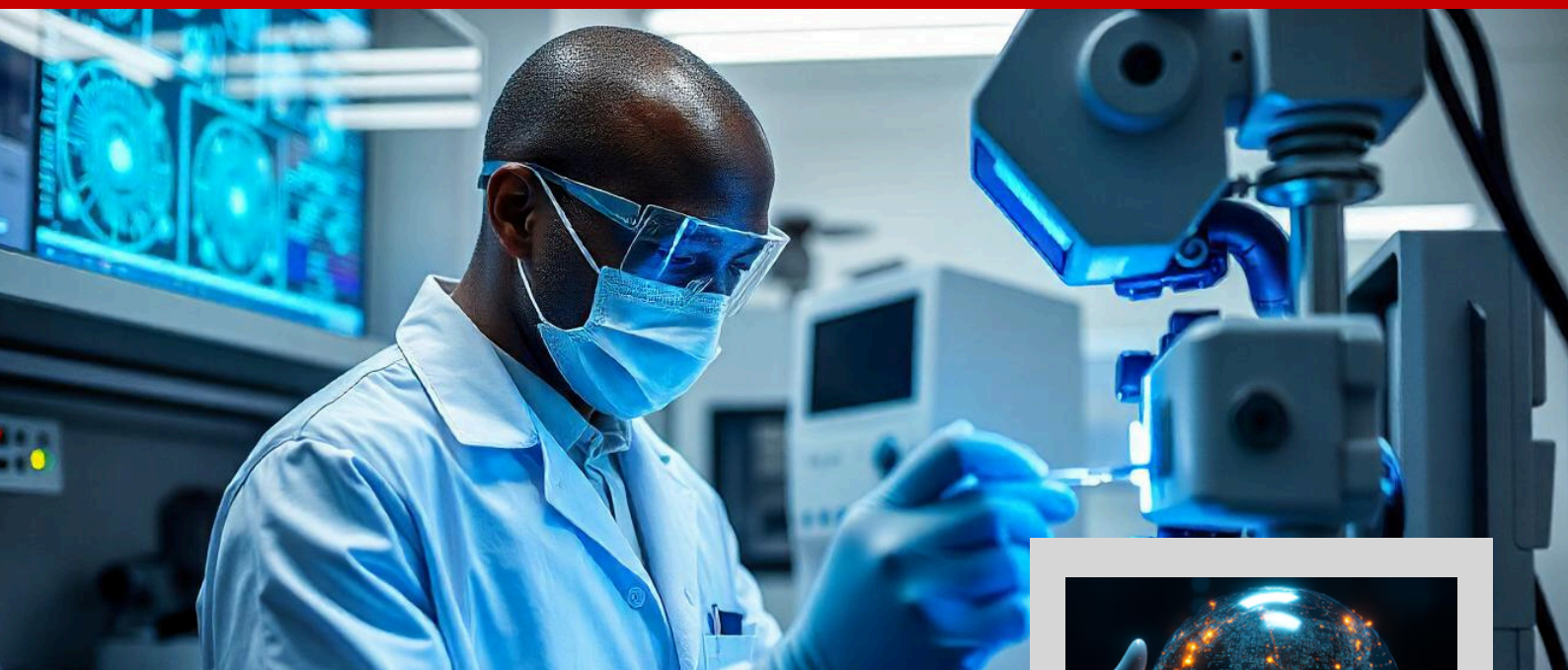


NEWSLETTER

AFRICAN NEWSLETTER ON ONE HEALTH AND BIOSECURITY



BIOSECURITY IN THE AGE OF ARTIFICIAL INTELLIGENCE (AI): WHAT ARE THE BENEFITS AND RISKS FOR AFRICA?



Spotlight– Dr. Sarah R. Carter

In this edition, we focus on a subject that is increasingly relevant in today's interconnected world: "Biosecurity in the Age of AI: What Are the Benefits and Risks for Africa?"

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Newsletter

AFRICAN NEWSLETTER ON ONE HEALTH & BIOSECURITY

VOLUME 18 | SEPTEMBER 2024

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INTELLIGENCE (AI): WHAT ARE THE BENEFITS
AND RISKS FOR AFRICA?**

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Welcome Address by GET COO



Dr. Bobadoye Ayodotun

Chief Operating Officer, GET Africa

Dear Readers,

Welcome to the 18th edition of the GET newsletter. Our newsletter has become one of the biggest platforms where we explore critical and timely topics in biosecurity and one health. In this edition, we focus on a subject that is increasingly relevant in today's interconnected world: **"Biosecurity in the Age of AI: What Are the Benefits and Risks for Africa?"**

As technology advances at an unprecedented pace, artificial intelligence (AI) is playing a transformative role in various sectors, including healthcare and biosecurity. AI's ability to analyze vast amounts of data rapidly and accurately presents immense opportunities for enhancing disease detection, monitoring, and response.

However, alongside these benefits come significant risks and ethical considerations, particularly concerning data privacy and the potential misuse of technology. Africa, with its unique socio-economic landscape and public health challenges, stands at a crucial crossroads. Harnessing AI's potential while safeguarding biosecurity is essential to ensuring the continent's sustainable development and resilience against emerging biosecurity threats. This volume brings together insightful perspectives from experts discussing both the promising opportunities and the critical challenges AI poses for biosecurity in Africa. From analyzing the role of AI in predicting and managing disease outbreaks to understanding how we can integrate indigenous knowledge with modern technological approaches, this edition aims to provide a comprehensive overview of the current landscape and future possibilities for AI in Africa. We invite you to engage with these discussions, reflect on the potential paths forward, and consider how we can collaboratively build a safer, more secure future.

We sincerely thank our contributing writers, whose expertise has enriched this conversation, and to our readers, whose continued support inspires us to delve deeper into these important issues. Your feedback is invaluable to us, and we look forward to your thoughts on this edition. Together, let's navigate the evolving landscape of biosecurity and AI, working towards a healthier and more secure Africa.



SPOTLIGHT

GET AFRICA NEWSLETTER SEPTEMBER 2024 VOL. 18



Dr. Sarah R. Carter

Principal, Science Policy Consulting LLC

Dr. Sarah R. Carter is the Principal at Science Policy Consulting LLC, where she focuses on societal and policy implications of emerging biotechnologies, including issues of responsible innovation, biosecurity, and international norms. She earned her PhD in Neuroscience from the University of California–San Francisco in 2007 and moved to the Washington, DC area to participate in science policy fellowships through the American Association for the Advancement of Science (AAAS) and at the National Academies of Science, Engineering, and Medicine. In 2009–2010, she worked at the White House Office of Science and Technology Policy (OSTP) and later joined the policy team at the J. Craig Venter Institute, a leading synthetic biology non-profit research institution. There, she conducted in-depth projects on regulatory and societal challenges related to advanced biotechnologies, including their biosecurity implications. In 2016, Dr. Carter founded Science Policy Consulting LLC and has provided insights and support to non-profit and non-governmental organizations, academic institutions, companies, and U.S. government agencies.

Her work has focused on advances in biotechnology tools and capabilities and their implications for biosecurity. As the tools for engineering biology advance, they promise new opportunities to improve biosecurity, but they could also be misused to cause harm. Dr. Carter has worked to develop and support policies and practices that safeguard those capabilities against misuse so that their benefits can be realized. In recent years, she has worked closely with the Nuclear Threat Initiative (NTI) on projects related to DNA synthesis screening and the implications of AI for biosecurity and has supported the launch of the AIxBio Global Forum. She is also a Senior Fellow at the Federation of American Scientists where she tracks broader trends in the bioeconomy.

Dr. Carter is the granddaughter of former U.S. President Jimmy Carter and Rosalynn Carter. These personal ties and their inspiring work through the Carter Center have always reminded her of the importance of public health initiatives, the need for international engagement, and the imperative to find solutions that work for everyone.

AlxBio and Biosecurity: Reserving a Seat at the Table for Africa

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The convergence of artificial intelligence (AI) and the life sciences will yield significant opportunities for the African continent, including for biosecurity and pandemic preparedness. AI tools and capabilities can be applied to improve biosurveillance more rapidly develop medical countermeasures, and optimize the production and distribution of vaccines and medicines. However, Africa will face significant challenges in realizing the full benefits of AI in the life sciences, particularly because AI may exacerbate existing problems related to equity, access, capacity and infrastructure, and bias. Furthermore, as with any new technology, AI tools and capabilities come with some risks, and biosecurity experts have highlighted the potential that AI models could enable malicious actors to more easily generate pathogens and toxins, including some with significant biosecurity implications. It will be critical for Africa to have a seat

at the table as the technology advances.¹ By incorporating African perspectives, we can ensure that AI development is more equitable, inclusive, and responsive to the specific needs of Africa. This is vital as new biosecurity solutions are developed and risks are assessed and mitigated.

