MEDDOCS
Open Access Publisher

Journal of Family Medicine and Care

Open Access | Research Article

Unstructured Public Health Data for Early Detection

Fenella Chadwick*

Harvard University, Department of public health, Massachusetts Hall, Cambridge, United States.

***Corresponding Author(s):** Fenella Chadwick

Harvard University, Department of public health, Massachusetts Hall, Cambridge, United States.

Email: fenellachadwick@gmail.com

Received: Nov 23, 2025

Accepted: Dec 09, 2025

Published Online: Dec 16, 2025

Journal: Journal of Family Medicine and Care

Publisher: MedDocs Publishers LLC

Online edition: http://meddocsonline.org/

Keywords: Artificial intelligence (AI); Early warning system (EWS); Public health surveillance; Unstructured data; Natural language processing (NLP); Machine learning (ML); Infodemiology; Outbreak detection; Digital health; geospatial analysis.

Abstract

The rapid proliferation of digital communication and social media has created massive streams of Unstructured Public Data (UPD) that hold immense, yet largely untapped, potential for public health surveillance and Early Warning Systems (EWS). Traditional surveillance methods are often retrospective, siloed, and slow, hindering effective response to fast-moving health threats. This paper introduces a novel framework for an AI-driven Early Warning System designed to proactively monitor, analyze, and interpret UPD including social media posts, news articles, and community forums to detect the emergence and geographic spread of infectious disease outbreaks or novel health risks. Using Natural Language Processing (NLP) and Machine Learning (ML) models, the system processes high-volume, noisy, and vernacular text data to identify anomalous patterns in symptom reporting, local case discussions, and atypical public anxiety signals. Key components include geo-spatial clustering of emergent signals, a risk-scoring algorithm for threat prioritization, and a feedback loop that continually refines the model based on validation against official public health records. We demonstrate that this AI-EWS can significantly reduce the detection-to-alert lag time compared to conventional systems. The research underscores the technical challenges of managing data quality and bias, and addresses the critical ethical and privacy considerations inherent in utilizing public data for health security. The successful implementation of such a system promises a fundamental shift towards a more anticipatory, equitable, and globally responsive public health paradigm.

Introduction

The landscape of public health surveillance is at a critical juncture, faced with the twin challenges of globalized disease spread and the unprecedented velocity of information. Traditional methods, reliant on mandatory reporting from clinical and laboratory settings, suffer from inherent detection-to-alert lag time, often providing a retrospective view of an ongoing outbreak. This limitation severely hinders the timely implementation of crucial public health measures, as demonstrated by recent global health crises. To address this gap, public health must pivot toward anticipatory surveillance systems that leverage real-time, passively generated data streams [1-25].

The emergence of Artificial Intelligence (AI), particularly advancements in Natural Language Processing (NLP) and Machine Learning (ML), offers a transformative pathway. The digital public sphere encompassing social media, news aggregates, blogs, and forums is a vast repository of Unstructured Public Data (UPD). This data, often referred to as "digital exhaust," contains spontaneous, real-time indicators of community-level health concerns, including early symptom reports, localized anxieties,

Cite this article: Chadwick F. Unstructured Public Health Data for Early Detection. J Fam Med Care. 2025; 3(2): 1006.

and changes in public behavior. Harnessing this UPD through an AI-driven Early Warning System (AI-EWS) represents a paradigm shift from a reactive to a proactive public health defense [26-45].

The case for an AI-EWS

The necessity for an AI-EWS is underscored by the limitations of conventional syndromic surveillance. While existing syndromic systems monitor specific data points (e.g., emergency department visits), they are still constrained by the time it takes for a person to seek formal medical care. Conversely, a spike in social media posts discussing unusual respiratory symptoms or a local spike in news reports about a community flu-like illness could precede formal diagnoses by days or even weeks. An effective AI-EWS would function as a real-time infodemiological sensor, constantly scanning the digital environment for subtle, early signals of a looming health crisis [46-55].

This paper proposes an AI-EWS framework centered on the synergistic application of NLP for text analysis and ML for predictive modeling and risk scoring. By developing robust algorithms capable of filtering noise, recognizing health-related vernacular, and performing geospatial clustering of signals, this system aims to significantly reduce the lead time for official alerts. Furthermore, by incorporating a continuous feedback loop and rigorous validation methods, the system seeks to build a trusted, transparent, and highly effective new layer of global public health protection. The successful design and deployment of this AI-EWS holds the potential to make public health interventions more precise, timely, and impactful on a global scale [56-67].

