Unlocking inclusive vaccination strategies by investigating individual vaccine responses with the InSilicoVACCINE suite

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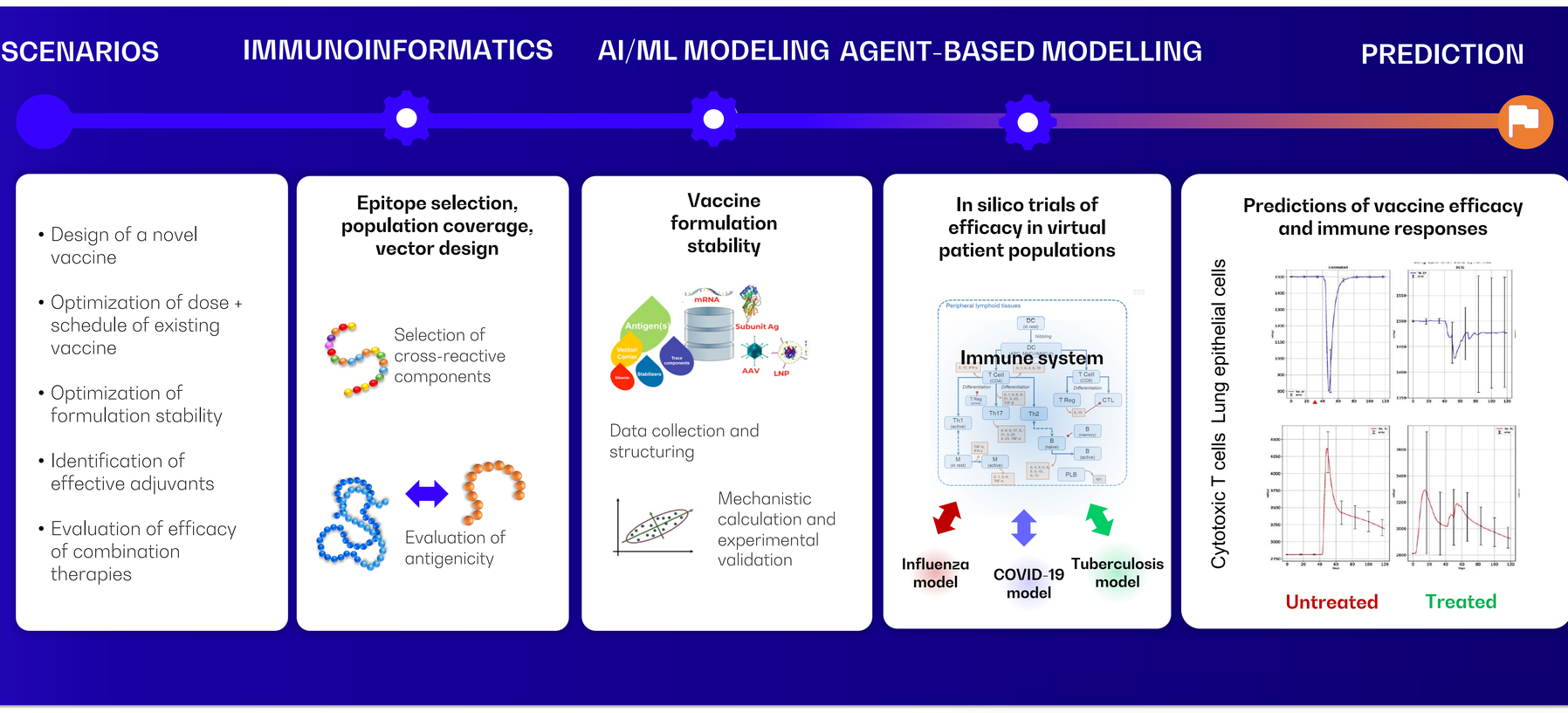
InSilicoTrials

Background

Vaccination can provide population immunity against serious infectious diseases. However, the immune response can vary substantially among vaccine recipients, ultimately leading to varying degrees of protection at the individual level. For instance, vulnerable individuals undergoing treatments that compromise their immune systems may experience reduced vaccine efficacy. To account for such vulnerable subpopulations during vaccine development, improving the understanding of vaccination at the individual level is crucial. For this purpose, computational analysis through the InSilicoVACCINE suite (http://insilicotrials.com) can offer invaluable insights.