The Benefits of AlxBio in Africa

Rapid advances in AI are already changing a wide range of life science industries from drug development and disease diagnostics to engineered microorganisms for the production of biofuels, food proteins, specialty chemicals, and other valuable compounds. In agriculture, AI-powered synthetic biology has the potential to improve crop production and food security by designing crops with enhanced yield, improved resistance to pests and diseases, and reduced environmental impact.²

¹ The Economist. How to ensure Africa is not left behind by the AI revolution. The Economist 2024 Jul 25 [Accessed 30 August 2024]. Available from: <https://www.economist.com/leaders/2024/07/25/how-to-ensure-africa-is-not-left-behind-by-the-ai-revolution>

² Schoeman M. How AI can inclusively transform agri-food systems in Africa. Brookings 2024 May 16 [Accessed 30 August 2024]. Available from: <https://www.brookings.edu/articles/how-ai-can-inclusively-transform-agri-food-systems-in-africa/>

AI models could also be developed to analyze vast amounts of data on soil conditions, weather patterns, and crop health to optimize planting, fertilization, and irrigation, and address emergent climate change issues.

AI models are also likely to yield significant benefits for biosecurity and pandemic preparedness, improving the ability to rapidly design vaccines and antibodies and deliver these interventions on time and to those in need. Some experts predict that AI-enabled protein design tools will enable the design of new antibodies based on a pathogen's genome within days and allow them to be produced within weeks. Older methods require months to produce antibodies and require access to patient samples. Experts also estimate that mRNA vaccines could be designed and deployed in as little as two to three weeks, rapidly stemming outbreaks. In the future, AI may be able to analyze transportation patterns, event-based surveillance information, and other data streams to design optimal delivery routes for tests, vaccines, personal protective equipment, and medical countermeasures, and recommend infrastructure purchases such as cold-chain equipment to optimize the resilience and adaptability of vaccine delivery routes. A report from the Nuclear Threat Initiative (NTI) titled,

"The Convergence of Artificial Intelligence and the Life Sciences" highlights some of these benefits [note: SRC was an author of this report].³ These promising applications of AI in vaccine development and distribution will become increasingly relevant as African leaders work toward the Partnerships for African Vaccine Manufacturing goal of producing 60% of the vaccines needed across the continent by 2040.⁴

Perhaps the most urgent capability gap that AI can help address across the African continent is the ability to rapidly detect the emergence of disease and understand the dynamics associated with its spread, as demonstrated by the recent outbreak of the mpox virus. These challenges are due, in part, to the lack of funding for diagnostic equipment and pressures on already-fragile healthcare systems,⁵ but more effective methods for gathering and analyzing epidemiological and genomic data would improve our understanding of the unfolding crisis. AI could be a powerful tool for analyzing large datasets to understand trends, track viral evolution among populations, and identify high-risk variants before they spread widely. This type of integrated, AI-enabled biosurveillance would require infrastructure investment, and there are promising continent-wide efforts and emerging technological solutions that may pave the way.

³ Carter S, Wheeler NE, Chwalek S, Isaac CR, Yassif J. The Convergence of Artificial Intelligence and the Life Sciences: Safeguarding Technology, Rethinking Governance, and Preventing Catastrophe. NTI. 2023, 31-32. [Accessed 30 August 2024]. Available from: <https://www.nti.org/analysis/articles/the-convergence-of-artificial-intelligence-and-the-life-sciences/>

⁴ Africa Centres for Disease Control and Prevention. A Breakthrough for the African Vaccine Manufacturing. [online]. ACDC: Accra, Ghana; 2023 [Accessed 30 August 2024]. Available from: <https://africacdc.org/news-item/a-breakthrough-for-the-african-vaccine-manufacturing/>

⁵ Cheng M. WHO declares mpox outbreaks in Africa a global health emergency as a new form of the virus spreads. Associated Press 2024 Aug 14 [Accessed 30 August 2024]. Available from: <https://apnews.com/article/who-mpox-africa-health-emergency-cc9bdf31b49d06bec5efd44fb55d5e42>

For example, Africa CDC's Pathogen Genomic Initiative 2.0 seeks to build an integrated genomic surveillance approach that enables the timely sharing of data to inform public health actions.⁶ Additionally, portable, automated metagenomic sampling systems are becoming cheaper and more widely available, especially in remote and low-resource settings.⁷ These investments and capabilities are small yet promising steps toward the ultimate goal of creating agile and responsive AI-enabled biosurveillance systems across the African continent.

The Challenges and Risks of AIxBio in Africa

While AI offers immense potential for Africa, AI development is unevenly distributed with only a handful of countries – mainly in the U.S., Europe, and China – driving innovation, largely due to the availability of substantial resources, including research funding, computational infrastructure, availability of curated data, and a trained workforce. Furthermore, while many of the forthcoming AI models and tools may be available at scale, the research and development infrastructure required to effectively deploy these new tools is not present across all countries. This geographical bias has significant implications for Africa as consequential

decisions about AI's purpose, functionality, and safeguards are primarily made in regions with vastly different contexts and priorities.⁸

Dr. Oyewale Tomori once said that reaping the benefits of AI for Africa requires significant investment, but we get the risks for free. It is true that, in addition to the challenges that Africa will face in realizing the benefits of AI for biosecurity, advances in AI also pose biosecurity risks for the continent. As noted in the NTI report, experts have pointed to the potential that AI tools that design biological systems could be misused to cause harm. For example, as AI tools are developed for biosurveillance purposes that can identify harmful new viral variants, these same capabilities could suggest new variants that a malicious actor may want to generate.⁹ General-purpose, foundation, or "frontier" AI models (such as those that underlie OpenAI's ChatGPT) could enable malicious actors to more easily access information about how to turn a new pathogen design into a biological reality or ideas about how to target vulnerable populations, agriculture, or infrastructure. These frontier AI models may also contribute to the generation of misinformation and disinformation, which is likely to have significant implications for the biosecurity landscape in Africa.

⁶ Africa Centres for Disease Control and Prevention. Africa Pathogen Genomics Initiative | Africa PGI 2.0. [online] [Accessed 30 August 2024]. Available from: <https://africacdc.org/africa-pathogen-genomics-initiative-africa-pgi/>

⁷ Berke A. Defense-Forward Biosecurity. Asimov Press 2024 [Accessed 30 August 2024]. Available from: <https://press.asimov.com/articles/defense-forward-biosecurity>

⁸ Anthony A, Sharma L, Noor E. Advancing a More Global Agenda for Trustworthy Artificial Intelligence. Carnegie Endowment for International Peace 2024 Apr 30 [Accessed 30 August 2024]. Available from: <https://carnegieendowment.org/research/2024/04/advancing-a-more-global-agenda-for-trustworthy-artificial-intelligence?lang=en>

⁹ Dybul M. chairperson. Biosecurity in the Age of AI: Chairperson's Statement, May 2023, The Rockefeller Foundation's Bellagio Center. Helena, 2023 [Accessed 30 August 2024] Available from: https://938f895d-7ac1-45ec-bb16-1201cbbc00ae.usrfiles.com/ugd/938f89_74d6e163774a4691ae8aa0d38e98304f.pdf

There are efforts underway, primarily in developed countries at the forefront of AI innovation, to improve AI safety and reduce the biosecurity risks related to AI models. AI Safety Institutes are quickly being established in the U.K., the U.S., and other countries. Industry commitments, such as those made at the White House in July 2023,¹⁰ include the need to assess frontier AI models for biosecurity risks. AI tools specific to biology have also been a focus for risk mitigation efforts. The AI protein design community recently developed principles for responsible development¹¹ and NTI and others are working to advance technical guardrails for these tools.

A key challenge for these efforts has been the difficulty in finding the right balance between enabling the benefits of these tools while reducing biosecurity risks. This challenge is especially acute in the context of AI tools specific to biology because these tools hold such significant promise for biosecurity. As risk mitigation efforts advance, it will be critical that the benefits of these tools are maintained and that they are accessible to all. Discussions and decisions about how to strike this balance are moving rapidly, and this is one area where perspectives from Africa would be particularly valuable.

A Path Forward

There are some steps that Africa could take to reap the benefits of AI for biosecurity and to engage with the international community on risk mitigation approaches. Within Africa, efforts to strengthen the knowledge base about AI tools and capabilities could include training programs for policymakers, researchers, and practitioners as well as knowledge-sharing platforms (including, perhaps, the GET Consortium). Capacity-building efforts could prioritize digital infrastructure, cybersecurity, and governance frameworks for AI. Multi-stakeholder engagement across Africa could ensure a balanced perspective.

Collaborative engagement with the international community will be critical. Current efforts to govern AI have been led by a handful of mostly Western countries, including the US, the UK, and the European Union. As AI Safety Institutes are being established in countries around the world, an African AI Safety Institute could provide a valuable way to ensure that countries at the forefront of innovation have a reliable interface with African perspectives and priorities. Another way to contribute to international discussions will be to participate in the AIxBio Global Forum,¹² recently launched by NTI.