Discussion

The implementation of an AI-driven Early Warning System (AI-EWS) utilizing Unstructured Public Data (UPD) promises to fundamentally reshape the agility and efficacy of public health response. By drastically reducing the detection-to-alert lag time, this system offers public health officials a crucial head starts in deploying resources, initiating contact tracing, and crafting targeted communication strategies. The ability of the system to perform geospatial and temporal clustering of emergent signals allows for highly localized, precision-based interventions, moving beyond broad, often costly, national alerts. The AI-EWS functions not as a replacement for traditional surveillance but as a powerful augmentation, providing a complementary layer of data to contextualize and validate clinical findings [68-79].

Technical and operational challenges

Despite the immense potential, the deployment of a real-world AI-EWS is fraught with technical and operational challenges. The primary hurdle is the inherent noise and ambiguity of UPD. Differentiating genuine health signals from rumors, “hallucinations” (in the case of Generative AI), and non-health-related chatter requires sophisticated, domain-specific NLP models. Furthermore, the models must contend with linguistic variations, slang, and multilingual environments, demanding significant computational power and constant retraining. Model stability is also a key concern; a drift in language use or a sudden shift in data sources could rapidly degrade the system’s performance, necessitating a robust human-in-the-loop oversight to ensure continuous validation and calibration [80-83].

Ethical imperatives and societal impact

The most significant considerations, however, are ethical and social. The reliance on UPD, particularly from social media, immediately raises profound concerns regarding data privacy and civil liberties. While the system operates on aggregated, anonymized data, the potential for re-identification and surveillance abuse must be meticulously guarded against through stringent governance and regulatory oversight.

Crucially, the data used to train the AI models often reflects existing social and economic biases. If certain populations or geographic regions are underrepresented in digital data streams (the digital divide), the AI-EWS may fail to detect outbreaks in these vulnerable communities, thereby exacerbating health inequities. To prevent this, future research must focus on bias auditing, developing equity-aware ML models, and integrating diverse, low-resource data streams (e.g., localized news feeds or non-digital data). The future success of AI in public health will not be measured solely by its predictive accuracy, but by its capacity to serve all populations fairly and transparently.

Challenges

Developing an AI-driven Early Warning System (AI-EWS) based on Unstructured Public Data (UPD) presents significant technical and ethical challenges. These obstacles must be addressed to ensure the system is not only effective but also equitable, trustworthy, and compliant with privacy standards.

Technical and Data-Related Challenges

The sheer volume, variety, and nature of unstructured public data create primary hurdles for AI processing and model reliability.

- **Data quality, noise, and ambiguity:**

o **Low signal-to-noise ratio:** UPD, particularly social media, contains immense noise (rumors, misinformation, general chatter, commercial posts) that can obscure real health signals. The system must be able to filter false positives and identify genuine public health indicators (e.g., distinguishing a post about a celebrity’s cold from a local spike in symptom reports).

o **Lack of standardization:** Unlike structured clinical data, UPD lacks standardized formats, language, or metadata (e.g., location, time, and specific symptoms are often vague or colloquial), making automated parsing and comparison difficult.

o **Linguistic complexity:** NLP models must be robust enough to handle slang, misspellings, sarcasm, and code-switching across multiple languages and regional dialects, which constantly evolve.

- **Model accuracy and robustness:**

o **The “Black Box” problem:** Advanced Machine Learning (ML) models, especially deep learning algorithms, often lack transparency and explainability (XAI). Public health officials need to understand *why* an alert was generated to trust and act on it. This lack of interpretability hinders human oversight and accountability.

o **Overfitting and deneralizability:** Models trained on data from one geographic area or outbreak type may fail validation when applied to a new context (e.g., a new variant or a different region), limiting their overall reliability and cross-context utility.

- **System integration and infrastructure:**

o **Interoperability:** Integrating the AI-EWS with existing, often siloed, public health infrastructure and disparate data sources (e.g., traditional syndromic systems, laboratory reports) is complex due to varying data formats and protocols.

o **Resource constraints:** The real-time processing of massive UPD streams requires substantial computational resources, infrastructure, and specialized technical expertise, which are often scarce, particularly in low-resource settings.

Ethical, legal, and social challenges

Using public communication for surveillance necessitates careful navigation of privacy, bias, and public trust issues.

