

Learning from 536 AD: climate collapse, pandemics, and the urgency of collective action in the 21st century

Aprendendo com o ano 536 d.C.: colapso climático, pandemias e a urgência da ação coletiva no século XXI

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ABSTRACT

This article revisits the year 536 AD, often described as one of the darkest periods in human history due to a climatic collapse and the Justinian Plague, drawing a parallel with contemporary challenges shaped by climate change, pandemics, and scientific disinformation. Through a narrative review and theoretical reflection, it highlights how extreme events (such as floods, droughts, and wildfires) are intensifying, undermining ecosystems and disproportionately affecting vulnerable populations. The COVID-19 pandemic revealed structural weaknesses in health systems and the impact of denialism (information avoidance). Unlike ancient societies, today's humanity possesses scientific knowledge, technological resources, and strategies capable of mitigating these crises; yet political inertia and cultural resistance continue to hinder coordinated action. The historical experience of 536 serves as a warning: scientific knowledge alone is insufficient unless it is ethically, collectively, and responsibly mobilized. The article concludes that only through urgent, science-based collective action can humanity avoid repeating cycles of collapse.

Keywords: Climate Change; Pandemics; Information Avoidance; History as Topic; Community Action; Public Policy.

RESUMO

Este artigo revisita o ano 536 d.C., frequentemente descrito como um dos períodos mais sombrios da história humana em razão de um colapso climático e da Peste Justiniana, traçando um paralelo com os desafios contemporâneos moldados pelas mudanças climáticas, pandemias e desinformação científica. Por meio de uma revisão narrativa e reflexão teórica, o estudo destaca como eventos extremos (como enchentes, secas e incêndios florestais) vêm se intensificando, comprometendo ecossistemas e afetando de forma desproporcional as populações vulneráveis. A pandemia de COVID-19 revelou fragilidades estruturais nos sistemas de saúde e o impacto do negacionismo (evitação da informação). Diferentemente das sociedades antigas, a humanidade atual dispõe de conhecimento científico, recursos tecnológicos e estratégias capazes de mitigar essas crises; contudo, a inércia política e a resistência cultural continuam a dificultar uma ação coordenada. A experiência histórica de 536 serve como alerta: o conhecimento científico, por si só, é insuficiente se não for mobilizado de forma ética, coletiva e responsável. O artigo conclui que apenas por meio de uma ação coletiva urgente e baseada na ciência a humanidade poderá evitar a repetição de ciclos de colapso.

Palavras-chave: Mudança Climática; Pandemias; Evitação de Informação; História como Assunto; Ação Comunitária; Política Pública.

INTRODUCTION

Throughout history, certain events have served as milestones revealing human vulnerability in the face of natural and biological forces. The year 536 CE (*Common Era*) is often cited as one of the darkest periods ever endured by humanity. Historical accounts and scientific evidence point to a succession of global catastrophes, including an inexplicable haze that

shrouded the skies, obstructing sunlight and causing a dramatic drop in global temperatures¹. Recent studies suggest that this phenomenon resulted from a massive volcanic eruption, possibly in Iceland, that released vast quantities of sulfur particles into the atmosphere, reflecting solar radiation and triggering a "volcanic winter"². This climatic disruption led to successive crop failures, widespread famine, social collapse, and even

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reports of cannibalism. At the same time, the Justinian Plague—one of the earliest bubonic plague pandemics, swept across Europe, dramatically increasing mortality rates and deepening human suffering³.

In dialogue with this historical backdrop, this article proposes an integrated reading of the "Earth-system shocks" that characterize both the year 536 CE and the Anthropocene: (i) the paleoclimatic reconstruction of an abrupt, multidecadal cooling in the 6th century, now consolidated by high-resolution proxies such as wood-anatomical records and ice cores, refining the notion of the Late Antique Little Ice Age⁴; (ii) contemporary parallels under anthropogenic global warming and the transgression of planetary boundaries, with observable impacts on the frequency and intensity of extreme events, biosphere integrity, and water and food security⁵⁻⁷; (iii) the amplification of health risks through zoonotic spillover in contexts of land-use change and biodiversity loss, demanding responses grounded in the One Health framework^{8,9}; and (iv) the structuring role of disinformation and the "infodemic" in eroding public trust and undermining evidence-based policies¹⁰⁻¹².