¹⁰ The White House. FACT SHEET: Biden-Harris Administration Secures Voluntary Commitments from Leading Artificial Intelligence Companies to Manage the Risks Posed by AI. [online]. Washington D.C.; 2023 [Accessed 30 August 2024]. Available from: <https://www.whitehouse.gov/briefing-room/statements-releases/2023/07/21/fact-sheet-biden-harris-administration-secures-voluntary-commitments-from-leading-artificial-intelligence-companies-to-manage-the-risks-posed-by-ai/>

¹¹ Responsible AIxBioDesign. Community Values, Guiding Principles, and Commitments for the Responsible Development of AI for Protein Design. [online]. 8 March 2024 [Accessed 30 August 2024]. Available from: <https://responsiblebiodesign.ai/>

¹² Nuclear Threat Initiative. NTI Convenes the First International AI-bio-Forum. NTI 2024 Apr 17 [Accessed 30 August 2024]. Available from: <https://www.nti.org/news/nti-convenes-the-first-international-ai-bio-forum/>

This Forum is the only international platform that seeks to convene diverse stakeholders to address pressing biosecurity risks associated with rapid advances in AI tools and capabilities.

AI holds tremendous promise for improving biosecurity, and Africa will play

an important role in ensuring that these benefits can be realized. African perspectives are also urgently needed in discussions of how AI tools and capabilities should be developed and disseminated to ensure that AI is used responsibly and equitably for the benefit of all.



Hayley Anne

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Dr. Aparupa Sengupta

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Harnessing Artificial Intelligence for Biosecurity in Africa: Opportunities and Challenges

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Abstract

This article investigates the integration of artificial intelligence (AI) in biosecurity efforts across Africa, exploring both the possible advantages and accompanying concerns. AI's potential to boost disease surveillance, agricultural biosecurity, and genetic research provides major advantages for a continent dealing with infectious illnesses, food shortages, and insufficient healthcare systems. AI-powered disease monitoring can simplify early identification and response, while precision agriculture can increase crop health and food security. Additionally, AI-driven bioinformatics can speed genomic research and medication development. However, the adoption of AI in biosecurity also brings obstacles, including the possible weaponization of biological pathogens, ethical issues over data privacy, and the amplification of digital inequalities. The article underlines the need for solid regulatory frameworks, investment in digital infrastructure, and international engagement to guarantee that AI's benefits are exploited while reducing its potential drawbacks in the African setting.

Introduction

The combination of biosecurity with artificial intelligence (AI) represents a substantial shift in how biological risks are controlled worldwide. Biosecurity, which has historically focused on safeguarding biological systems from hazardous agents such as viruses, bioterrorism, and environmental hazards, is increasingly using AI technology to improve detection, response, and mitigation efforts. AI is the creation of machines that can execute

activities that would normally require human intellect, such as data processing, pattern recognition, and decision-making (1). The ability of AI to handle massive volumes of data quickly, identify risks in real-time, and optimize solutions creates tremendous prospects to transform biosecurity policies.

For Africa, which faces difficulties such as new infectious illnesses, food insecurity, and inadequate healthcare systems, the use of AI in biosecurity offers considerable

promise. AI's capacity to rapidly evaluate epidemiological data, predict disease outbreaks, and offer early warnings can be critical in preventing and managing pandemics. In areas with limited human resources, AI can act as a force multiplier, supporting governments in recognizing and responding to biosecurity risks more efficiently (2). However, these advantages come with considerable concerns, particularly in poor countries like Africa, where infrastructure, regulation, and governance institutions may not be completely prepared to deal with the ethical, security, and operational difficulties brought by AI (2).

AI has been used in a variety of biosecurity applications, ranging from disease monitoring to agricultural protection, but its increasing use raises concerns about data privacy, equality, and the potential for AI to be weaponized (3). Furthermore, the discrepancy in access to AI technology between industrialized and developing countries, particularly those in Africa, may worsen existing vulnerabilities and inequities. Furthermore, AI systems may unintentionally perpetuate prejudice, resulting in ineffective or detrimental consequences, particularly in locations underrepresented in global data sets (4). As AI evolves, Africa must handle the potential challenges that come with this technological revolution in biosecurity, ensuring that it contributes to the continent's long-term security and growth.

This article seeks to examine the potential of artificial intelligence (AI) in enhancing biosecurity measures in Africa, with a specific focus on disease detection, agricultural biosecurity, and genetic

research. Additionally, it will analyze the correlated hazards, such as the militarization of artificial intelligence and ethical problems related to biology and deliberate on the measures that African nations might use to alleviate these difficulties. Gaining a comprehensive understanding of the ambivalent characteristics of artificial intelligence (AI) in the field of biosecurity is crucial for devising tactics that optimize its capabilities while also protecting against its potential for abuse.

Benefits of AI in Biosecurity for Africa

1. Enhanced Disease Surveillance and Early Detection

Artificial intelligence (AI) provides African nations with sophisticated instruments for disease monitoring, allowing for immediate analysis of data to identify nascent dangers before they grow into widespread epidemics. Machine learning algorithms have the capability to evaluate extensive quantities of health data from many sources, including social media, medical records, and environmental sensors, in order to detect trends and forecast epidemics. AI-powered systems have the capability to monitor real-time reports of uncommon symptoms or surges in health-related web searches, which might suggest the appearance of a novel illness (5).

Amidst the COVID-19 epidemic, AI-powered applications such as BlueDot and HealthMap offered timely alerts about the virus's transmission by examining worldwide travel patterns, social media discussions, and other data sources (6). African nations, many of which lack adequate health infrastructure, might profit greatly from such technology to detect, and limit the

spread of illnesses such as Ebola, malaria, or other zoonotic diseases endemic on the continent.

2. Precision Agriculture and Food Security

AI can greatly boost biosecurity in African agriculture, which is crucial for food security across the continent. By employing AI technologies to monitor crop health, forecast pest infestations, and optimize resource utilization, farmers can limit the impact of biological hazards, such as diseases and invasive species, on their crops. Precision agricultural techniques, enabled by AI, offer the capacity to manage farms more effectively, conserve water, and apply fertilizers and pesticides in a targeted manner, therefore avoiding crop losses and boosting biosecurity (7).

AI models can also aid in anticipating climatic trends, which are vital in regulating the consequences of climate change on agriculture. Africa, which is particularly sensitive to the consequences of climate change, might utilize AI-driven climate models to foresee times of drought or floods that could increase food shortages or accelerate the spread of plant diseases.

3. Bioinformatics and Genomic Research

AI's role in Bioinformatics and genomic research presents another avenue for improving biosecurity in Africa. AI-driven tools can analyze genetic data to identify potential biological threats, such as new virus strains or antibiotic-resistant bacteria. This is particularly important for African countries where infectious diseases remain a significant public health challenge.

AI can also be used to develop new vaccines or treatments for diseases that disproportionately affect the African population, such as malaria or HIV/AIDS. By leveraging AI to accelerate drug discovery and optimize vaccine distribution, African nations can strengthen their biosecurity frameworks, reducing the impact of pandemics and other biological crises (8).

Risks of AI

1. Weaponization of Biological Agent

While AI may be used to increase biosecurity, it also raises the possibility of being exploited to develop or deploy biological weapons. The potential of AI to scan enormous databases, predict biological processes, and enhance genetic engineering techniques might be leveraged by bad actors to generate more dangerous viruses or drug-resistant germs (9). For Africa, where governance and regulatory systems may not be as solid as in industrialized countries, the danger of AI being exploited for bioterrorism is particularly worrying. Weak biosecurity controls might render the continent vulnerable to both domestic and international entities wanting to exploit new technologies for destructive ends.

2. Ethical Concerns and Data Privacy

AI's reliance on massive datasets creates ethical problems, specifically around data privacy and the fair deployment of AI in Africa. Many AI-driven biosecurity solutions require access to health, genetic, and personal data from humans. In African nations where data protection regulations are either weak or poorly implemented, the collecting and use of

such data might lead to violations of privacy and abuse of sensitive information (10).

Additionally, there is the danger of prejudice in AI algorithms, which might disproportionately damage African communities. AI models are generally trained on datasets from more developed nations, leading to possible biases when deployed in African environments. This might result in erroneous projections or solutions that do not effectively address Africa's distinct biosecurity issues.

3. Digital Inequality Technological Dependency

While AI holds enormous promise for boosting biosecurity, the technical divide between Africa and more developed nations remains a substantial obstacle. Many African countries lack the infrastructure, experience, and financial resources needed to properly integrate AI-driven biosecurity systems. This digital disparity might deepen the gap between African states and the rest of the globe, making it harder for the region to protect itself from biological dangers.

