VIRO - AI

Viral Insight & Rapid Optimization - Analytics Intelligence

SCITECH PARK

Institute : Dr. D. Y. Patil College of Engineering & Innovation, Varale, Talegaon, Pune - 410206

Team : Team Rakshanu

Theme : MedTech / BioTech / HealthTech

Demo Video Link : https://tinyurl.com/bdhhftt6

Prototype Link : https://viroai2.netlify.app

RAKSHANU
BIOTECH TEAM

Team Leader Name : Sairaj Popat Jadhav
Branch : Bachelor of Engineering
Email : sairajjadhav433@gmail.com
Stream : Artificial Intelligence & Data Science
Phone. no : +91 935 686 0010
Year : TE

Team Member 1 : Vedant Lanjekar
Branch : Bachelor of Engineering
Email: vedantlanjekar456@gmail.com
Stream : Artificial Intelligence & Data Science
Phone. no : +91 907 602 7036
Year : TE

Team Member 2 : Yash Yogesh Wase
Branch : Bachelor of Engineering
Email : yashwase13@gmail.com
Stream : Artificial Intelligence & Data Science
Phone. no : +91 749 948 9664
Year : TE

Team Member 3 : Mrigyisha Rajendra Sawant
Branch : Bachelor of Engineering
Email : mrigyishasawant@gmail.com
Stream : Artificial Intelligence & Data Science
Phone. no : +91 788 768 1402
Year : BE

PROBLEM STATEMENT

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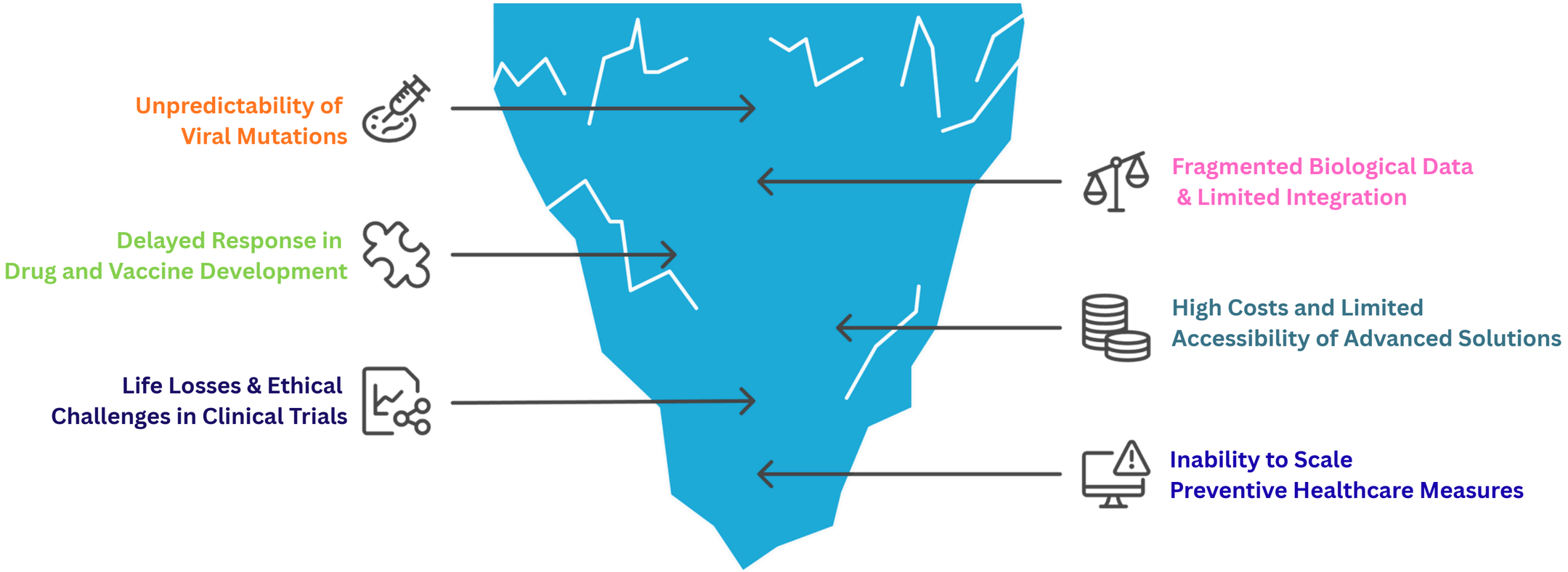
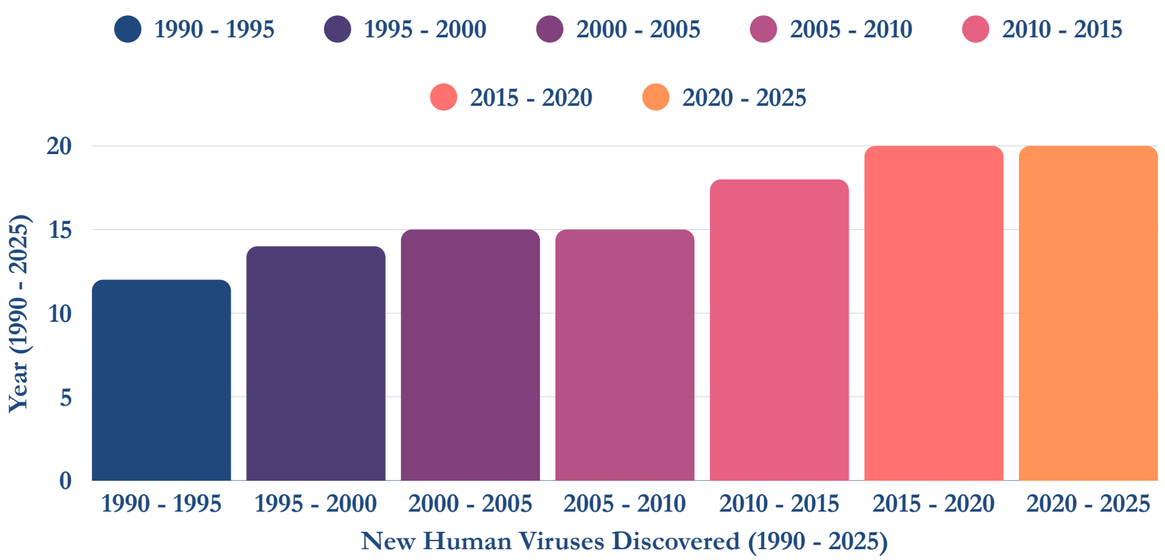
The rapid mutation of viruses impedes timely vaccine and drug development, resulting in delayed outbreak response and increased mortality. Current systems lack predictive precision and integration between genomic analytics and therapeutic modeling. VIRO–AI addresses this gap by leveraging artificial intelligence to forecast viral mutations, simulate molecular interactions, and accelerate the discovery of effective antivirals—enabling proactive, data-driven responses to evolving infectious diseases.

