# A quantum vaccinomics approach to vaccine development

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*A quantum vaccinomics approach was proposed based on the characterization of vector-host-pathogen molecular interactions and the immunological quantum to further advance the design of more effective and safe vaccines*

## Vaccines and the control of infectious diseases

According to the World Health Organization (WHO), vaccines currently prevent between 2 and 3 million deaths and protect many millions more from illness yearly, which supports that it constitutes the most effective preventive intervention to reduce disease, disability, and death from a variety of infectious diseases. Vector-borne diseases (VBD) represent a growing burden for human and animal health worldwide and vaccines are the most effective and environmentally sound approach for the control of vector infestations and pathogen infection and transmission [1]. However, the development of effective vaccines for the control of VBD requires new experimental approaches for the identification of protective antigens and vaccine formulation [2].

## From quantum physics to quantum vaccinomics

Biological systems are dynamical with constant exchange of energy and matter with the environment in order to maintain the state of non-equilibrium characteristic of living systems. Quantum biology is supported by several mechanisms within living cells that operate under non-trivial features of quantum mechanics such as quantum tunneling, which has been proposed to be involved in DNA mutation biological process [3]. Recent evidences showed that living organisms may depend on the dynamics of small number of molecules such as proteins that are well localized (at nanometer scale) and operating over short time periods (in picoseconds), which support that non-trivial quantum mechanical processes play an important role in living systems before decoherence induced by surrounding environment can wash them out. Despite the fact that area of quantum biology related to DNA mutation requires experimental evidence that are difficult to obtain, it is accepted that quantum dynamics within living systems has been subjected to optimizing evolution, and life has learned to manipulate these quantum systems to its advantage in ways that need to be approached by future quantum biology studies [3]. The immune system contains random processes such as the direct correlation between atomic coordination and peptide immunogenicity that support quantum immunology [4].

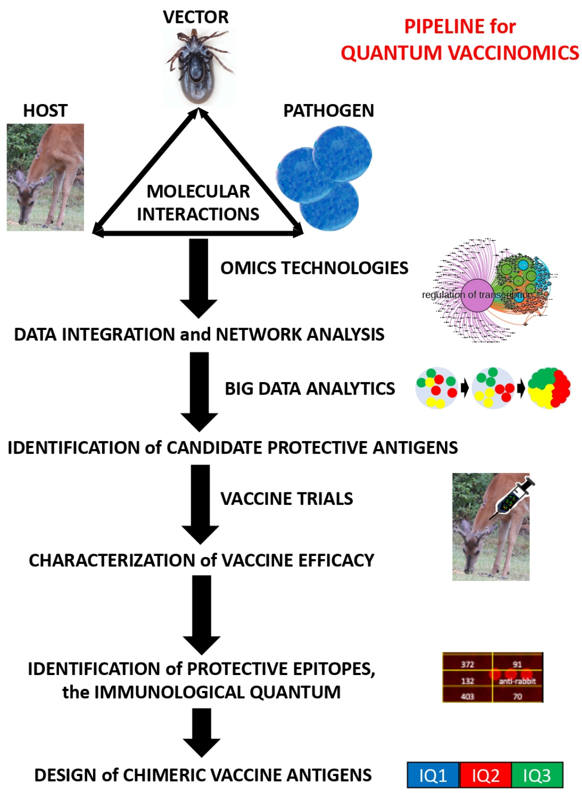


Figure 1: Proposed pipeline for quantum vaccinomics. We thank Katherine M. Kocan (OSU, USA) for the host, vector and pathogen images.

The characterization of vector-host-pathogen molecular interactions and vaccinomics have been proposed as approaches for the development of vaccines for the control of VBD [5]. Then, based on the Albert Einstein's definition of the photon as a quantum of light, the immune protective epitopes were proposed as the immunological quantum [6]. These facts led to the proposal of quantum vaccinomics as the characterization of the immunological quantum to further advance the design of more effective and safe vaccines [6].

Our proposed pipeline for quantum vaccinomics (Fig. 1) consists of the characterization of vector-host-pathogen molecular interactions using omics technologies combined with multi-omics data integration and network analysis [5]. The role of cell interactome and regulome in vector-host-pathogen interactions is then used in a vaccinomics and Big Data analytics approaches for the identification of proteins playing a central role in the regulation of biological processes and with protective antigen capacity in vaccination trials [5]. The selected proteins are then used in quantum vaccinomics for the identification and characterization of the protective epitopes or immunological quantum (IQ) for the design and production of chimeric protective antigens [6].

## Conclusions

The application of quantum vaccinomics would allow the identification of multiple candidate protective antigens and immunological quantum. The combination of ectoparasite vector-derived with pathogen-derived immunological quantum in designed vaccine chimeric antigens is the basis for developing vaccines effective for the control of vector infestations and pathogen infection/transmission. This methodological approach would allow the development of vaccine formulations for the prevention and control of multiple infectious diseases.

## Notes

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