Moreover, dependence on AI systems developed and maintained by foreign corporations might generate a dependency that threatens Africa's sovereignty in regulating its biosecurity. If African states grow unduly reliant on foreign technology, they may be subject to external influence or manipulation, especially in times of crisis (11).

Conclusion

Biosecurity in the era of AI poses both revolutionary prospects and major concerns for Africa. AI technology may

increase disease surveillance, improve agricultural biosecurity, and speed genomic research, therefore increasing the continent's ability to respond to biological threats. However, the possible exploitation of AI for bioterrorism, ethical concerns over data privacy, and the risk of technological reliance must be properly handled. For Africa to effectively leverage the benefits of AI in biosecurity while reducing these threats, there is a need for solid governance frameworks, investment in digital infrastructure, and international engagement.

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multiple certifications, she is well-versed in public health crises, infection prevention, and biorisk management. Highly organized, adaptive, and adept in both laboratory research and program implementation, Sarah is devoted to improving healthcare outcomes, particularly in resource-limited situations.

Artificial Intelligence (AI) In Africa: Challenges and Prospects in Biosecurity

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Executive Summary

In recent years, the intersection of artificial intelligence (AI) and biosecurity has become increasingly significant and a crucial area of focus. Healthcare systems are known to be very fragile in Africa; the potential for AI to transform biosecurity measures is immense. AI's rapid development presents both profound opportunities and serious challenges in the field of biosecurity. This article elaborates on the benefits and risks associated with the use of AI in biosecurity and the various ways it can be used to enhance biosecurity. Genuine concerns about AI in Africa are highlighted, while ways through which Africa can ultimately benefit from advancement in AI for biosecurity are buttressed. AI has the potential to contribute to sustainable development in Africa. It will encourage resource optimization and utilization. The technology will support the transition to renewable energy, creating more sustainable and efficient cities, supporting development in agriculture, and improving healthcare outcomes. By leveraging AI technologies, Africa can drive sustainable development and improve the quality of life for its citizens.

Keywords: Biosecurity, AI, Benefits Risk, Africa

Introduction

Biosecurity refers to the measures and practices implemented to prevent the introduction, spread, and transmission of harmful biological agents, such as pathogens, invasive species, or genetically modified organisms. In the age of AI, biosecurity has become even more important due to advancements in biotechnology and the potential misuse of these technologies. Protecting biodiversity by preventing the

introduction of invasive species, biosecurity helps to preserve Africa's unique ecosystems and outbreaks: Biosecurity measures can help prevent the spread and risk of pandemics and epidemics. The term works well in Safeguarding food security through the protection of crops and livestock from diseases and pests; biosecurity helps to ensure a stable and secure food supply for Africa's growing population. Biosecurity practices can help farmers

adopt more sustainable and environmentally friendly farming methods, reducing the use of harmful chemicals and improving overall crop health. Its support for Agricultural sustainability is second to none. It is naturally a careful measure geared towards preventing the introduction of harmful microscopic and macroscopic organisms intentionally or unintentionally outside their native range and/or within new environments due to measures taken to stop the distribution of harmful organisms to human, animal, and plant life. It combines processes and systems that have been put in place by bioscience laboratories, customs agents, and agricultural managers to prevent the use of dangerous pathogens and toxins in our vicinities in Africa. The major aim of biosecurity is to protect human health and boost agricultural productivity through the prevention, control, and management of biological risk factors. Biosecurity also aims to protect against acts of bioterrorism, prevent adverse biosecurity events, and offer advice on appropriate interventions and political and social changes that should be adopted by government regulatory agencies.

Biosecurity hazards are biological agents and toxins that pose a threat to human health, animals, wildlife, or plants. Such hazards include waste microorganisms' viruses or toxins from biological sources such as venoms from animals and insects (Kadri et al. 2023).

Biosecurity

Biosecurity could be defined as the measures aimed at protecting populations from biological threats, including infectious diseases, bioterrorism

and the spread of harmful biological agents. Its many benefits include;

Dictation of Biohazards in Our Vicinities

1. Food biosafety, which is a biological, chemical, or physical agent in, or condition of, food with the potential to cause an adverse health effect.
 2. ZOONOSIS is a biological agent that can be transmitted naturally between wild or domestic animals and humans.
 3. Animal health. Any pathogenic agent that could produce adverse consequences on the community.
 4. Plant health. Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plant products.
- Plant Health quarantine. A pest of potential economic importance to the area but not widely distributed is officially controlled.

Deep Meaning of Artificial Intelligence (AI)

This refers to the simulation of human intelligence in machines that are programmed to think, learn, and act like humans. These machines are designed to perform tasks that typically require human intelligence, such as problem-solving, decision-making, and pattern recognition.

AI technologies can be broadly categorized into three main types:

1. Narrow or weak AI: This type of AI is designed to perform a specific task or set of tasks, such as image recognition, natural language processing, or voice recognition. Narrow AI systems are trained on large datasets and can learn from experience, but they are limited in their ability to perform a wide range of tasks.

2. General or strong AI: This type of AI is designed to have the ability to perform any intellectual task that a human being can perform. General AI systems are capable of learning, reasoning, and understanding in a way that is similar to human intelligence, making them more versatile and powerful than narrow AI systems.

3. Superintelligence: This type of AI is designed to have intelligence that is significantly beyond that of the best human minds. Super intelligent AI systems would be capable of solving complex problems and making decisions that are far beyond the capabilities of current human intelligence.

AI technologies are being used in a wide range of applications, including healthcare, finance, transportation, and manufacturing. As AI continues to evolve and become more advanced, it has the potential to transform various industries and improve numerous aspects of our lives.

In the age of AI, biosecurity continues to play a crucial role in protecting people, animals, and the environment from biological threats. However, AI technologies can also be used to enhance biosecurity efforts and improve our ability to detect, prevent, and respond to biological threats.

Benefits of Artificial Intelligence on Biosecurity

AI in Africa has contributed immensely to enhancing disease surveillance and early detection in biosecurity. This allows quicker response to potential threats.

-Predictive Analysis: AI algorithms can predict the spread of diseases by

analyzing patterns in data such as human locomotion, population density and climate conditions. Through this feature, planning and implementing preventive measures can be achieved.

-Environmental Monitoring: AI can also be used to monitor and manage Africa's diverse ecosystems. These ecosystems are often under serious threat from human activities, and climate change. AI can also be able to track changes in land use, deforestation, and wildlife population through satellite imagery and machine learning. The data collected can be used for conservation efforts and biosecurity planning

The technology will strengthen biosecurity controls at the interface between digital design tools and physical biological systems. The use of AI tools will build next-generation pandemic preparedness and response capabilities. The convergence of artificial intelligence (AI) and life sciences is an emerging area of research and development with promising benefits and applications, but it may also have security implications. AI can increase and mitigate biosecurity risks, specifically on concerns of transmissible biological threats that could pose significant epidemic and pandemic-scale consequences.

Various Ways AI Can Be Used to Enhance Biosecurity

1. Predictive modeling: AI algorithms can be used to analyze large datasets and identify patterns and trends related to biological threats. By using predictive modeling techniques, such as machine learning and data mining, AI systems can help identify potential risks and provide early warnings for biosecurity threats.

2. Surveillance and monitoring: AI technologies, such as computer vision and sensor networks, can be used to monitor and detect biological threats in real-time. By analyzing data from various sources, such as camera feeds, sensor readings, and social media posts, AI systems can help identify unusual patterns and alert authorities to potential biosecurity threats.

3. Risk assessment and management: AI can be used to assess and manage biosecurity risks more effectively. By analyzing data from various sources, such as historical outbreaks, environmental conditions, and animal health data, AI systems can help identify high-risk areas and provide recommendations for biosecurity measures to prevent or mitigate the impact of biological threats.

4. Decision support: AI can be used to provide decision-makers with real-time insights and recommendations for biosecurity management. By analyzing data from various sources, such as epidemiological models, environmental data, and animal health data, AI systems can help inform decision-making processes and support the development of effective biosecurity strategies.

5. Biomedical research: AI can be used to accelerate biomedical research and improve our understanding of biological systems. By analyzing large datasets and identifying patterns and trends, AI systems can help researchers identify potential targets for drug development, predict the behaviour of pathogens, and develop more effective diagnostic and treatment tools.

In a nutshell AI has the potential to enhance biosecurity efforts by providing

predictive modeling, surveillance and monitoring capabilities, risk assessment and management tools, decision support systems, and accelerating biomedical research. By leveraging AI technologies, we can improve our ability to detect, prevent, and respond to biological threats, protecting human health, animal health, and the environment.