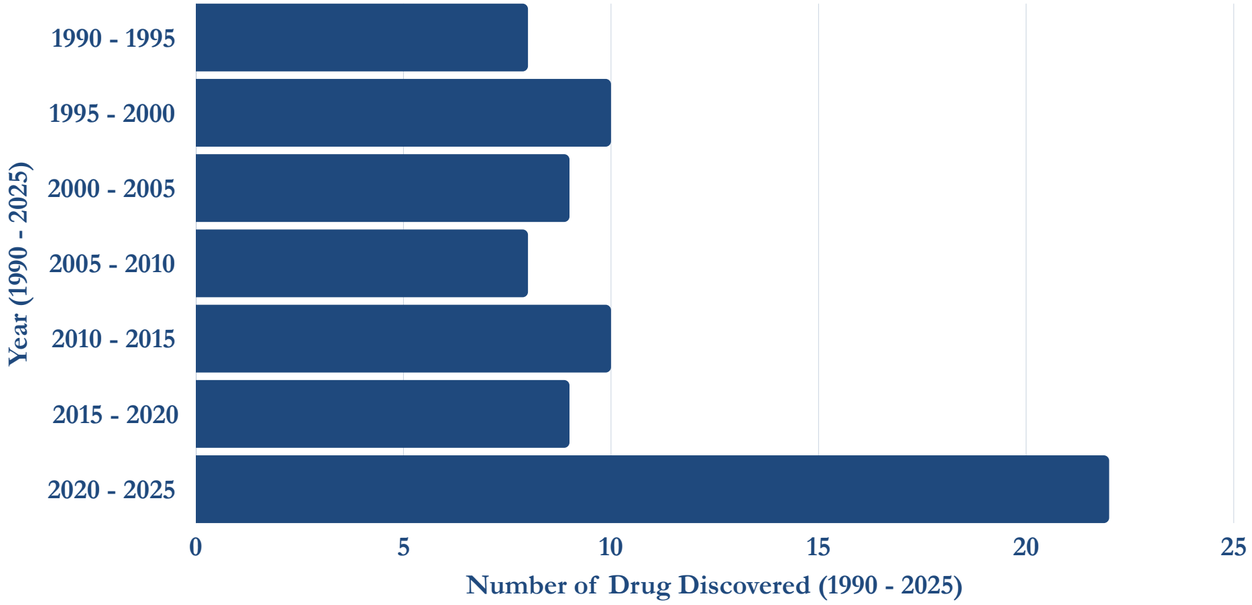


Absence of Real-Time Simulation & Antidote Recommendation Systems

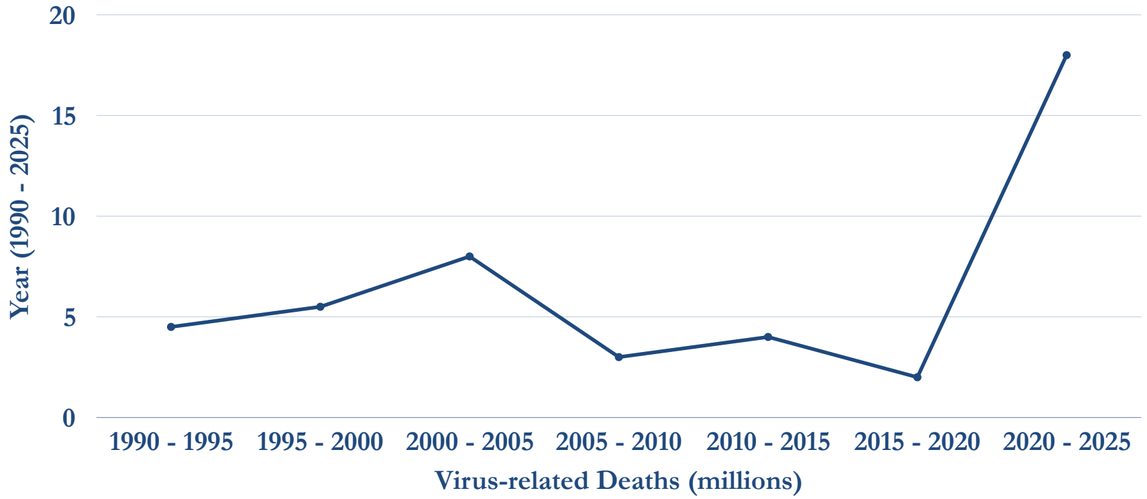
New Human Viruses Discovered (1990 - 2025)



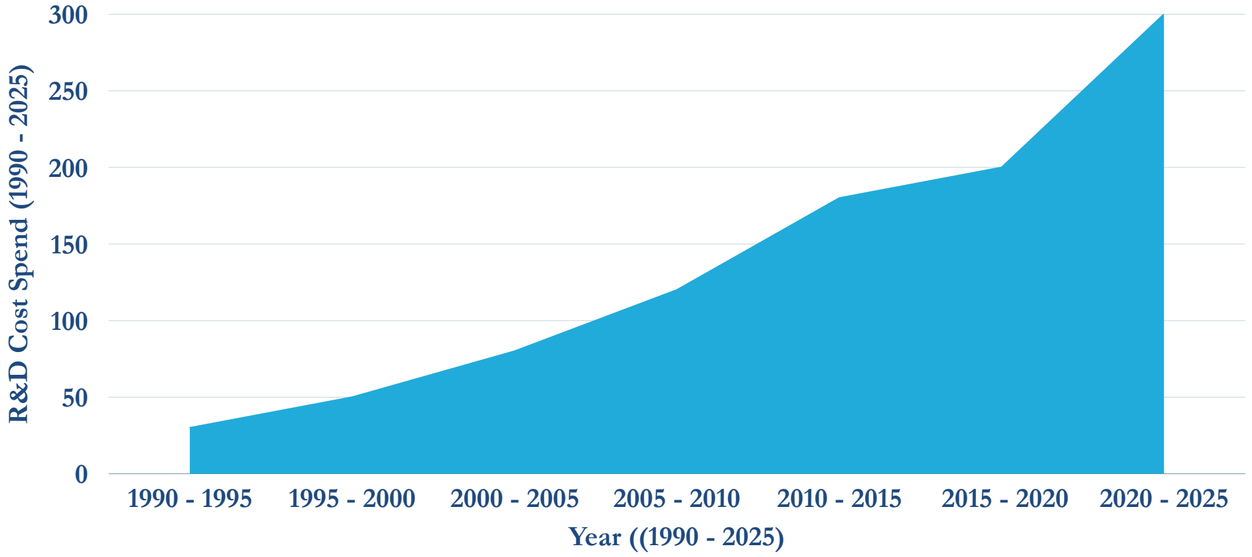
Antidotes Discovered (1990 - 2025)



Virus-related Deaths (millions)



Reserach & Development Cost in Drug Discovery(1990 - 2025)



PROPOSED SOLUTION

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VIRO–AI is an advanced AI-driven bioinformatics platform designed to predict viral mutations, simulate protein–ligand interactions, and accelerate antiviral discovery. It leverages artificial intelligence, molecular modeling, and evolutionary computation to analyze viral behavior at the genomic and structural levels, offering a transformative approach to predictive virology and therapeutic innovation.