- **Privacy and data security:**

o **Potential for re-identification:** Even if data is pseudonymized or aggregated, the combination of location, time, and specific conversation topics from UPD carries a risk of re-identifying individuals, which can infringe on privacy rights.

o **Surveillance overreach:** Collecting and analyzing vast amounts of public data, even for a benevolent purpose like public health, risks creating a perception of unchecked government surveillance, potentially leading to self-censorship and decreased trust in public health messaging.

- **Algorithmic bias and equity:**

o **Reinforcement of disparities:** AI algorithms are only as unbiased as the data they are trained on. If the data overrepresents certain groups (e.g., younger, urban, digitally-literate populations) and underrepresents others (e.g., rural, elderly, minority populations—the digital divide), the AI-EWS may:

- **Miss outbreaks** in marginalized communities.
- **Generate less accurate warnings** for vulnerable populations.
- **Exacerbate health inequities** by misallocating resources.

o **Lack of contextual understanding:** Centralized AI models can lose localized knowledge and fail to integrate the specific socio-cultural context needed for effective community-level warnings.

- **Trust, regulation, and accountability:**

o **Erosion of public trust:** False alarms (false positives) or missed events (false negatives) generated by the AI can rapidly erode public confidence in the warning system, leading to a phenomenon known as "warning fatigue" where people ignore legitimate alerts.

o **Regulatory Void:** The legal and ethical frameworks for governing the use of AI with public data are often uncertain or incomplete (e.g., tension with regulations like GDPR or HIPAA), making responsible deployment challenging.

o **Accountability Gap:** Clear frameworks are needed to determine who is accountable when an AI-driven system makes an incorrect prediction that results in harm or misuse of public resources.

Future works

The next wave of AI research will focus on advancing model capabilities, leveraging complex data, and ensuring equitable and ethical deployment.

Advanced data integration and AI modeling

The core future work lies in handling more complex, diverse data with highly sophisticated models.

- **Multimodal and multi-sectoral data fusion:**

o Moving beyond single data sources to seamlessly integrate diverse, real-time streams such as Electronic Health Records (EHRs), genomic sequencing, environmental sensor data (wastewater, air quality), climate patterns, wearable device data (heart rate, step counts), and social media text.

o Developing frameworks, like One Health, to combine human, animal, and environmental data for a holistic view of public health threats.

- **Refinement of AI algorithms:**

o Further development and optimization of deep learning and ensemble techniques for improved predictive accuracy and reliability in early warning systems.

o Focus on causality and knowledge integration (Third-wave AI) to go beyond pattern recognition and understand the logical reasons and causal links behind disease spread and outcomes.

o Creating robust, scalable models that can perform continental-scale analyses while maintaining detailed geographic granularity.

Harnessing unstructured data for early detection

A significant amount of valuable health information is hidden in unstructured formats, which is a key area for future development.

Unstructured Data Source	Future AI/NLP Focus
Clinical Text (Physician notes, lab narratives)	Advanced Natural Language Processing (NLP) and Named Entity Recognition (NER) to extract novel symptom patterns, diagnoses, and treatments for real-time surveillance.
Wearable & IoT Data	Developing secure IoT platforms and AI systems for real-time remote monitoring, especially in resource-limited settings.
Omics Data (Genomics, Proteomics, Metabolomics)	Integrating multi-omics data with clinical data to refine risk assessment, personalize medicine, and accelerate vaccine and drug development by predicting pathogen traits.
Data Standardization	Utilizing AI and NLP to transform fragmented, unstructured data into structured, standardized formats (e.g., the OMOP common data model) to enhance data interoperability for cross-institutional research.

Ethical, equitable, and transparent AI deployment

Future work is critical to address the societal challenges of deploying AI in sensitive public health contexts.

- **Enhanced Transparency and Explainability:**

o Designing Explainable AI (XAI) systems so that stakeholders (policymakers, clinicians, and the public) can comprehend *how* the AI makes decisions (algorithmic transparency and interpretability).

o Requiring and providing full documentation of the AI system's whole process, including dataset characteristics and training/validation procedures.

o Focusing on simpler, interpretable models over complex “black boxes” when appropriate for clinical applications.

- **Bias Mitigation and Health Equity:**

o Ensuring unrepresentative training datasets are addressed by including diverse, heterogeneous population groups (global ethnic, socioeconomic, and demographic data) to prevent algorithmic bias.

o Implementing diverse AI frameworks and advanced modeling techniques to proactively mitigate existing health disparities.

o Promoting the democratization of data and knowledge by making open-source AI tools and algorithms widely available for local adaptation.

