Ardigen

Design multi-epitope peptide-based vaccines with Artificial Intelligence

Design of more immunogenic and selective peptide-based vaccines with Artificial Intelligence

You can reduce the costs of your therapy development pipelines by leveraging our AI-driven technology

Learn about our technology, **Ardigen's ARDesign platform**, based on cutting-edge **computational immunology and machine learning**, and supported by experimentally-generated datasets. The platform enables the compilation of **the ranked list of peptide antigens for the vaccine composition**.

We build partnerships to improve therapy development pipelines.

In a nutshell...

✔ Determine **patients' HLAs**

✔ Detect putative **peptide antigens**

✔ Predict the likelihood of **pHLA binding and presentation** on the cell surface

✔ Assess the probability of attracting T-cells to generate **functional responses**

Difficulties you may encounter...

Low efficacy of the vaccine

Low specificity of Tumor Associated Antigens (TAAs)

High toxicity of the vaccine

Targeting **only CD8+ T-cells**

Immune evasion of the tumor

Lack of immunogenicity of chosen epitopes

Tumor **heterogeneity**

With Ardigen's ARDesign platform you can:

Identify specific **mutations** and **chromosomal aberrations**.

Determine **gene expression levels.**

Detect **Tumor-Specific Antigens** originating from indels and SNVs, or **Tumor-Associated Antigens** that are over-expressed in tumor tissues.

Include all essential steps needed for **target recognition** by the immune system, such as protein expression levels, pHLA binding affinity, **presentation on the cell surface with ARDisplay-I predictions**, or immunogenicity.

Only a tiny fraction of proteins fragments are displayed via HLA and our **state-of-the-art solution ARDisplay-I, outperforms significantly standard AI-based models** and achieves over 2 times higher score in Average Precision.

Pinpoint **off-targets presented on a patient's healthy tissue** that impose danger or cause various side effects.

Analyze **tumor microenvironment** with RNA-seq data deconvolution and analysis of tumor-infiltrating immune cells to examine its influence on the **immune response.**

Counter immune evasion by detecting **most common Immune Escape Mechanisms (IEMs)** related to HLA allele expression and antigen processing & presentation pathways.

Design of more immunogenic and selective peptide-based vaccines with Artificial Intelligence
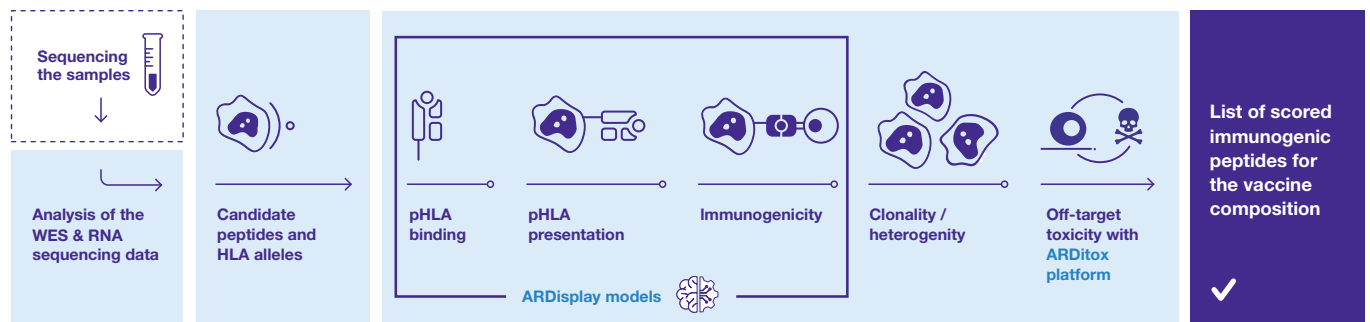
Value we deliver...