Concerns About AI In Africa

In Africa, negative thoughts about AI lie in the future use and application of AI in biological conflict in line with the views of some experts, including former Google CEO Eric Schmidt and Dario Amodei, CEO of Anthropic, who, in his testimony before the US Senate Judiciary Subcommittee on Privacy, Technology, and the Law, warned that in just two to three years, AI has the potential to “greatly widen the range of actors with the technical capability to conduct a large-scale biological attack.” OpenAI’s Sam Altman has called for regulation on AI models “that could help create novel biological agents.” President Biden’s recent Executive Order on Safe, Secure and Trustworthy Development and Use of Artificial Intelligence explicitly tasks relevant agencies with assessing the ways in which AI can increase and potentially help mitigate biosecurity risks.

Deliberate use of microorganisms like viruses or bacteria to cause disease or death has a long and terrible history: Japan weaponized typhus and cholera in World War II, and the Soviet Union’s bioweapon program throughout the Cold War included producing and stockpiling smallpox, anthrax, and drug-resistant plague. The United States also developed its own bioweapon program in this period, including anthrax and Q-fever, until it was terminated by President Nixon in 1969.

Researchers in Africa currently have shown concerns that AI might increase bioweapon know-how. AI experts are concerned that highly capable AI models could assist non-experts in designing, synthesizing, and using these weapons, thus expanding the pool of actors that could access these dangerous capabilities. Concerns are increasingly centred on future capabilities rather than those of the present day.

MIT students recently demonstrated how large language model (LLM) chatbots could be used to help non-experts understand the process of manufacturing risky pathogens. Within one hour, students without science backgrounds had used the chatbots to list four viruses capable of causing a pandemic, identify reverse genetics as a means to manufacture them and suggest acquisition methods that could help bypass misuse screening.

In the future, more advanced AI capabilities may cause greater concern as LLMs increasingly enable the synthesis and production of sophisticated and accurate insights at an expert level. Even less advanced models, when focused on biological data, might give rise to biological risks. In 2022, an experiment revealed how AI used in pharmaceutical design could be tweaked to design highly toxic chemicals instead.

Today, the Centres for Disease Control warn that the bacteria that causes anthrax is one of the most likely agents to be used in a biological attack. To date, the development, containment, and deployment of such weapons have required significant resourcing and expertise. This does not mean such weapons have only been accessible to nation-states, but it has ensured that only

a limited number of actors have had the capability to develop them.

Researchers around the globe are concerned that AI might increase bioweapon know-how, while AI experts are concerned that highly capable AI models could assist non-experts in designing, synthesizing, and using these weapons, thus expanding the pool of actors that could access these dangerous capabilities. Concerns are increasingly centered around future capabilities rather than those of the present day.

In 2020, COVID-19 brought the world to its knees, with nearly 29 million estimated deaths, acute social and political disruptions, and vast economic fallout. However, the event's impact could have been far worse if the virus had been more lethal, more transmissible, or both. For decades, experts have warned that humanity is entering an era of potential catastrophic pandemics that would make COVID-19 appear mild in comparison. History is well acquainted with such instances, not least the 1918 Spanish Flu, the Black Death, and the Plague of Justinian—each of which would have dwarfed COVID-19's deaths if scaled to today's populations.

The Risks and Challenges

1. Data Privacy and Security: the use of AI in biosecurity relies on the collection and thorough analysis of large amounts of personal and health data. In Africa, where data protection laws are poorly implemented, there is a high chance of data breaches or misuse.

2. Bias And Inequality: AI systems are only as good as the data they are trained on. If the data presented is biased or

incomplete, the AI's predictions and recommendations may also be biased leading to unequal access to healthcare and resources.

1. Dependence On Foreign Technology: many African countries rely on AI technologies developed and controlled by foreign entities. This makes Africa vulnerable to unforeseen weaponization or withholding of AI during critical times.

2. Ethical Concerns: the use of AI in biosecurity raises ethical questions about surveillance, consent, and the potential for AI to be used in harmful ways, such as in the development of bioweapons.

The Way Forward

For Africa to fully benefit from the advancements in AI for biosecurity, there is a need for a concerted effort to address the associated risks. These include:

Strengthening Data Protection Laws: African countries need to develop and enforce robust data protection laws to ensure that personal and health data are used responsibly and securely.

Building Local Capacity: Investments in education and infrastructure are necessary to build local expertise in AI and biosecurity. This will reduce dependence on foreign technologies and help tailor AI solutions to the unique needs of African populations.

International Collaboration: Africa should engage in international partnerships to share knowledge, resources, the best practices in AI and biosecurity. This collaboration can help mitigate the risks and amplify the benefits of AI.

Conclusion

AI has the potential to significantly enhance biosecurity in Africa by enabling early detection, predictive analytics, and improved resource allocation. However, the risks, including data privacy concerns, bias and ethical issues, must be carefully managed. By strengthening data protection laws, building local capacity, promoting ethical use of AI, and fostering international collaboration.

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Biosecurity in the Age of AI: Benefits and Risks for Africa with a Special Focus on Nigeria

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Introduction

Biosecurity refers to the strategic measures and protocols aimed at preventing the introduction, spread, and impact of harmful biological agents, whether they are naturally occurring, accidentally released, or intentionally introduced [1]. As the global community grapples with the rapid advances in artificial intelligence (AI), its application in biosecurity has gained significant attention. AI presents new opportunities and challenges in detecting, responding to, and managing biological threats. This review focuses on the intersection of biosecurity and AI in Africa, with particular attention to Nigeria, discussing the potential benefits, risks, and implications for the continent. Artificial intelligence has transformed many sectors, including healthcare, agriculture, and defense. In biosecurity, AI's capabilities include early detection of outbreaks, predictive modeling, enhanced surveillance, and efficient response mechanisms [2]. These applications are particularly crucial in regions like Africa, where resources for conventional biosecurity measures are

often limited. AI's ability to process vast amounts of data quickly and accurately makes it an invaluable tool in identifying emerging biological threats. Machine learning algorithms, for instance, can analyze patterns in data from various sources, such as social media, news reports, and medical records, to predict the likelihood of an outbreak [3]. AI can also assist in the development of vaccines and treatments by analyzing biological data and identifying potential targets for intervention.

Benefits of AI in Biosecurity for Africa

1. Early Detection and Response

One of the most significant benefits of AI in biosecurity is its potential for early detection of biological threats. In Africa, where public health infrastructure can be inadequate, AI-driven tools can play a critical role in identifying outbreaks before they spread widely. For example, AI-powered platforms like HealthMap and BlueDot have been used globally to detect disease outbreaks by analyzing data from various sources [4]. These tools

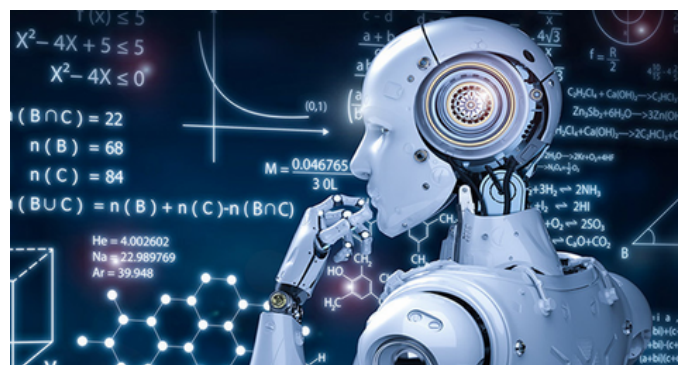
can be adapted and implemented in African countries to monitor disease patterns and provide early warnings. In Nigeria, AI has been applied in projects like the Nigerian Centre for Disease Control (NCDC)'s use of predictive analytics to anticipate outbreaks of diseases like Lassa fever and Ebola [5]. The NCDC has collaborated with international partners to deploy AI-driven models that analyze environmental, climatic, and social factors contributing to disease outbreaks. These models help identify high-risk areas and populations, enabling targeted interventions.

2. Enhanced Surveillance and Monitoring

AI can enhance biosecurity through improved surveillance and monitoring systems. In Nigeria, where surveillance networks are often fragmented and under-resourced, AI offers a way to integrate various data streams into a cohesive system [6]. AI-driven tools can analyze data from satellite imagery, environmental sensors, and health records to monitor potential biosecurity threats in real-time. This capability is crucial for a country like Nigeria, which faces challenges like porous borders and limited healthcare access in rural areas. For instance, AI-based systems can be used to monitor agricultural biosecurity by detecting pests and diseases that threaten food security. In 2018, Nigeria experienced an outbreak of the Fall Armyworm, which devastated maize crops across the country [7]. AI-driven monitoring systems could have provided early warnings and helped mitigate the impact by suggesting timely interventions.