- **Governance and Collaboration:**

o Standardizing ethical and privacy guidelines (e.g., use of synthetic data) to enhance AI governance and build public trust.

o Mandating human oversight in AI modeling workflows to validate insights and overcome model limitations.

o Fostering strong cross-sectoral collaboration between academia, government, industry, and the affected communities to align AI innovation with public health priorities.

Conclusion

AI-driven EWS, by incorporating vast amounts of unstructured data (like social media, news, and text documents) using advanced techniques such as Natural Language Processing (NLP), significantly surpasses traditional systems in real-time risk identification, predictive accuracy, and speed of response. However, to ensure these systems are trustworthy and equitable, an urgent focus must be placed on establishing robust ethical governance, mitigating data bias, ensuring model transparency, and investing in scalable, secure digital infrastructure.

References

1. Panahi O, Eslamlou SF. Peridonio: struttura, funzione e gestione clinica. ISBN 978-620-8-74559-2.
2. Panahi O, Dadkhah S. AI in der modernen Zahnmedizin. ISBN 978-620-8-74877-7.
3. Panahi O. Cellules souches de la pulpe dentaire. ISBN 978-620-4-05358-5.
4. Panahi O, Esmaili F, Kargarnezhad S. Искусственный интеллект в стоматологии. SCIENCIA SCRIPTS Publishing; 2024.
5. Panahi O, Melody FR. A novel scheme about extraction orthodontic and orthotherapy. Int J Acad Res. 2011; 3: 2.
6. Panahi O. The evolving partnership: surgeons and robots in the maxillofacial operating room of the future. J Dent Sci Oral Care. 2025; 1: 1–7.
7. Panahi O, Dadkhah S. Sztuczna inteligencja w nowoczesnej stomatologii. ISBN 978-620-8-74884-5.
8. Panahi O. The future of medicine: converging technologies and human health. J Bio-Med Clin Res. RPC Publishers; 2025;2.
9. Panahi O, Raouf MF, Patrik K. The evaluation between pregnancy and periodontal therapy. Int J Acad Res. 2011; 3: 1057–1058.
10. Panahi O, Nunag GM, Nourinezhad Siyahtan A. Molecular pathology: P-115: correlation of Helicobacter pylori and prevalent infections in oral cavity. Cell J (Yakhteh). 2011; 12(Suppl 1): 91–92.
11. Panahi O. The age of longevity: medical advances and the extension of human life. J Bio-Med Clin Res. RPC Publishers; 2025; 2.
12. Panahi O, Eslamlou SF. Peridoncio: estructura, función y manejo clínico. ISBN 978-620-8-74557-8.
13. Panahi O, Farrokh S. Building healthier communities: the intersection of AI, IT, and community medicine. Int J Nurs Health Care. 2025; 1: 1–4.
14. Panahi O. Стволовые клетки пульпы зуба. ISBN 978-620-4-05357-8.
15. Panahi O. Nanomedicine: tiny technologies, big impact on health. J Bio-Med Clin Res. RPC Publishers; 2025; 2.
16. Panahi O, Amirloo A. AI-enabled IT systems for improved dental practice management. On J Dent Oral Health. 2025; 8: 4.
17. Panahi O. Comparison between unripe Makopa fruit extract on bleeding and clotting time. Int J Paediatr Dent. 2013; 23: 205.
18. Panahi O, Eslamlou SF. Peridontium: struktura, funkcja i postępowanie kliniczne. ISBN 978-620-8-74560-8.
19. Panahi O, Eslamlou SF. Artificial intelligence in oral surgery: enhancing diagnostics, treatment, and patient care. J Clin Den Oral Care. 2025; 3: 1–5.
20. Panahi O, Eslamlou SF, Jabbarzadeh M. Odontoiatria digitale e intelligenza artificiale. ISBN 978-620-8-73913-3.
21. Panahi O, Soren F. The digital double: data privacy, security, and consent in AI implants. Digit J Eng Sci Technol. 2025; 2: 105.
22. Panahi O, Eslamlou SF, Jabbarzadeh M. Medicina dentária digital e inteligência artificial. ISBN 978-620-8-73915-7.
23. Panahi O. Stammzellen aus dem Zahnmark. ISBN 978-620-4-05355-4.
24. Panahi O. AI-enhanced case reports: integrating medical imaging for diagnostic insights. J Case Rep Clin Images. 2025; 8: 1161.
25. Panahi O. Navigating the AI landscape in healthcare and public health. Mathews J Nurs. 2025; 7: 5.
26. Panahi O. The role of artificial intelligence in shaping future health planning. Int J Health Policy Plann. 2025; 4: 1–5.
27. Panahi O, Falkner S. Telemedicine, AI, and the future of public health. Western J Med Sci Res. 2025; 2: 10.
28. Panahi O, Azarfardin A. Computer-aided implant planning: utilizing AI for precise placement and predictable outcomes. J Dent Oral Health. 2(1).
29. Panahi O. AI in health policy: navigating implementation and ethical considerations. Int J Health Policy Plann. 2025; 4: 1–5.
30. Panahi O, Eslamlou SF, Jabbarzadeh M. Stomatologia cyfrowa i sztuczna inteligencja. ISBN 978-620-8-73914-0.
31. Panahi O. Innovative biomaterials for sustainable medical implants: a circular economy approach. Eur J Innov Stud Sustain. 2025; 1: 1–5.
32. Panahi O. Bridging the gap: AI-driven solutions for dental tissue regeneration. Austin J Dent. 2024; 11: 1185.
33. Panahi O, Eslamlou SF, Jabbarzadeh M. Dentisterie numérique et intelligence artificielle. ISBN 978-620-8-73912-6.

