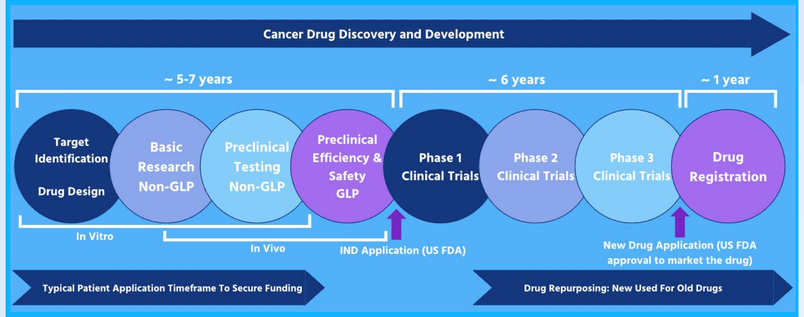
HIGH-THROUGHPUT MOLECULAR PIPELINE

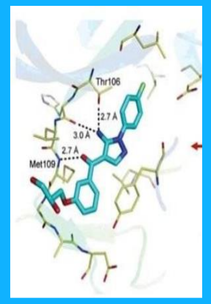
The Data Mine

PROJECT INTRO

- Drug development takes **10-15** years, $1-2 billion, and an **incredibly small** (1/10,000) **chance** of FDA **approval**



- **Project goal:** Develop a high-throughput molecular dynamics (MD) pipeline to accelerate early-stage drug discovery



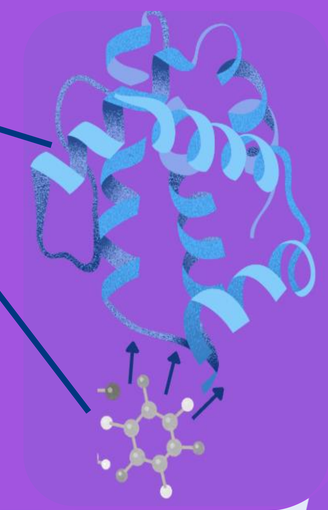
  - We prioritize compounds with selective binding to disease-relevant targets to reduce toxicity

CHEMISTRY OVERVIEW

Protein: large molecules produced by cells in the body

Ligand: smaller molecules that can attach to proteins and change what they do

Goal: Identify ligands with highest binding affinity to certain proteins



METHODOLOGIES

1. INPUT PREPARATION

Protein sequences and ligand structures → Clean sequences, Validate chemical structures → Validated, protein and ligand files

2. COMPLEX PREDICTIONS

3-D models of predicted complex structures ← Use AI (Boltz-1) to predict how they bind together

3. SYSTEM PREPERATION

Add water and ions to mimic physiological conditions → Equilibrate system at physiological conditions → Solvated, simulation-ready system

4. MOLECULAR DYNAMICS

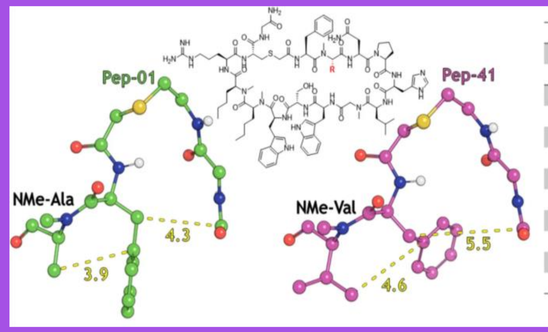
Time-resolved trajectory data ← Cleans structure, stabilize system, run 50–100 ns simulations

5. ML INSIGHTS & ANALYSIS

Analyze RMSD, RMSF, stability
Extract molecular descriptors for ML → Features and predictive insights

RESULTS

- Automated pipeline producing dynamic simulations of protein-ligand interaction
- Improved viability of therapeutic compounds



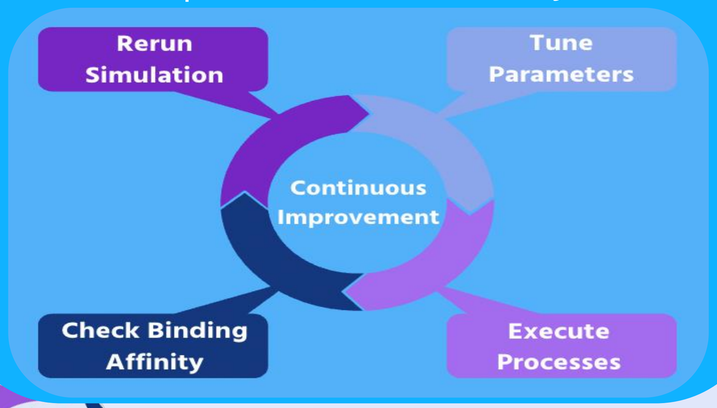
Peptide	Pep-01	Pep-41
R	CH_3	$CH(CH_3)_2$
HTRF pIC_{50}	8.1	6.0
Strain Energy	0.0721	0.0917
N63 W.B.	0.00	0.00
Y56 Hydro.	0.62	0.87
Y123 Pi-Pi	0.00	0.10
V76 W.B.	0.00	0.00
M115 Hydro.	0.37	0.28
Y123 Hydro.	0.49	0.46
V68 Hydro.	0.45	0.59
Y56 H-bond	0.00	0.00
Q66 W.B.	0.14	0.20

W.B. = Water Bridge
Hydro. = Hydrophobic

Mock results sourced from MDFit paper

FUTURE SCOPE

Future development of framework focused on improving predictive accuracy, expansion, and scalability



REFERENCES/ACKNOWLEDGEMENTS

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