



The Impact of Climate Change on Drug Safety and Efficacy

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DESCRIPTION

Climate change, a phenomenon characterized by rising global temperatures, shifting weather patterns and increased frequency of extreme weather events, poses significant challenges to various aspects of human health. One area that has garnered growing attention is the impact of climate change on drug safety and efficacy. As the climate continues to change, it influences various environmental factors that, in turn, affect the stability, potency and effectiveness of medications. Understanding these impacts is potential for ensuring the continued safety and efficacy of pharmaceuticals in a changing world. Temperature is a critical factor in the stability of pharmaceuticals. Most medications are formulated to be stable within a specific temperature range. However, climate change is leading to more frequent and severe heatwaves, which can compromise the integrity of these medications. Increased temperatures can accelerate the degradation of Active Pharmaceutical Ingredients (APIs), reducing their potency and effectiveness. For example, medications such as insulin, which requires refrigeration, are particularly vulnerable to temperature fluctuations. Heat exposure can cause insulin to degrade, rendering it less effective in managing blood glucose levels. Similarly, vaccines, which are also temperature-sensitive, can lose their efficacy if not stored at the recommended temperatures. The increasing frequency of heatwaves and power outages due to extreme weather events further exacerbates the risk of temperature-related drug degradation. Humidity is another environmental factor influenced by climate change that affects drug safety and efficacy. High humidity levels can lead to the absorption of moisture by hygroscopic drugs, which are medications that readily absorb water from the environment. This can result in changes to the drug's physical and chemical properties, potentially reducing its effectiveness or increasing the risk of adverse reactions. For instance, some oral medications, such as tablets and capsules, can become more susceptible to microbial contamination in high humidity conditions. This can lead to the growth of mold or bacteria on the medication, posing a significant health risk to patients. Additionally, moisture absorption can cause tablets to

disintegrate or dissolve prematurely, affecting their intended release and absorption in the body. Climate change affects water quality, which has implications for the safety and efficacy of medications. Flooding, increased precipitation and rising sea levels can lead to water contamination with pollutants, pathogens and chemicals. Contaminated water used in the manufacturing process of pharmaceuticals can compromise the quality of the final product, leading to safety concerns. Moreover, water contamination can impact the effectiveness of medications when used for reconstitution or administration. For example, contaminated water used to dissolve powdered medications can introduce harmful substances into the patient's body, potentially causing infections or adverse reactions. Ensuring the availability of clean and safe water is essential for maintaining the quality of medications in the face of climate change. Climate change is altering the geographic distribution and prevalence of vector-borne diseases, such as malaria, dengue fever, and Zika virus. Warmer temperatures and changing precipitation patterns create favorable conditions for the breeding and spread of disease-carrying vectors, such as mosquitoes and ticks. This has significant implications for the use and efficacy of medications used to treat these diseases. The increased prevalence of vector-borne diseases can lead to higher demand for specific medications, potentially resulting in shortages and increased prices.

Additionally, the widespread use of these medications can contribute to the development of drug resistance. For instance, the overuse of antimalarial drugs in response to the expanding range of malaria can accelerate the emergence of drug-resistant strains of the parasite, rendering existing treatments less effective. The storage and transportation of medications are critical components of ensuring their safety and efficacy. Climate change-induced extreme weather events, such as hurricanes, floods and wildfires, can disrupt supply chains and compromise the storage conditions of pharmaceuticals. Power outages resulting from these events can lead to the loss of refrigeration, affecting temperature-sensitive medications. Transportation disruptions can delay the delivery of medications to healthcare

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facilities and patients, potentially leading to shortages and lapses in treatment. Additionally, the increased frequency of extreme weather events can damage infrastructure, making it difficult to maintain the necessary storage conditions for medications during transit. Developing resilient supply chains and storage solutions is essential to mitigate the impact of climate change on drug safety and efficacy. Addressing the impact of climate change on drug safety and efficacy requires coordinated efforts at the regulatory and policy levels.

CONCLUSION

Regulatory agencies must update guidelines and standards to account for the changing environmental conditions that affect

pharmaceuticals. This includes revising storage and transportation requirements, as well as establishing protocols for managing drug shortages and ensuring the availability of temperature-stable formulations. Policymakers should also prioritize investments in climate-resilient infrastructure, such as temperature-controlled storage facilities and robust supply chain networks. Public health initiatives aimed at improving water quality and access to clean water are essential for safeguarding the safety of medications. Additionally, efforts to combat climate change, such as reducing greenhouse gas emissions and promoting sustainable practices, can help mitigate the broader impact on healthcare systems and medication safety.