The platform integrates genomic analysis, evolutionary modeling, and molecular dynamics simulations to forecast mutation pathways and evaluate their structural and functional impacts. By applying deep learning and generative algorithms, VIRO–AI designs novel drug and antibody candidates while computing pathogenicity scores, immune evasion potential, and outbreak risks with high precision.

Through its cloud-based architecture, VIRO–AI delivers real-time insights and interactive dashboards that support data-driven decision-making for researchers, pharmaceutical industries, and public health authorities. This enables proactive outbreak management, reduces drug development time, and strengthens global pandemic preparedness through predictive, adaptive, and intelligent virological analytics.

SYSTEM ARCHITECTURE

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Secure Web Portal (Streamlit / Dash)

User Authencation

Data Upload
3D Protein Structure, Virus Description, Clinical Behavior

Python (Flask / Fast API)

Input Data

AWS Cloud Storage

Genetic Data
Experimental Data
Epidemiological Data
Pharmacological Data
Pharmaceutical Library
Protein Structure

gsutil / AWS Cloud SDK

Data Processing & Knowledge Base

Mutation Prediction
Batch processing (Dask/Networks, Sequence Alignment, Spark)

Curated Knowledge Base
Contains data on viruses like SARS-CoV-2, HIV, Influenza A.

Antidote Optimization
LSTM/GRU Neural Networks, TensorFlow, PyTorch, RDKit.

Molecular Docking & Binding Affinity Predictions
TensorFlow, PyTorch, RDKit.

Python (Pandas, Dask)

Interactive Dashboard & 3D Visualization

Predicted Mutations
Deadliness Score
Antidote Candidates
3D Docking Simulation
Color-Coded Alerts

JavaScript (three.js), Python, PyVista, Open3D API.

Database Accessing / Adding new Research

INNOVATION & UNIQUENESS

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Mutation Forecasting

Predicts viral mutations for better preparedness.

Drug Generation

AI generates drugs and antidotes quickly.

Symptom Prediction

Predicts symptoms and preventive measures.

Molecular Visualization

Visualizes virus-drug interaction in 3D.

Bioinformatics Infrastructure

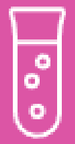
Scalable cloud-based bioinformatics infrastructure.

Deadliness Scoring

Scores deadliness and pathogenicity of viruses.

Chemical Modification

Modifies lead compounds for improved efficacy.



Trial Simulator

Simulates clinical trials in-silico for faster results.

Outbreak Forecasting

Forecasts outbreaks in real-time for rapid response.

Translational Pipeline

End-to-end translational pipeline for drug development.

BUSINESS IDEOLOGY

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Characteristic	Phase 1	Phase 2	Phase 3	Phase 4
Target Audience	Academic/research labs, ICMR, startups	Pharma companies, top pharma, CROs	National health agencies, state labs, hospitals	Central government, national health missions, PPPs
System Accuracy	Mutation prediction, protein folding, docking	Clinical trial simulation, drug-likeness, side-effect prediction	Outbreak forecasting, mutation-to-symptom, deadliness score	Multi-omics integration, vaccine prediction, outbreak prevention
Statistical Data	Viral genomes processed, protein models, docking simulations	Clinical trial simulations, drug molecules screened, candidate reduction	Genomes processed, samples handled, outbreak forecasts	Institutions covered, genomes processed, pandemic impact reduction
Revenue Potential	Pilot contracts with labs	SaaS/API licensing for pharma	SaaS subscription for ICMR, hospital partnerships	National licensing, pharma enterprise deals

FEASIBILITY & VIABILITY

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Feasibility

Viability

Mutation Prediction

Models forecast hotspots, validation ongoing

Drug Design

AI creates novel molecules, docking estimates binding

Deadliness Score

Weighted ensemble models combine factors

Outbreak Forecast

Stochastic models simulate outbreaks, data integrated

Data Acquisition

Raw material available, standardization needed

Protein Structure

DL achieves accuracy, dynamics feasible

Clinical Trial

PBPK models simulate ADME processes

Symptom Mapping

Knowledge graph infers symptoms, guidelines generated

Visualization

3D molecular visualization, interactive dashboards

POTENTIAL IMPACT & TARGET USERS

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Drug Discovery

Accelerates antiviral drug discovery using deep generative chemistry and virtual screening.

Clinical Trials

Reduces mortality and ethical risks in clinical trials through in-silico simulations.

Viral Evolution

Predicts viral evolution using genetic algorithms and evolutionary simulations.

Pandemic Preparedness

Improves pandemic preparedness and outbreak forecasting using epidemiological models.

Systemic Impact

Predicts organ-level and systemic impact using systems biology models.

Drug Optimization

Enhances drug optimization and chemical refinement using QM/MM simulations.

Democratization

Democratizes computational virology with cloud-native, GPU-accelerated architecture.

Visualization

Enhances visualization and interpretability with interactive 3D molecular visualization.