



ACCP 2023

Meeting on
Antimicrobial
Chemotherapy
in Clinical Practice (ACCP)

Genova | 16 -17 novembre 2023

Starhotels President

Presidente del Congresso
Prof. Matteo Bassetti

Potrà l'intelligenza artificiale migliorare le prescrizioni antibiotiche?



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Conflicts of interest

- Investigator-initiated grants (Pfizer, Gilead Italia, bioMérieux, Shionogi)
- Personal fees for speaker/consultant (Pfizer, Tillotts Pharma, Menarini)



Artificial intelligence

- AI is a field of computer science and statistics that serves to replicate human behaviour and problem-solving skills
- ML is a subset of AI where computers improve and automate the performance for a given task without explicit programming when trained on a set of data

Tran NK, et al. Curr Opin Infect Dis 2023; 36:235-242

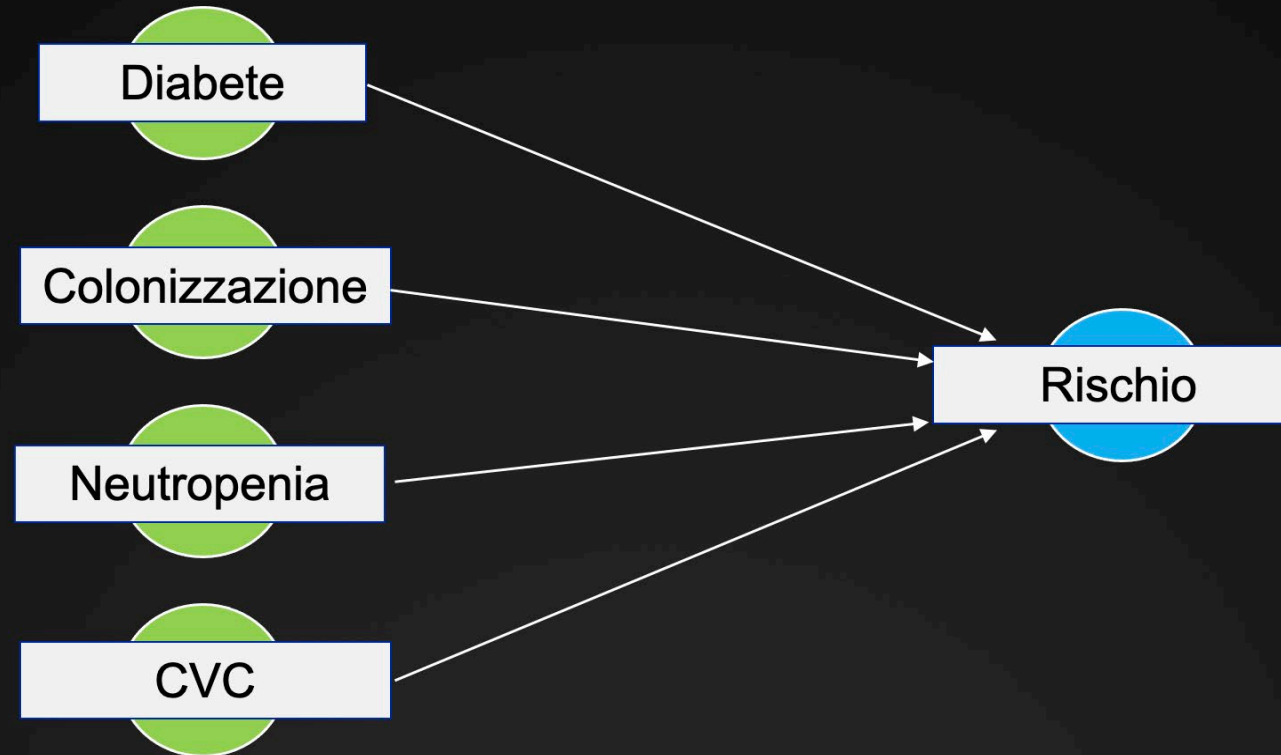


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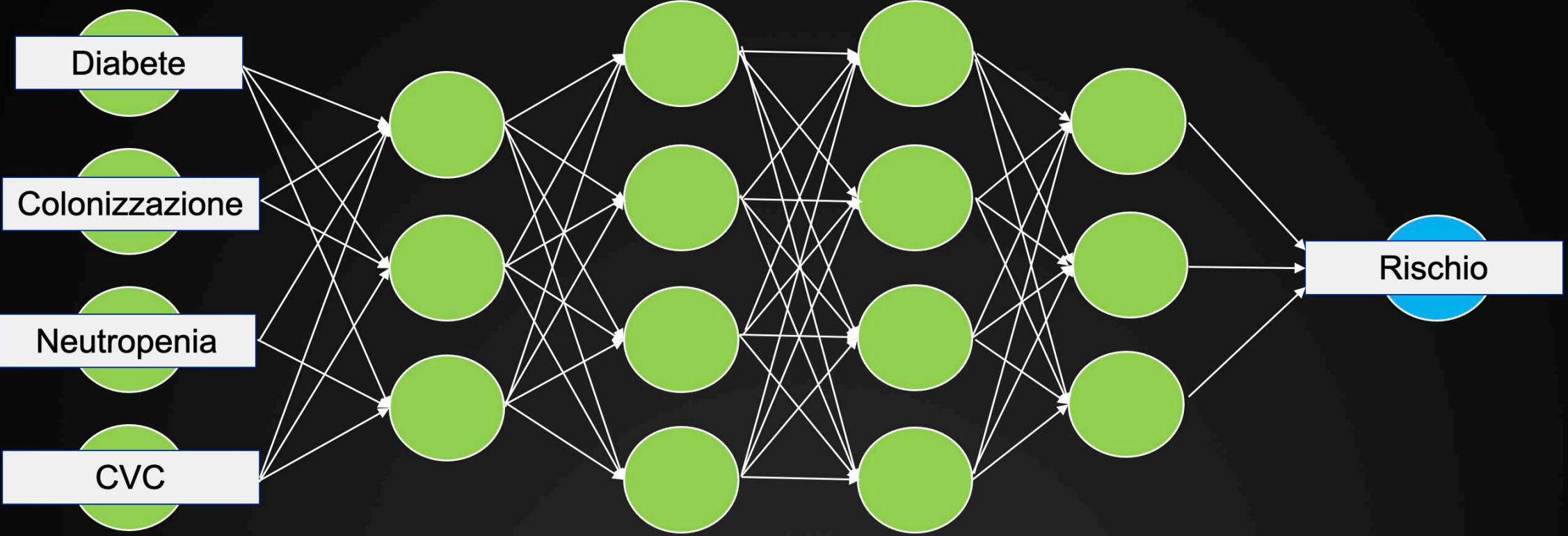
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Example of classical/ML model (e.g., LR)



Example of ML model (NNs)



Large language models (LLMs)

- Large language models (LLMs) can respond to free-text queries without being specifically trained in the task in question
- ChatGPT is a generative artificial intelligence (AI) chatbot
- ChatGPT-3 architecture has 175 billion parameters

Thirunavukarasu AJ, et al. Nat Med 2023; 29:1930-1940



Can Chatbot Artificial Intelligence Replace Infectious Diseases Physicians in the Management of Bloodstream Infections? A Prospective Cohort Study

Alexis Maillard,^{1,✉} Giulia Micheli,^{1,2} Leila Lefevre,¹ Cécile Guyonnet,^{3,4} Claire Poyart,^{3,4} Etienne Canouï,¹ Martin Belan,^{1,5,a} and Caroline Charlier^{1,5,6,7,a}

- 44 cases with a first episode of positive blood culture were included
- ChatGPT-4 provided detailed and well-written responses in all cases

Clin Infect Dis 2023: ciad632. doi: 10.1093/cid/ciad632



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- Empirical antimicrobial therapies were adequate in 28 (64%) case, and harmful in one (2%) case
- Source control plans were inadequate in four (9%) cases