3. Accelerated Research and Development

AI's role in accelerating research and development in biosecurity cannot be overstated. In Nigeria, where research funding is often limited, AI can help optimize resources by streamlining the R&D process. AI can analyze vast datasets from genomic studies, clinical trials, and epidemiological research to identify trends and potential breakthroughs [8]. This capability is particularly relevant in the development of vaccines and therapeutics for diseases prevalent in Africa. During the COVID-19 pandemic, Nigerian researchers collaborated with international partners to use AI in modeling the spread of the virus and developing strategies for vaccine distribution [9]. AI-driven simulations helped predict the impact of various public health measures, guiding policymakers in their response efforts.



Risks and Challenges of AI in Biosecurity for Africa

1. Ethical and Privacy Concerns

The use of AI in biosecurity raises significant ethical and privacy concerns. In Nigeria, where data protection laws are still evolving, the deployment of AI-driven surveillance systems could lead to misuse of personal data [10]. The collection and

analysis of health data, environmental data, and social media activity by AI systems can infringe on individuals' privacy rights. Moreover, there is a risk of bias in AI algorithms, which could result in unequal access to biosecurity measures and resources. To address these concerns, Nigeria needs to establish robust legal and ethical frameworks that govern the use of AI in biosecurity. This includes ensuring that AI systems are transparent, accountable, and designed to protect individuals' rights [11]. These resources are limited [12]. The cost of developing, deploying, and maintaining AI-driven biosecurity

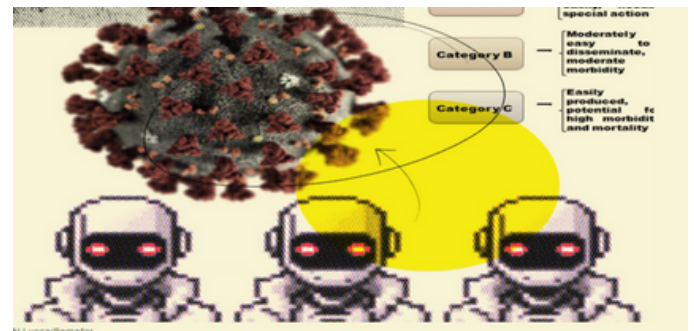
2. Resource Constraints

While AI offers numerous benefits, its implementation in biosecurity requires significant resources, including advanced infrastructure, technical expertise, and financial investment. In many African countries, including Nigeria, systems can be prohibitive, particularly in regions with limited budgets for public health. Moreover, the lack of technical expertise in AI and data science is a significant barrier to the effective use of AI in biosecurity. Nigeria must invest in education and training programs to build a workforce capable of developing and managing AI systems [13].

3. Dependence on External Technologies

Nigeria's reliance on foreign technology and expertise in AI is another challenge. While international collaborations are essential, they also create dependencies that can limit Nigeria's autonomy in biosecurity [14]. The country needs to develop its Indigenous AI capabilities to ensure that it can address its unique biosecurity challenges effectively.

Moreover, the reliance on external technologies raises concerns about data sovereignty. Nigeria must ensure that its data is managed and stored within its borders and that it retains control over how this data is used [15].



AI and Bioterrorism in Nigeria: Emerging Threats

The rise of AI also presents new risks in the realm of biosecurity, particularly in the context of bioterrorism. In Nigeria, where terrorist groups like Boko Haram and other militant factions operate, the potential use of AI to enhance bioterrorist capabilities is a growing concern [20]. AI can be used to design, develop, and deploy biological agents with unprecedented precision, posing significant challenges to national security. AI-driven technologies can facilitate the synthesis of novel pathogens, making it easier for terrorist groups to create and deploy biological weapons [21]. Moreover, AI can be used to evade detection by conventional surveillance systems, making it more difficult for authorities to respond to bioterrorist attacks. These capabilities underscore the need for Nigeria to strengthen its biosecurity infrastructure and develop strategies to counter the emerging threats posed by AI-enhanced bioterrorism. To address these challenges, Nigeria must invest in

advanced biosecurity measures, including AI-driven threat detection and response systems. Additionally, the country needs to enhance its intelligence-gathering capabilities to identify and neutralize bioterrorist threats before they materialize [22]. International collaboration will also be crucial in developing global norms and regulations to prevent the misuse of AI in bioterrorism.

Conclusion

The integration of AI into biosecurity presents both opportunities and challenges for Africa, with Nigeria at the forefront of this transformation. AI has the potential to revolutionize biosecurity by enabling early detection of outbreaks, enhancing surveillance and monitoring, and accelerating research and development. However, the deployment of AI in biosecurity also raises significant ethical, legal, and resource-related challenges that must be addressed. For Nigeria, the key to leveraging AI in biosecurity lies in developing robust legal and ethical frameworks, investing in infrastructure and capacity building, promoting indigenous AI development, strengthening international collaboration, and enhancing public awareness and engagement. By adopting a strategic approach, Nigeria can harness the power of AI to protect its population from biological threats while mitigating the risks associated with these advanced technologies. In the age of AI, biosecurity is not just a national concern but a global imperative. Nigeria's experience offers valuable lessons for other African countries and the international community as they navigate the complex landscape of biosecurity in the AI era.

As AI continues to evolve, countries like Nigeria must remain vigilant, adaptive, and proactive in ensuring that these technologies are used to safeguard public health and security.

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Biosecurity In the Age of Artificial Intelligence: What Are the Benefits and Risks for Africa?

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Overview

The swift progress of artificial intelligence (AI) technology is revolutionizing numerous sectors worldwide, including biosecurity. In Africa, a continent grappling with various obstacles in healthcare, agriculture, and environmental preservation, the use of AI in biosecurity offers both advantageous prospects and possible hazards. This article analyzes the advantages and potential drawbacks of using AI-powered biosecurity solutions in Africa, taking into account the distinct circumstances and requirements of the continent.

The advantages of artificial intelligence in enhancing biosecurity measures in Africa.

1. Improved illness monitoring and forecasting

Artificial intelligence (AI) technologies have the potential to greatly enhance disease surveillance and prediction capacities in Africa. Machine learning algorithms have the capability to analyze large volumes of data from diverse sources, such as satellite images, social media, and health records, in order to identify disease outbreaks with greater precision and at an earlier stage compared to conventional methods. This is especially critical for a continent that has traditionally been susceptible to outbreaks of infectious diseases.

AI models have been created to forecast malaria epidemics in Uganda by assessing variables, including rainfall patterns, temperature, and population density. These systems have the potential to assist African governments in efficiently distributing resources and implementing specific measures to prevent or reduce the impact of disease outbreaks.

2. Enhanced diagnostic techniques and therapeutic approaches

Artificial intelligence (AI) can improve diagnostic capacities, particularly in contexts with limited resources that are widespread in Africa. Machine learning algorithms have the capability to analyze medical pictures, such as X-rays and microscopy slides, in order to accurately

detect diseases like tuberculosis and malaria. This initiative has the potential to alleviate the scarcity of medical experts in numerous African nations and enhance the availability of high-quality healthcare in isolated regions.

Furthermore, artificial intelligence (AI) can aid in the creation of individualized treatment strategies by examining patient data and forecasting the results of treatment. This has the potential to enhance the effectiveness and efficiency of healthcare delivery, namely in the areas of chronic disease management and the fight against antibiotic resistance.

Agricultural biosecurity refers to the measures and protocols implemented to protect agricultural systems from the introduction and spread of pests, diseases, and other biological threats.

The implementation of AI in agricultural biosecurity has the potential to significantly enhance Africa's agricultural industry, which plays a vital role in the region's economy. Machine learning models have the capability to examine satellite imagery and sensor data in order to identify agricultural diseases, pest infestations, and environmental stressors at an early stage. This has the potential to assist African farmers in implementing timely interventions, thereby reducing crop losses and enhancing food security.

In addition, AI-driven systems can aid in the surveillance and control of invasive species, which present substantial risks to biodiversity and agricultural output in Africa. Through the examination of data regarding the distribution of species and many environmental parameters, these systems have the ability to anticipate the expansion of invasive species and

provide valuable information for implementing specific control measures.

3. Monitoring and preserving the environment

Artificial intelligence (AI) technology has the potential to improve and strengthen environmental monitoring and conservation initiatives in Africa. Machine learning algorithms have the capability to evaluate satellite photos and sensor data in order to identify deforestation, monitor wildlife populations, and observe changes in ecosystems. This data can provide valuable insights for conservation initiatives and aid African nations in effectively overseeing their natural resources.

AI-driven acoustic monitoring systems have been employed to identify illicit logging and poaching operations in African forests, facilitating enhanced law enforcement and safeguarding of wildlife.

Potential hazards and difficulties

1. Issues regarding the protection and confidentiality of data

The acquisition and examination of substantial quantities of personal and sensitive data for AI-powered biosecurity applications give rise to notable privacy and security apprehensions. Data protection rules in most African countries are still developing, and there may be insufficient measures in place to prevent data misuse or breaches. This has the potential to result in the exploitation of personal data or the compromise of national security.