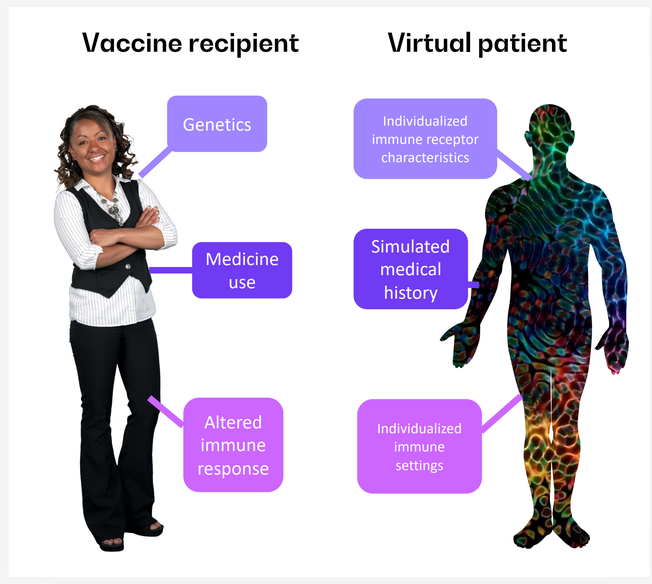
InSilicoVACCINE workflow

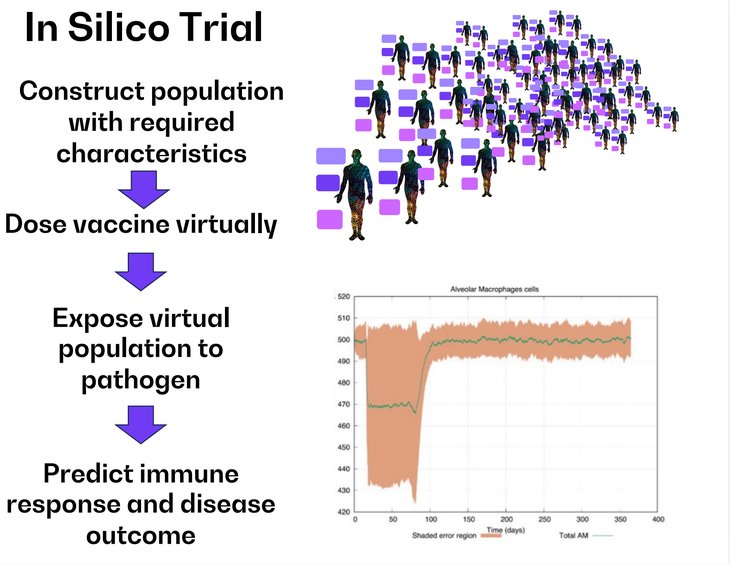
CM&S support throughout Vaccine Development



Vaccine Design at the Individual Level

The InSilicoVACCINE suite's individualizable immune system models give the opportunity to capture inter-individual variability and propagate an individual's current immune health to their vaccine-dependent protection. To achieve this, the simulators rely on an agent-based model which can emulate a variety of chronic and infectious diseases. Key characteristics include immune system heterogeneity, immune memory and interchangeable disease layers for specific infectious diseases.





Population-Specific InSilicoTrials

In particular, the suite encompasses virtual patients for vaccination to influenza A, COVID-19 and tuberculosis. These mechanistic disease modules represent the disease at the (patho-) physiological level. To incorporate vaccination, the models additionally describe the affinity between heterogeneous immune receptors and pathogen epitopes. Multiple existing and potential vaccines and adjuvants, covering a wide variety of vaccine types, have been used for simulator testing. The resulting simulators can be applied not only to investigate the response to vaccine, adjuvant or vaccination schedule in healthy patients, but can also be tailored to investigate the response of vulnerable subpopulations.

Conclusion

In conclusion, InSilicoVaccine is a versatile resource that can aid development of vaccine and (personalized) vaccination program design, by increasing understanding of inter-individual heterogeneity in vaccine response and predicting how individual immune system status and health can affect a vaccine's protective capabilities.

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