial costs to society are considerable. Increased healthcare costs arise from more frequent hospital admissions and medical treatments for heat-related illnesses. The higher energy consumption for cooling buildings and homes results in substantial economic losses, while reduced productivity and increased absenteeism due to heat-related health issues add to the economic burden (NRDC, 2022). The annual economic cost of heat-related health impacts in the U.S. is estimated to be several billion dollars per year, growing by at least one billion dollars per summer (NRDC, 2022).

To summarize, heat islands are a significant public health problem due to their impact on health, the environment, and the economy. Addressing this issue through targeted interventions and policies is crucial to improving health outcomes. Therefore, heat islands should be recognized as a critical area for public health intervention and research.

Problem Statement: Heat islands pose a significant public health problem due to their impact on vulnerable populations, leading to increased health risks, environmental damage, and substantial economic costs.

Supporting Data:

- urban areas can be 1-7°F hotter compared to rural areas (EPA, 2021)
- extreme heat causes 24% of weather -related deaths in the United States (CDC, 2020).
- The 55-64 age group accounts for 19% of heat related deaths (CDC, 2022)
- cost of heat-related health impacts in the U.S. is rising by billions of dollars per year (NRDC, 2022)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Using One Health to Explore Public Health Impact: Heat Islands
High performance computing
Cooling towers
Water conservation innovations
Alternative cooling solutions
Energy innovation and efficiency
Water use caused by heat islands
Sustainable architecture
Residential cooling
Irrigation
Green spaces
Urban agricultural demands
Efficient Urban design
Efficient urban planning
R
Heat Waves
Deforestation
Climate Change
Urbanization
Air pollution
Industrial activity
Walkable cities
Community engagement and education
Vehicle use
Policy and regulation
Electricity Consumption/generation
Ambient temperature of Heat Islands
Key:
Inflow factors
Outflow factors
Negative/balancing feedback loops
Positive/reinforcing feedback loops

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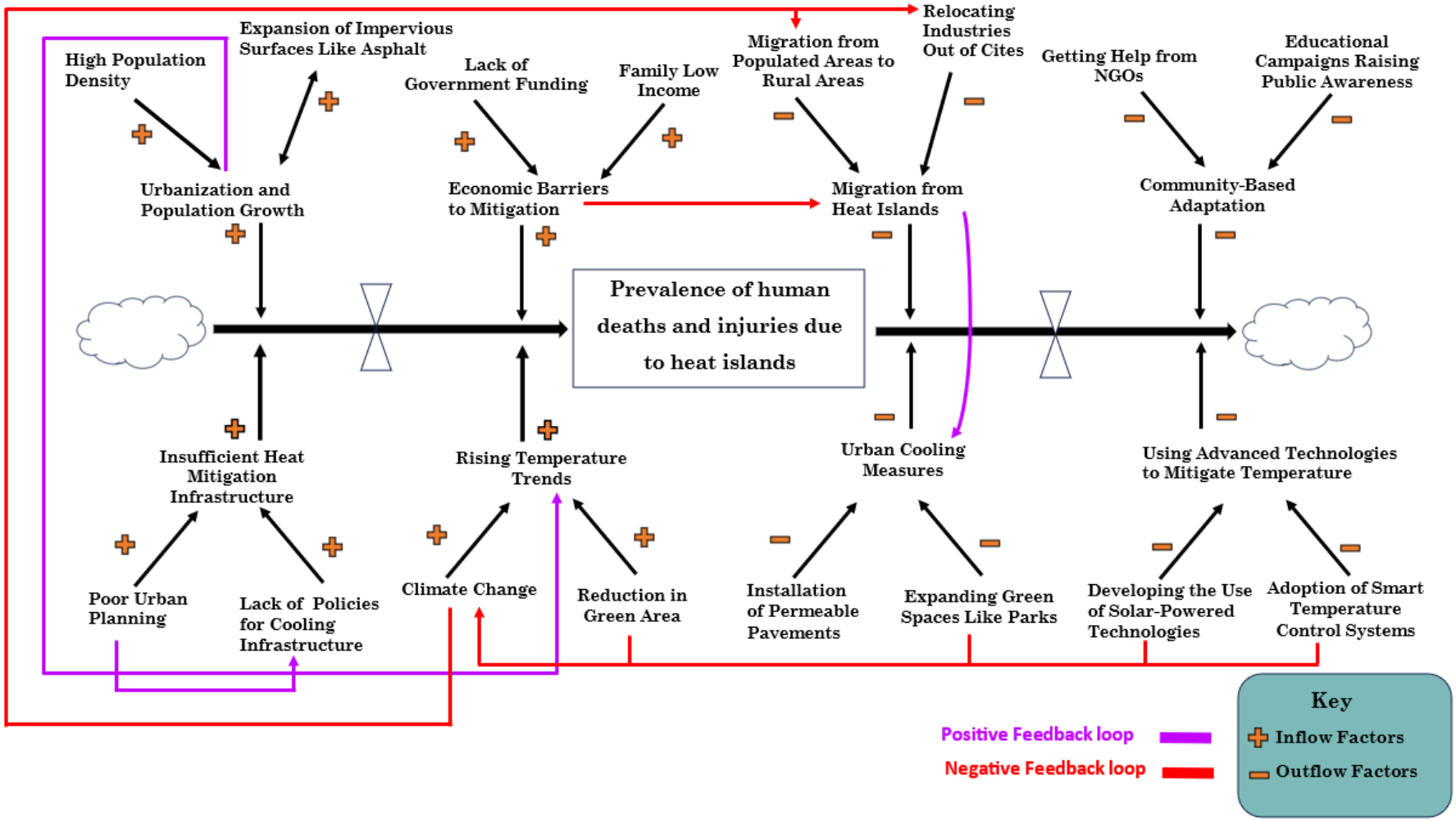
Using One Health to Explore the Public Health Impact of Heat Islands