2. The issue of algorithmic bias and fairness

AI systems trained on data mostly from

Western countries may exhibit suboptimal performance in African contexts due to disparities in population demographics, disease frequency, and environmental factors. This has the potential to result in biased or erroneous outcomes, which could worsen health disparities and other injustices.

3. Reliance on Foreign Technologies

Several African countries might rely on AI technology developed and run by foreign companies, which could jeopardize their technological independence and capacity to make biosecurity decisions. This interdependence could also worsen pre-existing economic inequalities between African states and more advanced countries.

4. The displacement of workers and the existence of gaps in skills

Integrating AI into biosecurity may result in employment displacement in specific industries, particularly for positions that require minimal skills. It's also true that many African countries lack AI and data science experts, which could make it harder to implement and oversee AI-based biosecurity solutions effectively.

5. Ethical Considerations and Potential for Dual Use

The ethical difficulties arise from the fact that certain AI technologies can be used for both civilian purposes and potentially harmful applications in the field of biosecurity. AI systems designed for disease surveillance have the potential to be misused for the purpose of monitoring

or controlling populations. Furthermore, there is a potential danger that AI may be employed to create very advanced biological weapons, hence presenting substantial security risks.

Conclusion

Africa can leverage the integration of AI in biosecurity to effectively tackle urgent issues in healthcare, agriculture, and environmental protection, hence opening up huge prospects. Nevertheless, these advantages are accompanied by significant hazards and difficulties that require meticulous handling. In order to optimize the utilization of AI in biosecurity while mitigating potential hazards, African nations should:

1. Establish comprehensive data protection and ethical artificial intelligence frameworks.
2. Allocate resources towards developing and enhancing local artificial intelligence capabilities and knowledge.
3. Foster global collaboration in the field of AI research and development.
4. Ensure that AI solutions are customized to suit the specific circumstances and requirements of the local environment.
5. Establish robust governance structures to supervise the implementation of AI in biosecurity applications.

Therefore, by adopting a proactive and well-balanced strategy, African nations can utilize the potential of artificial intelligence (AI) to improve their biosecurity capacities while also protecting themselves from potential risks and problems.



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Oyamakin**

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models for complex biological systems and their application to problems in science and industry, with an interest in understanding how statistical concepts are best communicated. He has collaborated with researchers from other disciplines like public health, forestry, and sociology within and outside the country and was among the delegates invited by UNDP (REDD+) to advance knowledge of climate change modeling. He was a participant in the WHO/TDR Programme on Implementation Science a Mentee of the Working Group providing technical content on projects and initiatives at the University of Ibadan Research Foundation, and a member/Mentee of the Ibadan Partnership on the Africa Research on Implementation Sciences and Education (ARISE) project hosted in Tanzania and the China-Harvard African Network (CHAN) project at the University of Ibadan. Lastly, he recently became a fellow of the Partnership for African Social and Governance Research (PASGR), which certified him as one of the Pedagogical Leaders in Africa.



Maximizing the Benefits of AI in Reducing Biosecurity Threats While Mitigating Its Risks in Emerging Biotechnology

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Overview of Biosecurity Challenges in Africa

Africa's biosecurity landscape is shaped by a complex interplay of factors that heighten the region's vulnerability to infectious diseases, bioterrorism, and biological accidents. With the continent's population expected to exceed 2.5 billion by 2050, rapid growth is placing unprecedented strain on already overstretched health systems [1]. Environmental pressures, particularly due to climate change, exacerbate these risks. Rising temperatures and shifting rainfall patterns disrupt ecosystems, increasing the risk of zoonotic diseases like Rift Valley fever. Furthermore, weak healthcare infrastructure, chronic underfunding, and a significant shortage of trained healthcare professionals severely limit the continent's capacity to effectively detect, respond to, and manage outbreaks of infectious diseases. These challenges underscore the need for strengthened biosecurity measures across Africa.

Introduction to AI's Potential Role in Mitigating Biosecurity Risks

Artificial intelligence (AI) is emerging as a crucial tool in enhancing biosecurity by providing advanced capabilities for monitoring, managing, and responding to bio-threat events [2]. The Biosecurity AI Network (BAIN) is a prime example of AI's application in this field, specifically designed to address the complex challenges of biosecurity in research. BAIN screens commercial nucleic acid and peptide orders against a comprehensive database of known pathogens and toxins, effectively preventing potential breaches. This system builds on a 2016 U.S. initiative [3], offering a holistic approach that includes securing nucleic acid synthesis and detecting risky primer binding sites. By addressing the threats posed by short oligonucleotides, which can be used to clone harmful genes, BAIN ensures a robust and comprehensive strategy for mitigating biosecurity risks, safeguarding research environments from potential biological threats.

Maximizing AI's Benefits for Biosecurity

Pandemic Preparedness and Early Pathogen Detection

The COVID-19 pandemic has spurred significant investment in AI for epidemic surveillance. Advanced AI and machine learning algorithms are now used to detect early signs of epidemics by analyzing open-source data, such as news reports and social media. This automated early warning system is particularly beneficial in low-income countries, where AI can compensate for the lack of human resources in traditional disease surveillance, which is often slow and dependent on multi-level reporting structures [4]. AI/ML algorithms analyze data, identify patterns, and predict outbreaks, enhancing human analysis by rapidly processing large datasets and detecting early-stage outbreak signals [5,6]. Several studies have already demonstrated AI's effectiveness in monitoring and predicting the spread of COVID-19 [9-12].

Examples of AI Tools Currently in Use for Monitoring Outbreaks in Africa

Epidemic Intelligence from Open Sources (EIOS):

Used by WHO's Africa Regional Office (AFRO), EIOS monitors online media for unverified rumours and reports on COVID-19. By July 2020, it had identified 163 unverified signals of potential outbreaks, followed up for verification with member states. EIOS helped detect COVID-19 in nine African countries and is now routinely used by the Nigeria Centre for Disease Control and Uganda's Ministry of Health for early warnings [13,14].

Outbreak Toolkit and R Templates:

This toolkit, aligned with WHO Global COVID-19 Surveillance Guidelines, aids in data collection, reporting, and analysis. It enables timely monitoring of COVID-19

outbreaks, especially in resource-limited settings, by combining epidemiological analysis tools with R packages from the R Epidemics Consortium.

Go.Data:

An integrated tool for managing case data, lab results, and contact tracing, Go.Data supports Ministries of Health with a web-based platform and mobile app for data entry and visualization. It facilitates efficient contact tracing, and daily follow-ups are available for both Android and iOS platforms.

AI's Role in Vaccine Development, Resource Allocation, and Predicting Disease Spread

Accelerating the identification of viable vaccine candidates is one of the main ways AI revolutionises vaccine development. Large-scale biological data can be analysed by AI algorithms, especially those that use deep learning and machine learning, to find potential targets for vaccine development. Conventional techniques frequently entail protracted trial-and-error procedures, while AI is able to quickly sort through data and identify candidates with great promise [15]. AI, for example, is capable of identifying proteins that are likely to elicit a robust immune response by analyzing the genetic sequences of pathogens. AI is crucial to the optimization of vaccine formulation as well. Choosing the appropriate antigens, adjuvants (substances that strengthen the immune response), and delivery methods is a crucial step in the development of a vaccine. AI systems are capable of analysing different formulation factors and forecasting the best possible combinations.

Dual-Use Dilemmas in AI and Synthetic Biology

Dual-use research of concern (DURC) involves work that can be used for both beneficial and harmful purposes [16]. While AI's integration into biotechnology offers advancements in health, agriculture, and environmental sustainability, it also raises biosecurity concerns. AI could be misused to accelerate the development of dangerous pathogens, enhancing synthetic biology by aiding in the design and synthesis of biological organisms. This poses risks, such as the creation of harmful organisms. Advances in DNA/RNA synthesis enable individuals with basic lab skills to recreate viruses [17]. AI can also automate the design of synthetic organisms, potentially leading to new, dangerous biological agents, raising concerns about the weaponization of viruses. Experts warn that AI could simplify the creation of bioweapons, complicating the distinction between natural outbreaks and deliberate attacks. Robust biosecurity frameworks and governance are crucial to prevent the exploitation of these technologies [18].

Ethical and Governance Challenges

AI governance faces significant ethical dilemmas, requiring regulation based on transparency, fairness, privacy, adaptability, and accountability [19]. Ethical frameworks must address the creation of synthetic life and the responsibilities of those managing these technologies. Effective governance is essential for ensuring trustworthy AI systems and adapting to future advancements. AI in synthetic biology

can both exacerbate and reduce socioeconomic inequalities, potentially leading to geopolitical instability if technologies are monopolized or weaponized [20,21]. Comprehensive governance frameworks are needed to promote innovation while preventing misuse. Transparency in AI applications, especially in developing biological agents, is crucial. International regulatory bodies must establish clear guidelines, and global cooperation is essential to address AI-related risks. Engaging diverse stakeholders from government, industry, academia, and civil society is vital for effective governance [22].

