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AI Innovations to Mitigate Avoidable Emergency Department Use

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Healthcare professionals across the United States are increasingly overworked, and physician shortages are projected to worsen in the coming decade. In regions such as the State of New York, emergency department (ED) utilization for non-emergent conditions remains disproportionately high. Our previous study identified a strong association between public insurance type and avoidable ED use, demonstrating persistent gaps in healthcare access and navigation. Patients with Medicare or Medicaid often experience limited primary care availability, appointment delays, and complex referral systems, leading to greater reliance on ED services for non-emergent needs. This paper explores strategies to reduce avoidable ED visits and improve healthcare efficiency using artificial intelligence (AI). Integrated AI-based tools are promising for identifying high-risk patients for non-emergent ED use and directing them to preventive and primary care resources. By linking these models with others that support healthcare systems in allocating resources, streamlining patient flow, and improving clinical decision-making, we can help reduce ED congestion. Future initiatives should prioritize integrating AI models into care settings and hospitals, and expanding this nationwide to improve patient well-being.

Healthcare professionals are increasingly overworked, overburdened, and burned out across the United States,[1] a trend increased by rising patient volumes and workforce shortages.[2-4] Over the next decade, a significant health care workforce shortfall is predicted, notably in primary and emergency care.[5] A nationwide shortage of physicians is expected by 2030,[6,7] and as many as 1 in 4 nurses reported plans to leave the healthcare workforce.[2] These factors have exacerbated pressure on the healthcare system, leading to longer wait times and lower quality of care.[4,8] In highly populated regions such as New York City, the use of emergency departments (EDs) for non-emergent conditions exceeds 40% annually.[9]

Many of these visits could be effectively managed in primary care settings[10,11]; however, barriers to healthcare access and fragmented insurance coverage continue to worsen unnecessary ED use. In our prior study examining the association between insurance type and emergency care use in the State of New York, we identified a strong association between insurance type and avoidable ED use. In this study, avoidable ED visits were defined as emergency department encounters for clinically low-acuity conditions (classified as minor severity) that do not require immediate emergent intervention and could be safely managed in primary or outpatient care. Specifically, publicly insured patients had 14% lower odds of avoidable EDs compared with privately insured patients (AOR = 0.86; 95% CI: 0.84–0.87; p<.001). Uninsured patients were also less likely than those who are privately insured to engage in an avoidable ED visit (AOR = 0.88; 95% CI: 0.81–0.95; p<.001). These findings suggest that publicly insured and uninsured populations are more likely to present to the ED for higher-acuity or unavoidable conditions rather than for non-emergent conditions.

In recent years, artificial intelligence (AI) has emerged as a powerful and transformative tool to help support health system efficiency and reduce unnecessary ED utilization. Predictive analytics integrated into electronic health record (EHR) systems can support clinical decision-making, enhance patient triage, and improve care navigation by identifying individuals who may benefit from timely primary care or preventive services, thereby alleviating burdens on EDs.[12-14] Such tools have a significant potential in high-density urban settings like New York, where ED demand remains high.[15-17] Early adoption of machine learning-based models has demonstrated success in accurately identifying patients at risk of avoidable ED visits by analyzing prior utilization patterns, comorbidities, and sociodemographic factors.[18]

Several large technology platforms have developed AI-driven clinical support tools to improve care coordination and preventive outreach. For example, Google Health and IBM Watson Health have introduced systems that integrate clinical and administrative data to help providers identify care gaps and direct patients to appropriate services.[19,20] IBM's AI support tools utilize deep learning and artificial neural network architectures to analyze large datasets, reducing bias in the process to support clinical decision making across multiple medical subspecialties. IBM Watson for Oncology (WFO), for instance, a tailored technology that

supports physician consensus, has demonstrated high concordance with physician recommendations, resulting in treatment alignment 85% of the time.[19] Wearable AI-enabled devices also contribute to earlier detection of clinical emergencies through real-time physiological monitoring.[19] Not only do these tools help healthcare workers and their burden, but they also improve patient outcomes by supplementing the decision-making process and providing patient information earlier, making more well-informed patients.[20]

Beyond clinician-facing tools, AI applications increasingly target patient-facing care navigation. Natural Language processing (NLP)-based chatbots have been deployed to guide patients toward appropriate levels of care, provide preventive health information, and reduce unnecessary ED presentations.[21] Collectively, these tools aim to reduce redundant and avoidable ED visits, enhancing overall communication and relationships between patients and primary care providers.[22] Additional AI approaches, including convolutional neural networks for operational analytics, have been applied to analyze images and specifically help manage hospital congestion.[23,24] For example, a study conducted in China demonstrated the use of convolutional neural networks to model emergency department congestion and diagnostic delays, identifying patterns related to patient age, service type, and wait times.[17,25] While limited to a single emergency department and geographic context, this work illustrates the potential of AI-driven operational tools to optimize patient flow and resource allocation. Importantly, such approaches may be transferable to high-volume emergency departments in other settings when adapted to patient populations and local workflows.