✔ Overcome the limitations of **laboratory screening**

✔ Design an off-the-shelf or personalized **cancer vaccines**

✔ Find ideal targets for therapy development that **address unmet clinical needs**

✔ With **ARDisplay-I model**, **select epitopes presented on the cell surface** and originating from intracellular antigens or cross-presentation

✔ Provide the **help of CD4+ T-cells** with **ARDisplay-II model**

✔ Avoid **off-target immunotoxicity**

Cell killing

HLA I

Antigen

CD8+

Cancer cell
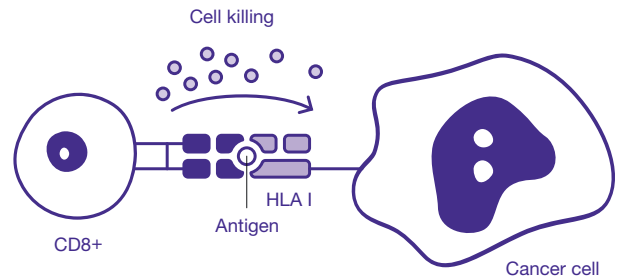
ARDesign platform

### Cancer vaccines development

Augment your **cancer vaccine therapeutic process with Artificial Intelligence** to improve efficacy, avoid toxicity and speed up therapy development

Sequencing the samples

Analysis of the WES & RNA sequencing data

Candidate peptides and HLA alleles

pHLA binding

pHLA presentation

Immunogenicity

ARDisplay models

Clonality / heterogenity

Off-target toxicity with **ARDitox platform**

List of scored immunogenic peptides for the vaccine composition

✔

Check how Ardigen's ARDesign platform performs in predicting experimentally validated immunogenic epitopes detected in GI tract cancer patients

Dataset used for this analysis is a subset of 28 gastrointestinal tract cancer patients (38 responses) from *Unique Neoantigens Arise from Somatic Mutations in Patients with Gastrointestinal Cancers* Parkhurst M, et al. Cancer Discov. 2019.

Mean number of immunogenic peptides detected per patient

No. immunogenic peptides

No. peptides per patient
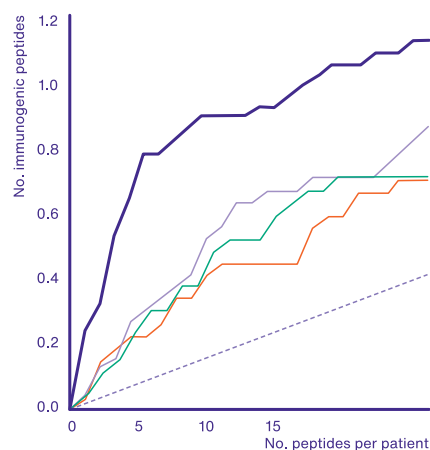
— ArdImmune Vax
— netMHCpan 4.0
— netMHCpan 4.0 (TPM>0)
— MHCflurry
-- Null model

Performance of Ardigen's ARDesign platform for each patient

Patient ID

Peptide rank
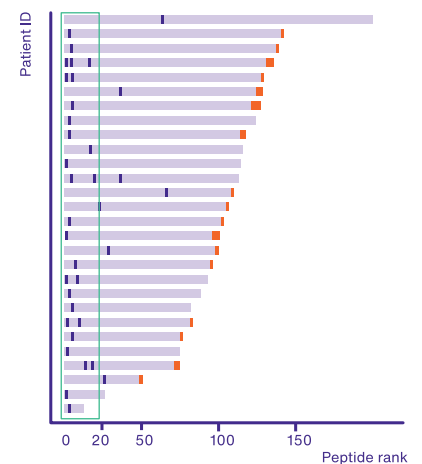
▮ Immunogenic CD8+ epitopes
▮ Epitopes predicted as toxic or tolerated
▮ Vaccine composition

Design peptide-based vaccines
identify epitopes causing off-target toxicities

Address off-target toxicity in cancer immunotherapies long before it happens

Ardigen's ARDitox platform (patent pending, see EP22461636) is a powerful tool for augmenting toxicity evaluation designed to improve cancer immunotherapy development.

This computational approach is ideal for screening target epitopes **to assess the risk of potential off-target toxicity**.

Your goals

Identify therapeutic targets with **the lowest risk of off-target toxicity** events.

Select which epitopes, from a vast number of possible off-targets, should be **tested experimentally**.

Predict any **possible side-effects** and prevent them with the appropriate drugs.