Leverage Points and Tradeoffs

System One: water use and ambient temperature of heat islands

1. Residential cooling (middle left of the diagram) is a LP because it is a feedback loop for ambient air temperature of heat islands. As residents use cooling methods such as air conditioners, they produce heat as a byproduct and increase the need for cooling. Policies that limit electricity use (not blackouts) during summer months can reduce the impact of this loop (Ramasubramanian & Ramakrishna, 2023).
    a. A trade off to limiting use of residential cooling during hotter seasons is that it can lead to increased indoor temperatures, which may negatively impact comfort and health, especially for vulnerable populations like the elderly and those with pre-existing health conditions (Ramasubramanian & Ramakrishna, 2023).
2. Community engagement and education (bottom right) is also a LP because of its potential to impact many other inflows and outflows of the system. Community engagement can lead to policies that positively impact the environment, reducing the effects of heat islands (EPA, n.d.).
    a. A trade off to increasing community engagement and education is that it can be expensive and time consuming (Bandy, 2011). The challenges of community engagement can divert attention from more pressing issues, especially in an urban environment.

System Two: human deaths and injuries caused by heat islands

1. In this Stock-Flow diagram, urbanization and population growth emerge as critical leverage points due to their direct influence on rising temperatures. Higher rates of urbanization often result in denser populations within heat-vulnerable areas, amplifying the exposure of individuals to heat-related risks. Additionally, urbanization can significantly contribute to the formation of economic barriers that hinder mitigation efforts. These barriers impede the development of essential infrastructure designed to reduce the impacts of heat islands and prevent associated deaths and injuries (Kuddus et al., 2020).
    a. A significant obstacle in addressing this issue is the limited availability of family planning services and education, which hampers efforts to regulate population growth. Furthermore, insufficient urban planning and infrastructure development often result in unchecked urban sprawl, compounding the difficulties associated with rapid urbanization (Chapman et al., 2017).
2. Another significant leverage point in my diagram is the role of advanced technologies in mitigating temperature increases. As an outflow in this system, competition for investment in clean energy innovation plays a pivotal role. Technologies such as electric vehicles and solar power offer powerful alternatives to gas or petroleum-based energy sources, potentially reducing injuries and deaths by preventing further temperature rise (Engel-Cox et al., 2022).
    a. However, advanced technology is a double-edged sword. While it has the potential to mitigate the creation of heat islands, it can also unintentionally intensify them. The development and recycling of products like electric vehicles and solar batteries, for instance, contribute to climate change. Many of these

technologies rely on components such as refrigerants and heavy metals, which release potent greenhouse gases like carbon dioxide (CO2) and methane (CH4) when burned or decomposed (Quantum, 2024).

Recommendation

Community engagement and education has the least amount of trade offs and highest potential impact on the larger system. This is likely the highest impact and most efficient leverage point to focus on regarding this system.

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Stock and Flow Diagram

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