Strategies for Developing Regulations and Oversight to Prevent Misuse

As AI revolutionizes biotechnology, it introduces risks like the creation of harmful biological agents, necessitating robust regulations and oversight.

1. Clear Regulatory Frameworks for AI in Biotechnology:

Adaptable frameworks are needed to govern AI use in biotechnology, defining acceptable practices and mandating transparency in areas like synthetic biology and genetic engineering. Requiring disclosure of AI models and datasets allows for peer review and oversight to prevent misuse [21].

2. International Cooperation for AI Governance:

National regulations alone can't address global biosecurity threats. International collaboration is vital for creating standardized guidelines and enforcement mechanisms. Global organizations should lead discussions on AI governance and

biosecurity, ensuring monitoring mechanisms track AI use in sensitive biotech fields [23].

3. Dual-Use Research Oversight:

AI's dual-use potential demands stricter oversight, especially in research involving sensitive technologies like synthetic pathogens. Governments and institutions must implement rigorous DURC review processes to assess risks and ensure the benefits outweigh potential dangers [24].

Ensuring Equitable Access to AI Technologies for Biosecurity

1. Reducing AI Access Disparities:

AI can enhance biosecurity, but unequal access may worsen global inequities, leaving low-income countries more vulnerable. To ensure fairness, international efforts must focus on sharing AI resources, expertise, and infrastructure globally [21]. Partnerships between governments, NGOs, and the private sector can help transfer AI technology and build local capacity for biosecurity research.

2. Ethical AI Distribution:

AI development should prioritize humanitarian goals, such as public health and ecosystem protection, rather than profit or national security. AI initiatives should align with the UN's Sustainable Development Goals (SDGs), emphasizing ethical use to promote cooperation rather than competition [21].

3. Democratizing AI Research:

Equitable access requires democratizing AI research through open science initiatives, allowing researchers from diverse backgrounds to contribute. This can accelerate innovation and prevent

monopolization by corporations or governments [25].

Importance of Global Cooperation in Managing AI and Biosecurity Risks

International collaboration is crucial for addressing biosecurity risks, which transcend borders. Collective action is required from governments, international organizations, and private entities to manage AI-driven biosecurity threats.

1. Enhancing Information Sharing and Threat Detection

Collaboration improves information sharing, enabling quicker identification of hazards. AI can analyze data from genomics, epidemiology, and environmental monitoring, which can then be shared globally for faster responses. Centralized platforms for real-time data sharing can help nations prevent AI misuse.

2. Developing Global Governance for AI in Biosecurity

Global cooperation should create binding agreements with clear guidelines for the ethical use of AI in biosecurity. These agreements must include enforcement mechanisms to ensure compliance [22].

3. International Capacity Building

Capacity building in low-income countries is vital. Collaborative efforts should provide resources, training, and expertise to enable all nations to participate in biosecurity efforts, reducing global vulnerabilities and promoting equitable access to AI benefits.

Creating Shared Standards for AI Use in Biosecurity Across African Nations

1. The Need for Regional Cooperation in Africa

African countries are increasingly using AI in healthcare, agriculture, and economic development but face challenges in ensuring responsible use in biotechnology. To address growing biosecurity risks, such as AI misuse for harmful biological agents, regional cooperation is essential. A unified approach allows African nations to pool resources and expertise for more effective AI monitoring, regulation, and enforcement in biotechnology.

2. Developing AI Biosecurity Standards in Africa

A key strategy for mitigating biosecurity risks is establishing shared regional standards for AI in biotechnology. These guidelines should focus on dual-use research, data privacy, and ethical concerns in AI-driven synthetic biology. A regional regulatory framework will ensure AI's safe use across Africa.

3. Leveraging Regional Institutions and Expertise

Institutions like the Africa CDC and the African Academy of Sciences (AAS) can lead the development of biosecurity standards. These organizations can serve as hubs for research, training, and policy creation, helping African countries share knowledge and resources for AI in biosecurity.

4. Promoting Public and Private Sector Collaboration

Public-private partnerships are crucial for implementing AI biosecurity standards. Governments should collaborate with tech companies, research institutions, and civil society to create policies that

foster responsible AI innovation while mitigating biosecurity risks. Private firms developing AI for biotechnology should follow ethical standards and engage in self-regulation. Public health organizations can also work with tech companies to develop AI tools for disease surveillance and outbreak detection [26].

Conclusion

AI offers significant potential for improving biosecurity in Africa through early pathogen detection, vaccine development, and resource allocation. However, its dual-use risks in biotechnology require robust governance, ethical frameworks, and international cooperation. Ensuring equitable access to AI technology and fostering collaboration between governments, the private sector, and international bodies is essential for creating effective regulations and preventing misuse. By promoting regional cooperation and shared standards, Africa can harness AI's benefits while safeguarding against biosecurity threats.

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**Faith Omolade Adebayo**

Faith Omolade Adebayo is a young professional in public health, biosafety, and biosecurity, currently working as a Project Officer and Research Assistant at the Global Emerging Pathogens Treatment Consortium (GET) in Nigeria. She holds a Bachelor's degree in Microbiology from Ekiti State University and is pursuing a Master of Public Health at Lead City University. Faith has been pivotal in executing impactful initiatives, such as the GET One Health School Project, which has educated over 5,000 students on the One Health approach. Faith also heads the iGEM Community's SynthAfrica project, promoting synthetic biology awareness across Africa. She is also actively involved in biosafety and biosecurity education efforts in Nigeria, supported by the United Nations Office for

Disarmament Affairs (UNODA). Selected as a 2023 UN Youth for Biosecurity Fellow, she contributed to global biosecurity discussions and is active in organizations like the YALI Network, United People Global, and the Nigerian Society for Microbiology. Her numerous scholarships and grants highlight her commitment to advancing public health and security, with a focus on promoting global health security, reducing disease emergence in Africa, and fostering scientific awareness.

**Dr. Adebisi Adewale Lateef**

Dr. Adebisi Adewale Lateef is an accomplished professional with a Doctor of Veterinary Medicine degree from Ahmadu Bello University, Zaria. He currently holds the position of research assistant at the esteemed Global Emerging Pathogen Treatment Consortium. In addition to his current role, Dr. Lateef is actively engaged in pursuing graduate studies in Medical Virology at the College of Medicine, University of Ibadan, exemplifying his dedication to expanding his expertise in the field. His profound interest lies in the study of emerging zoonotic diseases, with a specific emphasis on viral hemorrhagic diseases such as Ebola, Marburg, and Lassa fever. Dr. Lateef's work is underpinned by his unwavering commitment to tackling global health challenges

and proactively mitigating the threat of emerging infectious diseases. His holistic approach and tireless dedication contribute significantly to the advancement of medical research and public health initiatives.

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The Annual conference on One Health and Biosecurity is one of the biggest biosecurity conferences in Africa and it usually attracts about 400 global experts in various fields from all the continents of the world. The 10th African conference is organized by professionals from Global Emerging Pathogens Treatment Consortium (GET) with the support of the Lagos State Ministry of Health.

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- Biological Weapons
- Global Health
- Bioterrorism and Pandemic Planning
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SCHOLARSHIP OPPORTUNITIES

- ▶ Elsevier Foundation Chemistry for Climate Action Challenge 2025 (25,000 Prize)
<https://opportunitydesk.org/2024/08/30/elsevier-foundation-chemistry-for-climate-action-challenge-2025/> (**Application Deadline: September 15, 2024**)
- ▶ UNU-WIDER Visiting PhD Fellowship Programme for Doctoral Students (Fully Funded to Finland) <https://www.opportunitiesforafricans.com/unu-wider-visiting-phd-fellowship-programme-2025/> (**Application Deadline: September 30, 2024**)
- ▶ Wilson Center Fellowship 2025-2026
<https://opportunitiesforyouth.org/2024/08/30/call-for-applications-wilson-center-fellowship/> (**Application Deadline: October 1, 2024**)
- ▶ Harold W. McGraw, Jr. Center for Business Journalism Fellowship
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- ▶ Schlumberger Foundation Faculty for the Future Fellowships 2025 (USD 50,000 Per Year Grant) <https://scholarshipproar.com/schlumberger-foundation-faculty-for-the-future-fellowships/> (**Application Deadline: November 8, 2024**)
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- ▶ Oxford-Pershing Square Graduate Scholarships 2024
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The Global Emerging Pathogens Treatment Consortium (GET) was established in 2014 as a direct response to the 2014–2016 Ebola virus disease outbreaks in West Africa. GET is legally registered in Nigeria, Accra, Ghana, Sierra Leone, and the United States of America. Our primary purpose is to develop African-led and Afrocentric strategies within an international context to address emerging biosecurity threats effectively.



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