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Artificial intelligence for infectious risk assessment in the general population: methods, limits and the DARE (DIGIVAX) pilot

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Background. Artificial intelligence (AI) is a family of distinct methods, not a single technology, and its value in public health depends on data quality and interoperability. In Italy, no routine national infrastructure systematically links vaccination registries, surveillance of vaccine-preventable diseases (VPD) and pharmacovigilance, limiting timely vaccine effectiveness (VE) estimates. Within the DARE project, the DIGIVAX pilot addresses this gap.

Materials and Methods. We reviewed AI approaches relevant to infectious risk assessment (supervised machine learning, deep learning, natural language processing and event-based surveillance) and described the DIGIVAX architecture. A manual feasibility pilot in Sicily (about 4.8 million residents) linked the regional vaccination registry with the reference laboratory for invasive VPD.

Results. Supervised models support vaccine drop-out prediction, risk stratification and case classification; recurrent networks support nowcasting; NLP underpins event-based systems such as EIOS 2.0, HealthMap and epitweetr [1]. Main limits are training data bias [2], concept drift [3], opacity of black-box models and misinformation from generative AI. The pilot linked 48 cases (33 pneumococcal, 8 meningococcal, 7 Haemophilus influenzae). DIGIVAX relies on an integration hub (deterministic and probabilistic linkage, HL7 FHIR, pseudonymisation) feeding easy-access vaccination services, exploratory VE and individual recommendations. First-year KPIs include linkage rate, data completeness, post-reminder uptake, missed opportunities, timeliness and equity.

Conclusions. The current bottleneck is interoperability rather than the algorithm. Linkage between vaccination and surveillance data is feasible and DIGIVAX is designed as a replicable regional model. AI applications should follow, with external validation, explainability and governance under the EU AI Act and the European Health Data Space.

Note. The project is part of the Italian Complementary National Plan PNC-I.1 ”Research initiatives for innovative technologies and pathways in the health and welfare sector” D.D. 931 of 06/06/2022, ”DARE - DigitAl lifelong pRevEntion” initiative, “Digivax” Pilot Project - code PNC0000002, CUP: B53C22006460001.

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