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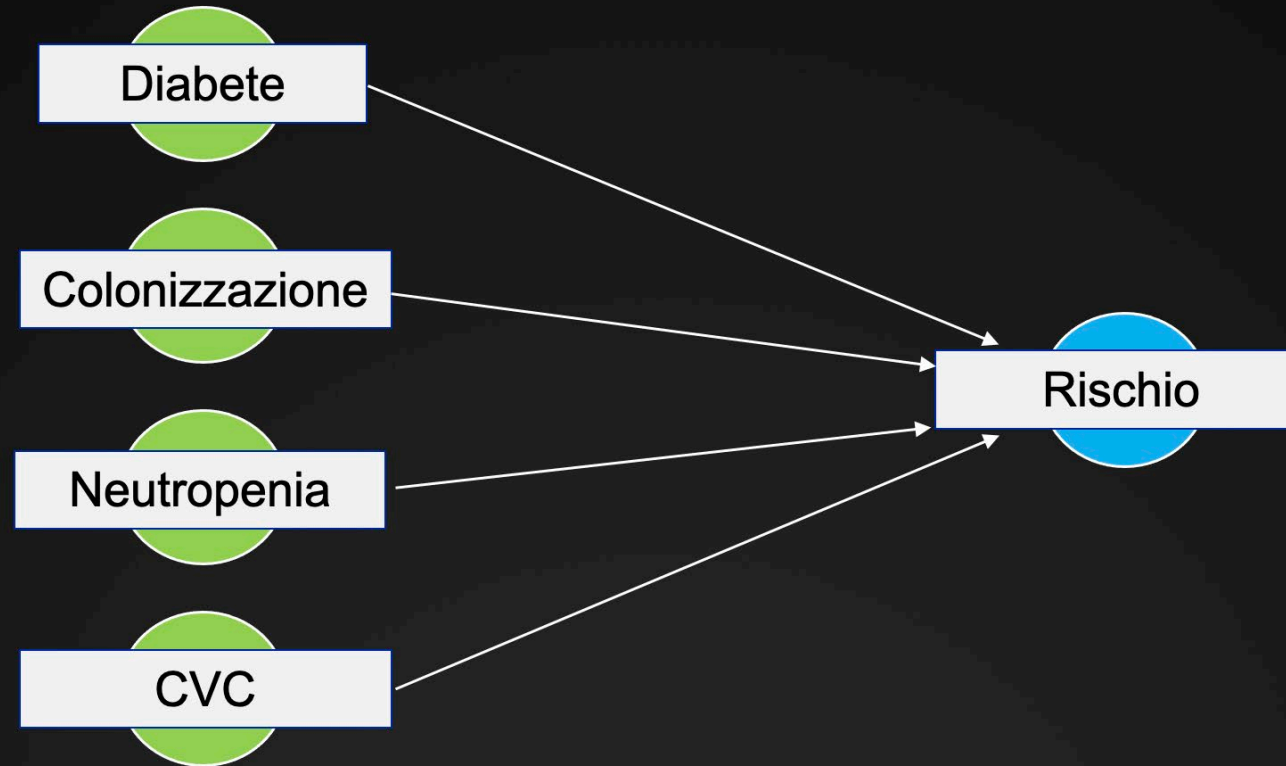
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- Definitive antibiotic therapies were optimal in 16 patients (36%), and harmful in two (5 %)
- Overall, management plans were considered optimal in only one patient, as satisfactory in 17 (39%), and as harmful in seven patients (16%)

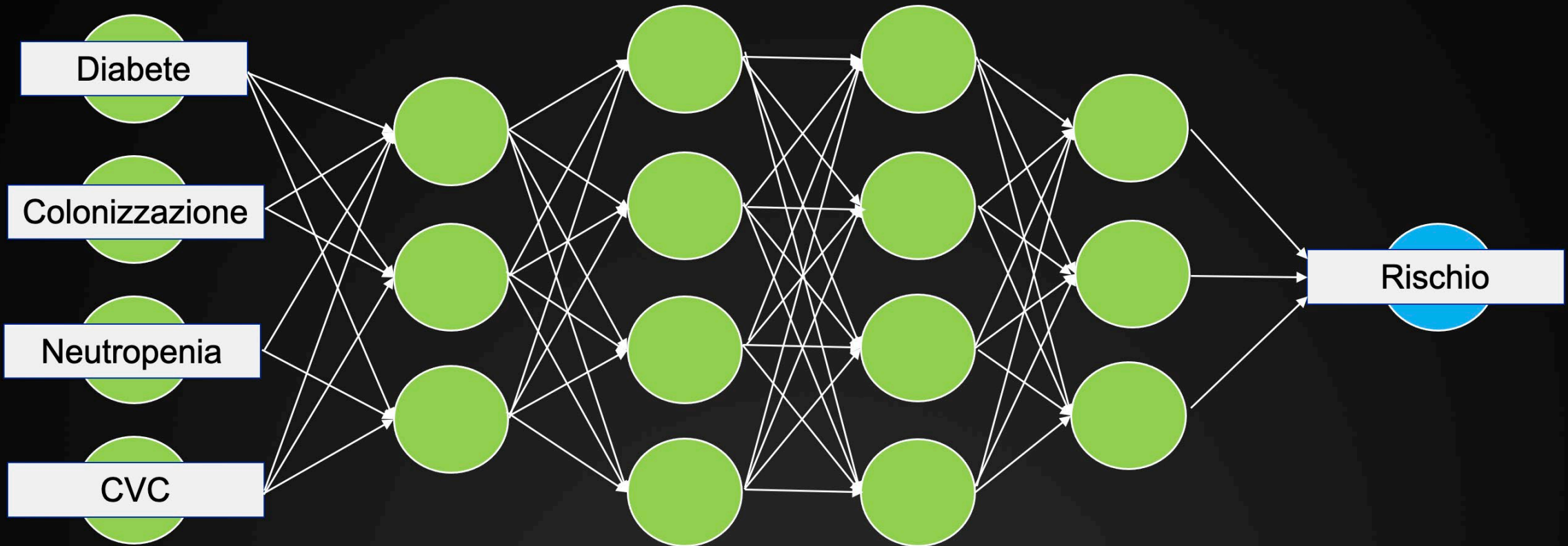
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“White box” model