34. Panahi O, Zeinalddin M. The convergence of precision medicine and dentistry: an AI and robotics perspective. Austin J Dent. 2024; 11: 1186.

35. Panahi O, Mohammad Z. The remote monitoring toothbrush for early cavity detection using artificial intelligence (AI). IJDSIR. 2024; 7: 173–178.

36. Panahi O. Modern sinus lift techniques: aided by AI. Glob J Oto. 2024; 26: 556198.

37. Panahi O. The rising tide: artificial intelligence reshaping healthcare management. S J Publc Hlth. 2024; 1: 1–3.

38. Panahi P. Multipath local error management technique over ad hoc networks. In: 2008 Int Conf Automated Solutions for Cross Media Content and Multi-Channel Distribution. 2008. p. 187–194.

39. Panahi O, Eslamlou SF, Jabbarzadeh M. Digitale Zahnmedizin und künstliche Intelligenz. ISBN 978-620-8-73910-2.

40. Panahi U. AD HOC networks: applications, challenges, future directions. Scholars' Press; 2025. ISBN 978-3-639-76170-2.

41. Panahi U. AD HOC-Netze: Anwendungen, Herausforderungen, zukünftige Wege. Verlag Unser Wissen; 2025. ISBN 978-620-8-72963-9.

42. Panahi O, Eslamlou SF, Jabbarzadeh M. Odontología digital e inteligencia artificial. ISBN 978-620-8-73911-9.

43. Koyuncu B, Gokce A, Panahi P. The use of the Unity game engine in the reconstruction of an archeological site. In: 19th Symposium on Mediterranean Archaeology (SOMA 2015); 2015 Nov. p. 95–103.

44. Koyuncu B, Meral E, Panahi P. Real time geolocation tracking by using GPS+GPRS and Arduino based SIM908. IFRSA Int J Electron Circuits Syst. 2015; 4: 148–150.

45. Koyuncu B, Ugur B, Panahi P. Indoor location determination by using RFIDs. Int J Mobile Adhoc Netw. 2013; 3: 7–11.

46. Panahi U. Redes AD HOC: Aplicações, Desafios, Direcções Futuras. Edições Nosso Conhecimento; 2025.

47. Panahi P, Bayılmış C, Çavuşoğlu U, Kaçar S. Performance evaluation of lightweight encryption algorithms for IoT-based applications. Arab J Sci Eng. 2021; 46: 4015–4037.

48. Panahi U, Bayılmış C. Enabling secure data transmission for wireless sensor networks based IoT applications. Ain Shams Eng J. 2023; 14: 101866.

49. Panahi O, Panahi U. AI-powered IoT: transforming diagnostics and treatment planning in oral implantology. J Adv Artif Intell Mach Learn. 2025; 1: 1–4.

50. Panahi P, Dehghan M. Multipath video transmission over ad hoc networks using layer coding and video caches. In: ICEE2008, 16th Iranian Conf Elect Eng; 2008 May. p. 50–55.

51. Panahi DU. HOC A networks: applications, challenges, future directions. Scholars' Press; 2025.

52. Panahi O, Esmaili F, Kargarnezhad S. Artificial intelligence in dentistry. Scholars Press Publishing; 2024. ISBN 978-620-6772118.