Design your toxicity assays, based on the list of **potentially affected tissues**.

Check how we stand out from other solutions

Standard approach

✘ Time-consuming and laborious process

✘ Expensive

✘ Evaluating small subspace of potential off-targets

✘ Selective types of tissue

ARDitox based approach
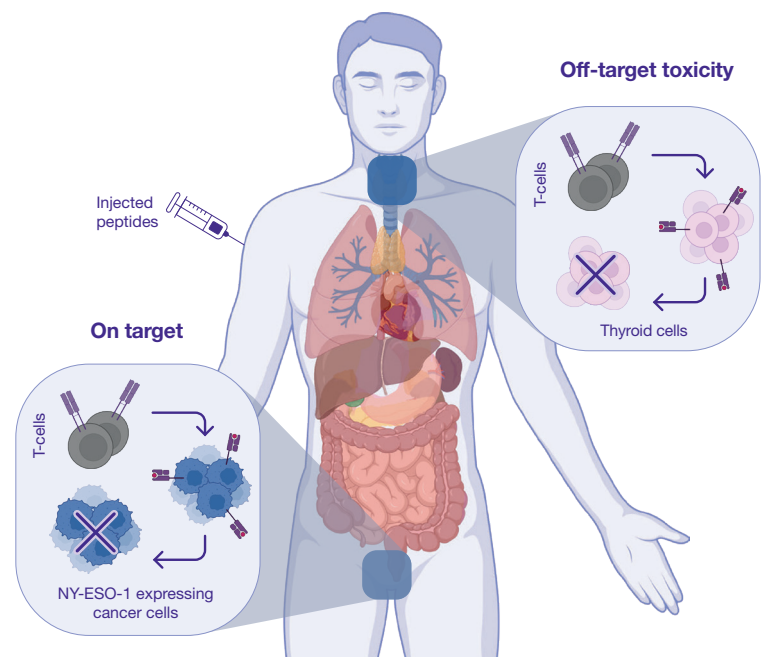
✔ Accelerated analysis and discovery

✔ Reduced cost of experiments

✔ Increased treatment safety with the evaluation of a large space of possible off-targets

✔ Unbiased analysis of all tissue types

Know the risks of off-target toxicity...

Peptide-based vaccines can lead to the development of autoimmune diseases caused by off-target toxicity. This occurs when the **similarity between the foreign and self-peptide** promotes the activation of autoreactive T- or B-cells initiated by the foreign one.

The clinical trials, based on peptide vaccination against **cancer-specific antigen NY-ESO-1**, have led to the development of **thyroid dysfunction** (Graves' disease) causing heart palpitations, weight loss, and feeling shaky or nervous[1].

The development of **autoimmune diseases** has also been observed in patients vaccinated against viruses, such as HBV, HPV, or H1N1[2].

Off-target toxicity

T-cells

Thyroid cells

Injected peptides

On target

T-cells

NY-ESO-1 expressing cancer cells

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[1] Anaya et al., Autoimmunity: From Bench to Bedside 2013
[2] Segal & Shoenfeld, Vaccine-induced autoimmunity: the role of molecular mimicry and immune cross-reaction, 2018

Design peptide-based vaccines
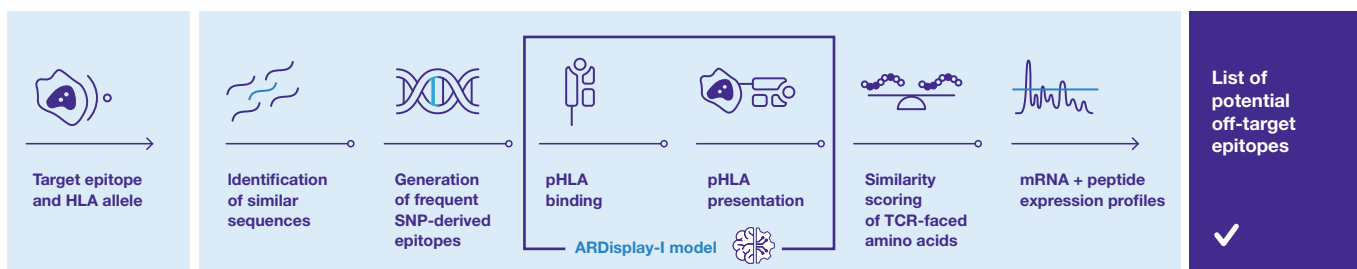## identify epitopes causing off-target toxicities

