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AI in foodborne disease surveillance: state of the art, clinical applications, and future perspectives

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Background. Foodborne diseases (FBDs) constitute a significant public health issue: the WHO estimates 600 million cases, 420,000 deaths, and 33 million DALYs annually. Traditional surveillance systems suffer from delays in outbreak recognition, under-reporting, and data fragmentation. Artificial intelligence (AI) is emerging as a strategic tool for the prevention and management of FBDs.

Materials And Methods. A systematic review of peer-reviewed literature (January 2019 – April 2026) was conducted on PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar, using MeSH terms such as "artificial intelligence", "machine learning", "foodborne diseases", and "outbreak detection". Original studies, reviews, meta-analyses, and reports from the WHO, EFSA, and FDA in English and available as free full text were included. Study selection and methodological quality were evaluated using the PRISMA protocol.

Results. Out of 847 identified articles, 62 were included in the analysis. Deep Learning (DL) models applied to hyperspectral imaging achieve a sensitivity of >94% for Salmonella, Listeria monocytogenes, and E. coli. AI systems demonstrated the ability to anticipate outbreak detection by approximately 4.2 days.

Conclusions. AI is a promising tool to transform FBD surveillance. Its implementation requires dataset standardization, privacy protection, the reduction of algorithmic bias, and harmonized regulatory frameworks. Future research must focus on prospective validation in real-world contexts, algorithmic equity, and integration with national surveillance infrastructures.