Despite these advancements, the implementation of AI in the United States emergency care remains uneven and fragmented. Significantly, the use of AI in emergency care also raises ethical and implementation concerns. AI systems trained on electronic health records and claims data may reproduce or amplify existing inequities if biases are present within the model or dataset. In a widely cited example, a risk-prediction algorithm used to allocate care underestimated the needs of Black patients because it relied on health care costs as a proxy for illness burden.[26] Additionally, deployment in emergency departments requires strong safeguards for patient privacy, transparent governance for data access and secondary data use, and ongoing monitoring to ensure transparency and fairness across demographic groups.[27-31] Therefore, AI tools intended to reduce avoidable emergency department visits should be implemented with equity-focused evaluation, bias auditing, and privacy protections to avoid unintended harm while improving system efficiency and patient outcomes. Although hospital systems have begun exploring and utilizing AI tools, widespread integration is still developing. For example, the Mount Sinai Health System has deployed AI models to predict hospital admissions from the ED, supporting more timely and effective bed management and patient flow.[32]

Similarly, Johns Hopkins Hospital has used AI triage tools to augment clinician assessment at the point of care, while Banner Health and Tampa General Hospital have applied predictive analytics for operational planning and resource allocation.[33,34] These initial implementations suggest that AI has the potential to improve emergency care delivery, but systematic evaluation is needed.

Many models demonstrate strong predictive performance in research settings, yet face barriers to real-world adaptation, including interoperability challenges, workflow integration, data governance concerns, and ethical considerations related to bias and equity. A coordinated approach that integrates patient-facing tools, clinical decision support, and operational analytics may be necessary to reduce non-emergent ED utilization while safeguarding against unintended harms in a meaningful way. When thoughtfully designed and equitably deployed, AI-enabled systems have the potential to enhance patient outcomes, improve care efficiency, and alleviate provider burden across the United States healthcare systems.

POSITIONALITY

Nickol Georgy: The first author is an undergraduate researcher trained in quantitative biology, whose work and lived experiences have cultivated a deep interest in addressing inequities in healthcare access and utilization. This perspective, shaped by exposure to diverse patient populations through community health and interpretation work, informed the focus on avoidable emergency department use and the role of artificial intelligence in improving care efficiency for publicly insured individuals.

Dr. Circe Gray Le Compte: I am a social epidemiologist with Master of Science and Doctor of Science degrees in social and behavioral sciences from Harvard University. I specialize in qualitative and quantitative research and have several decades of experience in senior health communications roles. Much of my research focuses on the cognitive health outcomes of Black gay and bisexual men and trans women, and other sexual and gender minorities disproportionately impacted by HIV. This research may seem misaligned with me personally, as a white woman; however, my approach to health speaks to my formative experiences as a bisexual person growing up in lower socioeconomic, rural areas of the U.S. I ensure that my professional and academic endeavors center health through the lenses of justice and equity, showing how structural conditions, power, and access influence disparate health outcomes among historically marginalized populations. I employ mixed methods that privilege the lived experiences of communities, paired with rigorous, reflexive

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ABOUT THE AUTHOR(S)

Nickol Georgy is an undergraduate student at the University of Southern California majoring in Quantitative Biology and minoring in Applications of Artificial Intelligence. She is an aspiring researcher who is passionate about advancing health equity through community-based work, policy reform, and interdisciplinary research, and is particularly interested in research that bridges social justice with medicine and policy.

Dr. Circe Gray Le Compte: She was part of the board that re-founded Boston Congress of Public Health Review, when it was at Harvard University, in 2013. She has served as its editor-in-chief/co-editor-in-chief since 2014. In addition to this role, she serves as co-CEO, CTO, and BCPH Studio lead for the Boston Congress of Public Health, which publishes the journal. She holds Master of Science and Doctor of Science degrees from Harvard University, in social and behavioral sciences, and has decades of communications experience, serving as Director of Communications for the National Minority AIDS Council (NMAC); Senior Director at Impact Marketing + Communications; and Senior Contractor and Senior Director of Health Services Research and Communications with HealthHIV. She holds a postdoctoral fellowship with the Division of Gender, Sexuality, and Health at Columbia University/New York State Psychiatric Institute and works as a senior director of Impact Marketing + Communications.

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