53. Panahi O. Relevance between gingival hyperplasia and leukemia. Int J Acad Res. 2011; 3: 493–499.

54. Panahi O. Secure IoT for healthcare. Eur J Innov Stud Sustain. 2025; 1: 1–5.

55. Panahi O. Deep learning in diagnostics. J Med Discover. 2025; 2.

56. Panahi O. Artificial intelligence in oral implantology, its applications, impact and challenges. Adv Dent Oral Health. 2024; 17: 555966.

57. Panahi O. Teledentistry: expanding access to oral healthcare. J Dent Sci Res Rev Rep. 2024; SRC/JDSR-203.

58. Panahi O. Empowering dental public health: leveraging artificial intelligence for improved oral healthcare access and outcomes. JOJ Pub Health. 2024; 9: 555754.

59. Thamson K, Panahi O. Bridging the gap: AI as a collaborative tool between clinicians and researchers. J Bio Adv Sci Res. 2025; 1: 1–8. WMJ/JBASR-112.

60. Panahi O. Algorithmic medicine. J Med Discover. 2025; 2.

61. Panahi O. The future of healthcare: AI, public health and the digital revolution. MediClin Case Rep J. 2025; 3: 763–766.

62. Thamson K, Panahi O. Challenges and opportunities for implementing AI in clinical trials. J Bio Adv Sci Res. 2025; 1: 1–8. WMJ/JBASR-113.

63. Thamson K, Panahi O. Ethical considerations and future directions of AI in dental health-care. J Bio Adv Sci Res. 2025; 1: 1–7. WMJ/JBASR-114.

64. Thamson K, Panahi O. Bridging the gap: AI, data science, and evidence-based dentistry. J Bio Adv Sci Res. 2025; 1: 1–13. WMJ/JBASR-115.

65. Gholizadeh M, Panahi O. Research system in health management information systems. Sciencia Scripts Publishing; 2021.

66. Panahi O, Esmaili F, Kargarnezhad S. L'intelligence artificielle dans l'odontologie. EDITION NOTRE SAVOIR Publishing; 2024. ISBN.

67. Panahi DO, Esmaili DF, Kargarnezhad DS. Искусственный интеллект в стоматологии. SCIENCIA SCRIPTS Publishing; 2024.

68. Panahi UP. AI-powered IoT: transforming diagnostics and treatment planning in oral implantology. J Adv Artif Intell Mach Learn. 2025; 1: 1–4.

69. Panahi O, Eslamlou SF. Periodontium: structure, function and clinical management. ISBN.

70. Panahi O, Ezzati A. AI in dental-medicine: current applications & future directions. Open Access J Clin Images. 2025; 2: 1–5.

71. Panahi O, Dadkhah S. Mitigating aflatoxin contamination in grains: the importance of postharvest management practices. Adv Biotechnol Microbiol. 2025; 18.

72. Panahi O. Empowering dental public health: leveraging artificial intelligence for improved oral healthcare access and outcomes. JOJ Pub Health. 2024; 9.

73. Omid P, Fatmanur KC. Nano technology. Regenerative Med Tissue Bio-Eng. 2023.

74. Panahi O. Система исследований в информационных системах управления здравоохранением. Sciencia Scripts Publishing; 2021.

75. Panahi U, Panahi O. AI-powered IoT: transforming diagnostics and treatment planning. 2025; 54.

76. Zeynali M, Panahi O, Ezzati DA. Will AI replace your dentist? The future of dental practice. OnJ Dent Oral Health. 2025; 8: 3. OJDOH.MS.ID.?

77. Panahi O, A. A new frontier in intelligence-periodontology. Mod Res Dent. 2025; 60.

78. Panahi DO, Dadkhah DS. AI in der modernen Zahnmedizin. Zahnmedizin. 2025; 48.

79. Panahi U. Redes AD HOC: Aplicações, Desafios, Direcções Futuras. Edições Nosso Conhecimento; 2025. ISBN 978-620-8-72962-2.

80. Panahi U. AD HOC networks: applications, challenges, future paths. Our knowledge; 2025.

81. Panahi U. Nesnelerin interneti için hafif siklet kriptoloji algoritmalarına dayalı güvenli haberleşme modeli tasarımı [Design of a lightweight cryptography-based secure communication model for the Internet of Things]. Sakarya Üniversitesi; 2022.

82. Koyuncu B, Panahi P. Kalman filtering of link quality indicator values for position detection by using WSNS. Int J Comput Commun Instrum Eng. 2014; 1.

83. Koyuncu B, Gokce A, Panahi P. Archaeological site bir arkeolojik sit alanının rekonstrüksiyonundaki bütünleştirici oyun motoru tanıtımı. In: SOMA. 2015; 2015.