Experimentally verify epitopes pinpointed by ARDitox platform as likely to cause side effects

Model relevant biological events that contribute to off-target toxicity using state-of-the-art bioinformatics, AI-based components and our expertise. Simply provide the peptide sequence and HLA type of interest to **obtain a list of putative off-targets, prioritized according to their risk score**, along with the associated genes and their expression levels in different tissues.

ARDitox platform

Off-target toxicity

Identify potential **off-target toxicities in cancer immunotherapies with Artificial Inteligence** to improve safety, and speed up therapy development

| Target epitope and HLA allele | Identification of similar sequences | Generation of frequent SNP-derived epitopes | pHLA binding | pHLA presentation | Similarity scoring of TCR-faced amino acids | mRNA + peptide expression profiles | List of potential off-target epitopes |

ARDisplay-I model

Check how we stand out compared to other solutions[1]

Typically, the **number of permitted mismatches** between the target peptide and the potential off-target epitopes is limited to only a few amino acids, while this **factor is the most important in safety evaluation.**

Extend the reference proteome (of the human population or your study cohort) with **genetic polymorphisms** to get a broader collection of possible cross-reactive epitopes.

Incorporate **Ardigen's ARDisplay-I model, our custom deep learning pHLA presentation model**, trained on mass-spectrometry data, that outperforms[2] standard models like MHCflurry or netMHCpan.

Recognize **TCR-facing amino acids** (epitope) from HLA-facing ones (agretope). Include this while comparing the target peptide with putative off-targets and **determine the risk of cross-reactivity** based on the physico-chemical properties of the selected amino acids.

For the selected cross-reactive peptides, generate **mRNA and protein expression levels** in wide range of tissues.

Our method **directly pinpoints off-target epitope sequences** that might impose danger.