By assembling these four analytical axes, the text argues that historical analogy is not a mere rhetorical device but a heuristic framework for guiding risk governance, science communication, and international cooperation.

This article aims to present a comparative analysis between the catastrophic events of 536 CE and the multiple global challenges of the 21st century, emphasizing structural similarities, fundamental differences, and the ethical and political implications of this historical analogy. Drawing on recent literature, it argues that despite remarkable advances in science and technology, humanity remains vulnerable to the combined effects of climate change, pandemics, and disinformation.

Methodologically, the analysis is organized into three stages that structure the remainder of the manuscript: first, it systematizes the state of the art on the 536 CE episode and its physical-climatic mechanisms, deriving lessons about social vulnerability under rapid forcings; second, it develops parallels with the 21st century in light of scientific consensus (IPCC) and integrative frameworks (Planetary Boundaries and One Health), discussing implications for climate justice, food security, and health surveillance; third, it examines how degraded informational ecosystems, marked by high volumes of rumors and algorithmic incentives to novelty, erode the social contract of science and explores which institutional and communicative interventions (infodemic management, media literacy, platform transparency) are most promising.

The central argument, developed in the following sections, is that only the ethical and coordinated mobilization of knowledge, from climate monitoring to pathogen-surveillance networks and evidence-based communication, can break cycles of collapse and reduce systemic risk at the global scale.

CONTEMPORARY CRISES AND HISTORICAL PARALLELS

The 21st century is marked by a new wave of global crises that, in several respects, echo the patterns of suffering and instability witnessed in the 6th century¹³. The climate crisis, intensified by anthropogenic activity, has increased the frequency and severity of extreme weather events, including floods, droughts, and large-scale wildfires¹⁴. In 2024, Brazil experienced simultaneous and contrasting climatic extremes: devastating floods in the South and historic droughts in the Midwest, affecting even the Amazon, one of the world's wettest biomes. That same year, Europe faced a similar dichotomy, with catastrophic flooding in the central region and destructive fires in Portugal, reinforcing scientific projections of a warming planet and its repercussions on the environment, the economy, and particularly on vulnerable populations.

The experience of the ozone hole demonstrates that scientific consensus and international governance can reverse environmental damage on a planetary scale¹⁵. The Montreal Protocol, anchored in decades of assessment by independent panels, eliminated roughly 99% of ozone-depleting substances, placed recovery on track, and generated significant climate co-benefits. Projections indicate a return to 1980 levels around 2040 globally, 2045 in the Arctic, and 2066 in Antarctica, while the Kigali Amendment could avert an additional 0.3–0.5 °C of warming by 2100¹⁶⁻²⁰. In contrast with the online distortions that today delegitimize science, the ozone case shows that evidence-guided policies, rather than disinformation, can mitigate systemic risks and strengthen institutional capacities transferable to the contemporary climate crisis^{15,21}.

In public health, history likewise records successes when evidence-based measures were adopted in a timely and coordinated manner. Modern quarantine, institutionalized in Ragusa in 1377, emerged as a rational response to plague²². Ecclesiastical and civic responses evolved during the Black Death in the 14th century, and in Rome, during the Great Plague of 1656, the administration under Pope Alexander VII, coordinated by Girolamo Gastaldi, implemented sanitary cordons and extensive public regulations²³⁻²⁶. In the 20th century, non-pharmaceutical interventions, isolation, suspension of mass gatherings, and mask use reduced mortality during the 1918 influenza pandemic^{27,28}, and recent studies show that masks attenuate the emission of respiratory viruses²⁹. On the pharmacological side, the eradication of smallpox and the over 99% reduction in polio cases since 1988 illustrate the power of vaccines, although polio still warrants international attention³⁰⁻³³. The resurgence of measles in 2024–2025 in the World Health Organization (WHO) European Region, driven by insufficient vaccination coverage, demonstrates the risk of backsliding^{34,35}. These precedents reinforce that a new convergence of climatic shocks and pathogen emergence, as in 536 CE, will be averted only if effective environmental governance, health surveillance, and science communication capable of containing the infodemic are integrated^{28,29,36}.

Concurrently, the COVID-19 pandemic exposed the fragility of modern societies when confronted with emerging biological threats³⁷. Despite the rapid identification of SARS-CoV-2 and the unprecedented development of vaccines, the pandemic was exacerbated by widespread scientific denialism, resistance to preventive measures, and the promotion of ineffective or dangerous treatments, all of which contributed to millions of preventable deaths^{38,39}. Moreover, the likely zoonotic origin of the virus serves as a warning about the risks of continued human encroachment into natural habitats and increased interaction with wildlife, conditions that facilitate the emergence of novel pathogens^{40,41}.