“Black box” model



Interpretability and Explainability

- **Explainability** can be defined as the ability to explain how a black box model has produced an output, usually through replicating the prediction with another less accurate but interpretable model
- A model is **interpretable** when each step of the computations leading to the eventual prediction and the relative contribution of the different features can be easily inferred (white box models)

Giacobbe DR, et al. Ann Med 2023. Accepted for publication.



Some open questions

- Sufficient explainability
- Data transparency
- Privacy issues
- Role of ML-CDSSs (summary of relevant features? Suggestion of decision?)
- Responsibility for the decision



Communication

Validation of an Automated System for the Extraction of a Wide Dataset for Clinical Studies Aimed at Improving the Early Diagnosis of Candidemia

Daniele Roberto Giacobbe ^{1,2,*}, Sara Mora ³, Alessio Signori ⁴, Chiara Russo ^{1,2}, Giorgia Brucci ^{1,2}, Cristina Campi ^{5,6}, Sabrina Guastavino ⁵, Cristina Marelli ², Alessandro Limongelli ^{1,2}, Antonio Vena ^{1,2}, Malgorzata Mikulska ^{1,2}, Anna Marchese ^{7,8}, Antonio Di Biagio ^{1,2}, Mauro Giacomini ³ and Matteo Bassetti ^{1,2}

- Automated extraction of laboratory and microbiological variables (features)
- 1338 episodes of candidemia (8%)
- 14,112 episodes of bacteremia (90%)
- 302 episodes of mixed candidemia/bacteremia (2%)

Diagnostics 2023;13(5): 961. doi: 10.3390/diagnostics13050961



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RESEARCH ARTICLE

 OPEN ACCESS

 Check for updates

Early diagnosis of candidemia with explainable machine learning on automatically extracted laboratory and microbiological data: results of the AUTO-CAND project

Daniele Roberto Giacobbe^{a,b#} , Cristina Marelli^{b#}, Sara Mora^{c#}, Sabrina Guastavino^d, Chiara Russo^{a,b}, Giorgia Brucci^{a,b}, Alessandro Limongelli^{a,b}, Antonio Vena^{a,b}, Malgorzata Mikulska^{a,b}, Maryam Tayefi^e, Stefano Peluso^f, Alessio Signori^g, Antonio Di Biagio^{a,b}, Anna Marchese^{h,i}, Cristina Campi^{d,j}, Mauro Giacomini^c and Matteo Bassetti^{a,b}