Ardigen's ARDitox platform interactive dashboard
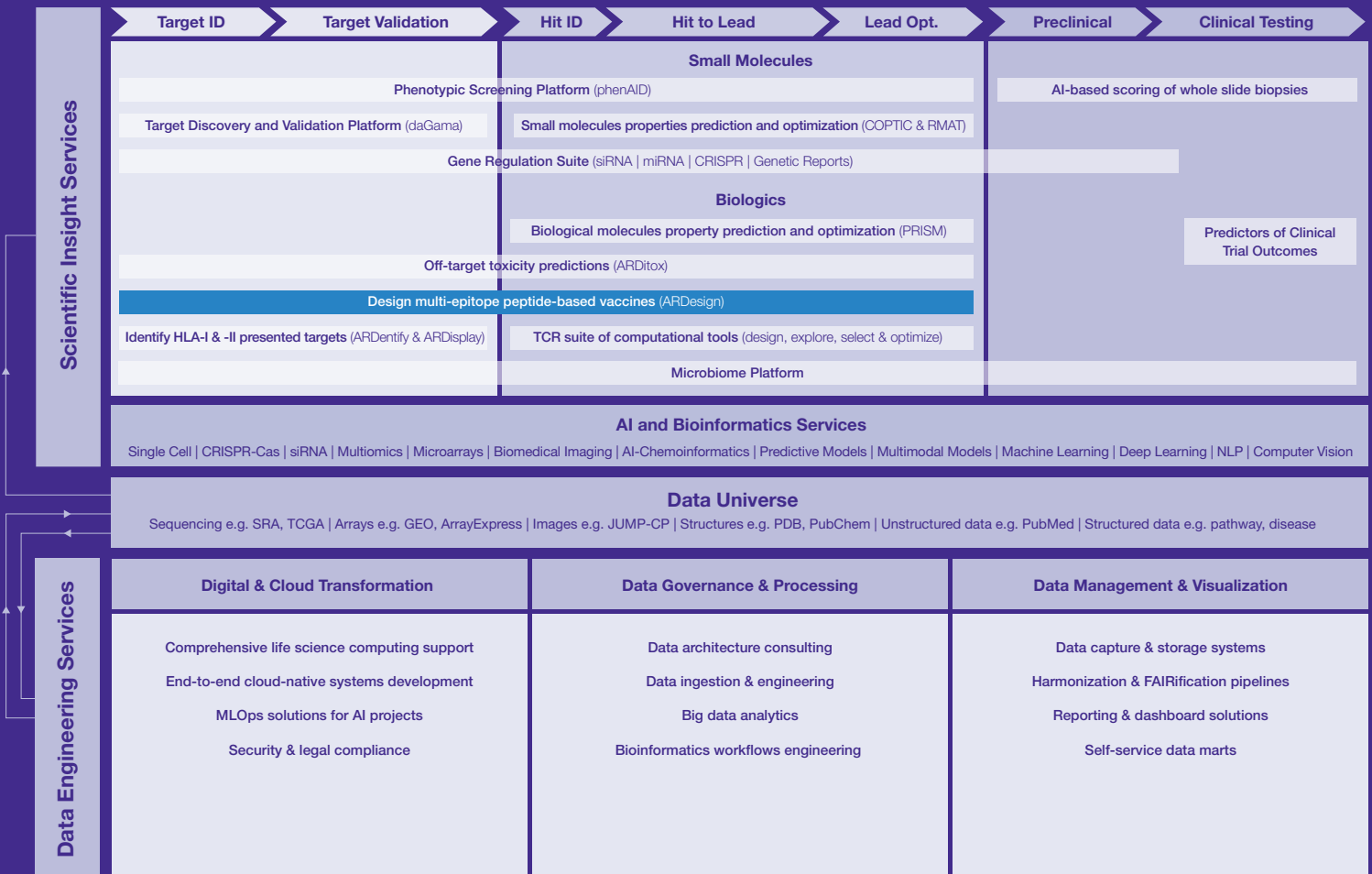
Scan to watch the video:

Ardigen

Artificial Intelligence & Bioinformatics for Precision Medicine

Discover Our Cutting-Edge Services and Accelerate Your Drug Discovery Process

Scientific Insight Services

Target ID	Target Validation	Hit ID	Hit to Lead	Lead Opt.	Preclinical	Clinical Testing

Small Molecules

Phenotypic Screening Platform (phenAID)

AI-based scoring of whole slide biopsies

Target Discovery and Validation Platform (daGama)

Small molecules properties prediction and optimization (COPTIC & RMAT)

Gene Regulation Suite (siRNA | miRNA | CRISPR | Genetic Reports)

Biologics

Biological molecules property prediction and optimization (PRISM)

Predictors of Clinical Trial Outcomes

Off-target toxicity predictions (ARDitox)

Design multi-epitope peptide-based vaccines (ARDesign)

Identify HLA-I & -II presented targets (ARDentify & ARDisplay)

TCR suite of computational tools (design, explore, select & optimize)

Microbiome Platform

AI and Bioinformatics Services

Single Cell | CRISPR-Cas | siRNA | Multiomics | Microarrays | Biomedical Imaging | AI-Chemoinformatics | Predictive Models | Multimodal Models | Machine Learning | Deep Learning | NLP | Computer Vision

Data Universe

Sequencing e.g. SRA, TCGA | Arrays e.g. GEO, ArrayExpress | Images e.g. JUMP-CP | Structures e.g. PDB, PubChem | Unstructured data e.g. PubMed | Structured data e.g. pathway, disease

Data Engineering Services

Digital & Cloud Transformation	Data Governance & Processing	Data Management & Visualization
Comprehensive life science computing support	Data architecture consulting	Data capture & storage systems
End-to-end cloud-native systems development	Data ingestion & engineering	Harmonization & FAIRification pipelines
MLOps solutions for AI projects	Big data analytics	Reporting & dashboard solutions
Security & legal compliance	Bioinformatics workflows engineering	Self-service data marts

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