SCIENTIFIC KNOWLEDGE AND COLLECTIVE RESPONSIBILITY

Despite these troubling parallels, fundamental differences distinguish the 6th century from the present. In 536 CE, humanity was subject to natural phenomena it could neither comprehend nor control. The volcanic eruption that triggered the climatic crisis was entirely beyond human agency, and the lack of microbiological understanding rendered any effective response to the Justinian Plague impossible. Today, however, we possess a wealth of scientific knowledge, technological resources, monitoring systems, and mitigation strategies capable of preventing, alleviating, or even reversing many of the crises we face. The consequences of climate change are scientifically predictable, and numerous viable solutions, such as reducing greenhouse gas emissions, restoring ecosystems, and developing early-warning systems, are within our reach⁴².

Considering what is already known and what occurred in 536 CE, confronting the twin threat requires simultaneous progress on mitigation, adaptation, and health preparedness. On the climate front, this entails accelerating decarbonization, safeguarding critical ecosystems, and embedding early-warning systems for heat waves and floods within local health action plans^{5,43,44}. On the health front, it calls for building climate-resilient, low-carbon health systems, with systematic risk assessment, infrastructure designed for extremes, and integrated environmental–epidemiological surveillance⁴⁵⁻⁴⁷. A One Health approach is pivotal: land-use change and global warming increase cross-species contacts and the probability of spillover, a dynamic evidenced both by global projections of viral sharing under warming^{41,48} and by studies linking deforestation and forest fragmentation to Ebola outbreaks in Africa^{49,50}. Prevention therefore demands aligning climate, biodiversity, and public-health policies to reduce the likelihood of a new cascade, in which climate disruption leads to food insecurity and social instability, which in turn foster the emergence and spread of disease, akin to that of the 6th century.

Nevertheless, political inaction, collective apathy, and resistance to scientific consensus have emerged as significant barriers to effective intervention. Denial of global warming and rejection of public health measures

during the pandemic reflect a dangerous cultural trend of disengagement from empirical reality⁵¹. The history of 536 CE offers a powerful warning: even when humanity possesses the knowledge and resources to act, failure to do so in a timely and coordinated manner can yield catastrophic consequences.

This agenda can only be sustained by networks of scientific production and collaboration capable of turning data into decisions: maintaining and expanding open genomic surveillance (for example, through the Global Initiative on Sharing All Influenza Data (GISAID)), leveraging the legacy of the Global Influenza Surveillance and Response System (GISRS) of the WHO as an early-warning platform for respiratory viruses, and scaling wastewater-based epidemiology as a community sentinel⁵²⁻⁵⁴. In countermeasure development, initiatives such as the "100 Days Mission" coordinate research, regulation, and manufacturing to sharply compress the interval between detection and vaccine availability, while the One Health Joint Plan of Action (2022–2026) provides a cooperative roadmap to prevent, detect, and respond to emerging risks⁵⁵⁻⁵⁷. In parallel, curbing the infodemic through monitoring, rapid response, and psychological inoculation (prebunking) is essential, strategies shown to reduce adherence to false narratives, so that scientific evidence can effectively guide collective action amid interlinked climate and health crises⁵⁸⁻⁶⁰.

CONCLUSIONS

The historical experience of 536 CE, marked by climatic catastrophes and pandemics, provides a potent metaphor for the existential risks of our time. While contemporary societies are equipped with vastly superior scientific and technological tools, these assets are rendered ineffective in the absence of collective action, ethical commitment, and political accountability. This historical analogy must not be interpreted as a fatalistic inevitability but rather as a call to vigilance: knowledge alone does not prevent collapse; it must be actively and responsibly mobilized.

The relevance of this analysis lies in its potential to inform evidence-based public policies, to promote a culture that values science, and to reinforce the urgency of international cooperation in the face of global threats. We are not as defenseless as we were in 536 CE, but we risk repeating history if we fail to act with lucidity, solidarity, and urgency.

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CONFLICTS OF INTEREST

The author declares no conflicts of interest.

AUTHOR'S CONTRIBUTIONS

HMS: participated in all stages of writing the text.



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