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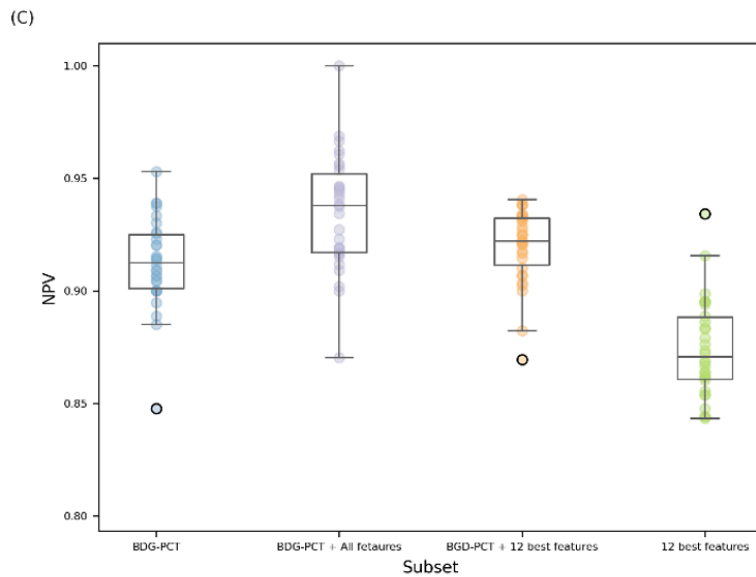
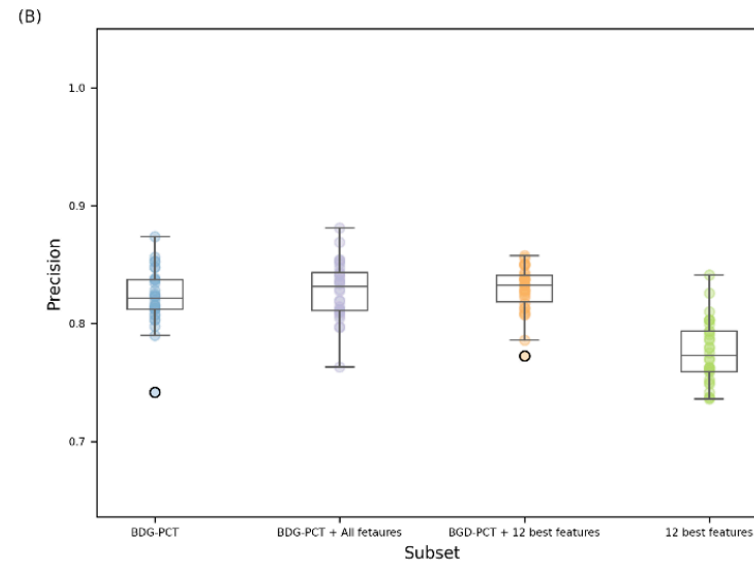
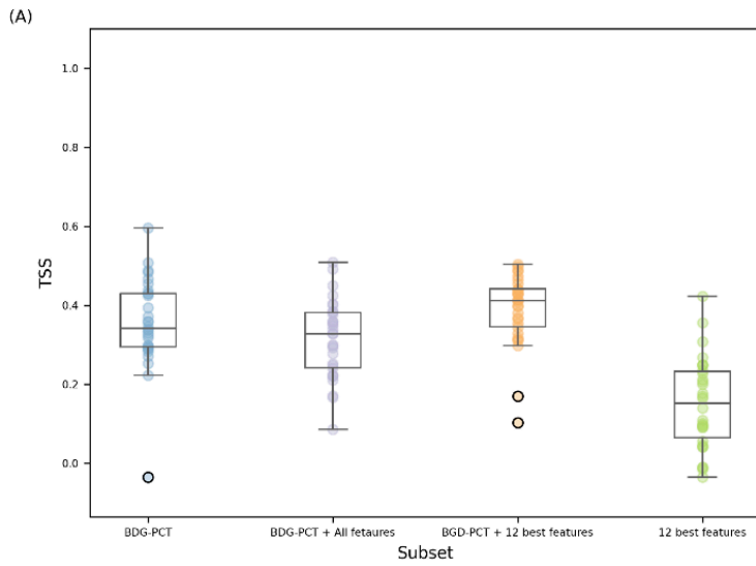


Figure 3 legend: Classification performances were evaluated in terms of: (A) true skill statistic (TSS), (B) Precision, and (C) negative predictive value (NPV). Each box plot shows results obtained on the validation set over the 10 folds of cross-validation and 3 shuffles (30 points in total).

Ann Med 2023. Accepted for publication.



Conclusions

- ML-CDSSs show the potential for dramatically reducing time-consuming task
- They may help recognizing unnoticed/unnoticeable relevant associations
- Interpretability or sufficient explainability should be guaranteed
- At the present time, they should be view as an aid rather than a substitute of humans for antibiotic prescription



Progetto MULTI-SITA

Resp. Scientifici: Matteo Bassetti, Daniele R. Giacobbe

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- 3 study ongoing
- 1 study published
- 2 studies starting in April 2024

Thank you



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