

RiFT

A Low-Cost, Rice Flour-Derived Trojan Horse Nanocarrier System for the Eradication of Methicillin-Resistant *Staphylococcus aureus*

PROBLEM

MRSA Epidemic → Highly Contagious + Ineffective Antibiotics

Transmission

Symptoms

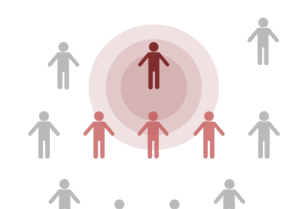
Fatalities



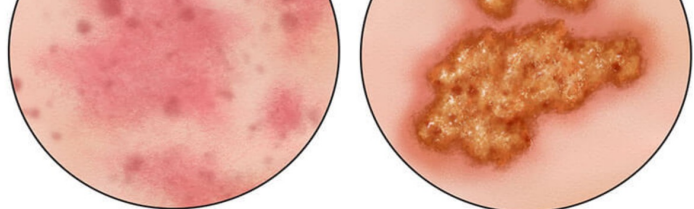
1.2 Million
People contract **invasive MRSA** in Hospitals

50 Million
People currently suffer from **Infection**

47%
Fatality Rate amongst MRSA Carriers



70 Million
People have been **colonized by MRSA** at some point in their Lives

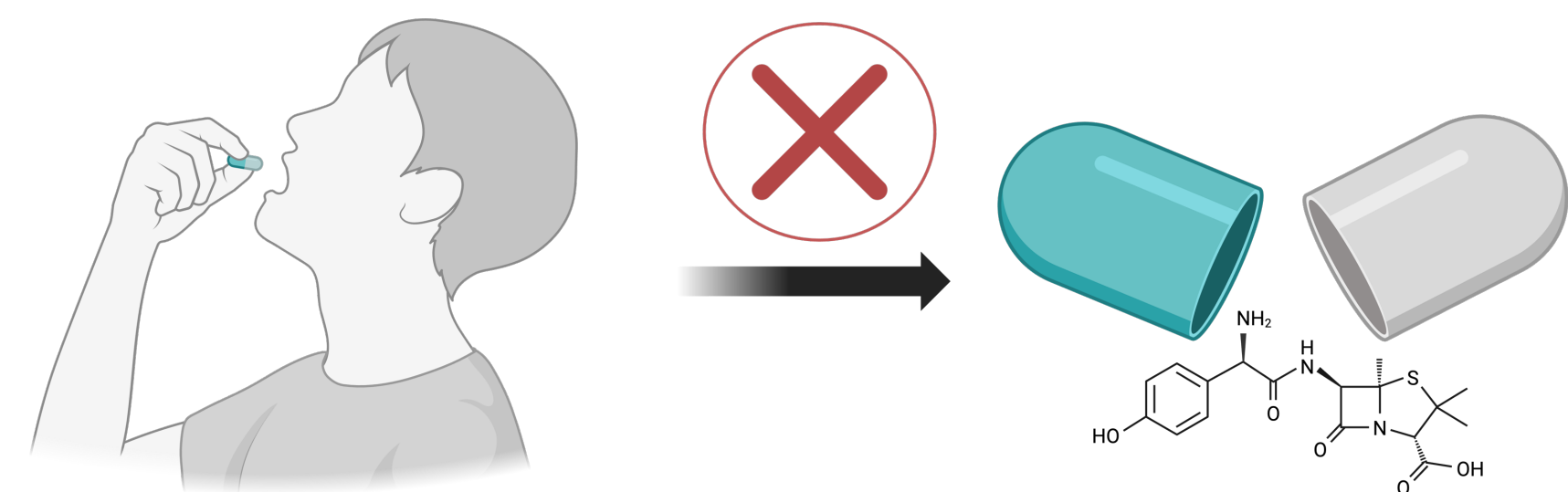


High-Risks of Immune Complications and Sepsis

Illustrations created with Adobe Illustrator by Bhavya

BACKGROUND

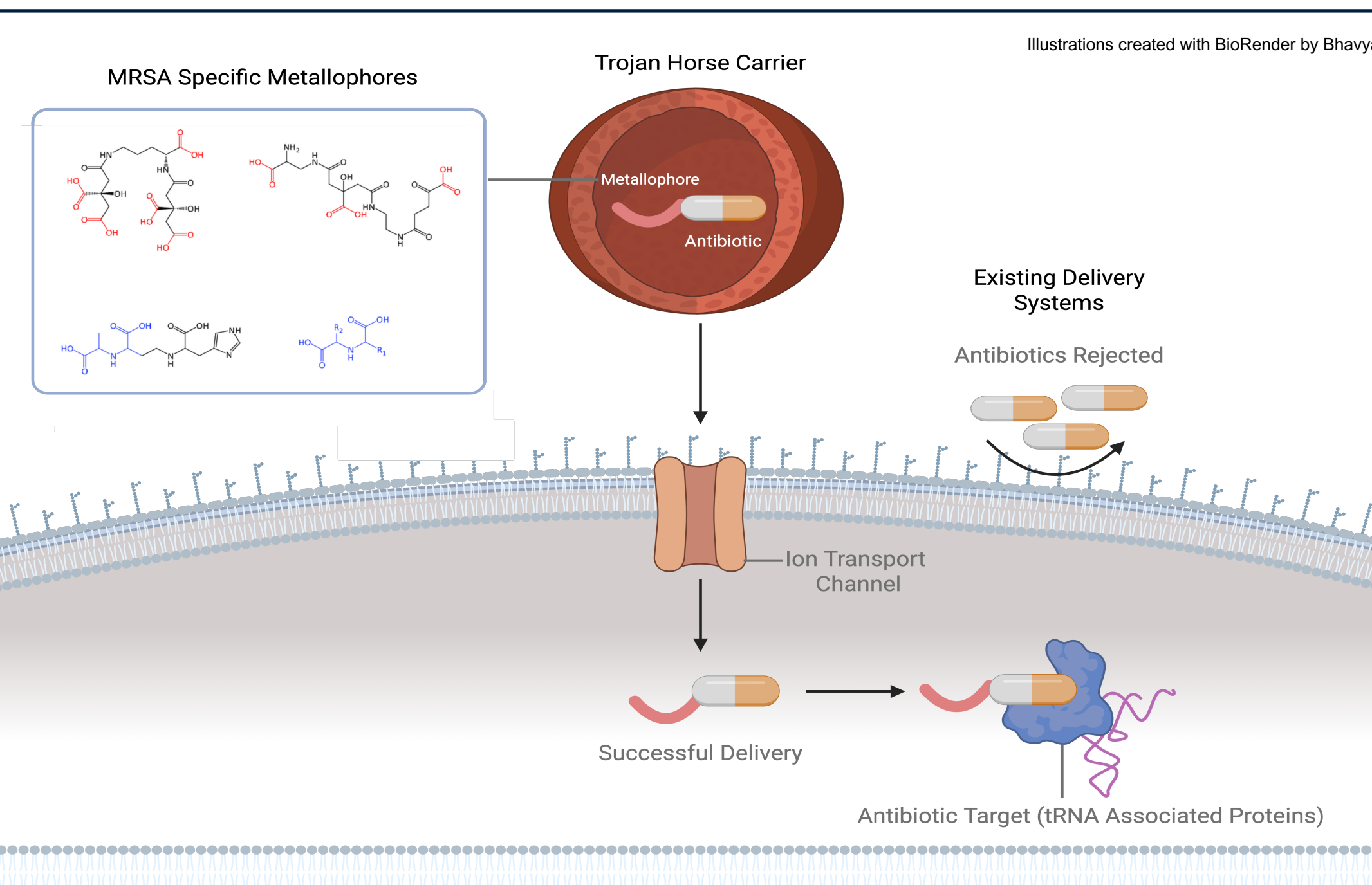
Methicillin Resistance



Illustrations created with BioRender by Bhavya

The overuse of Methicillin and **Antibiotic Drug Abuse** has led to over **80%** of *S. Aureus* Strains becoming Immune to Methicillin Attacks.

Trojan Horse Drug Delivery Systems



HYPOTHESIS

If rice flour carriers (**IV**) are used to deliver MRSA antibiotics **then** these antibiotics will be able to both prevent (**DV**) and heal (**DV**) MRSA **because** they can penetrate the bacterial cell membrane and stop the production of fully developed tRNAs.

EXPERIMENTAL SETUP

Computation

1. PyCharm IDE
2. HDOCK Web Server
3. PyMol
4. NIH PubChem Database
5. RDKit Library

Delivery

1. TinkerCAD Software
2. Rice Flour (**500g**)
3. Vitamin C (**100 mL**)
4. Xanthan Gum (**100g**)
5. Coconut Oil & Beeswax (**100g**)
6. Ethanol (**100 mL**)
7. PDMS (**1 Sheet**)
8. 3D Printer (**36 hrs. usage**)

IV

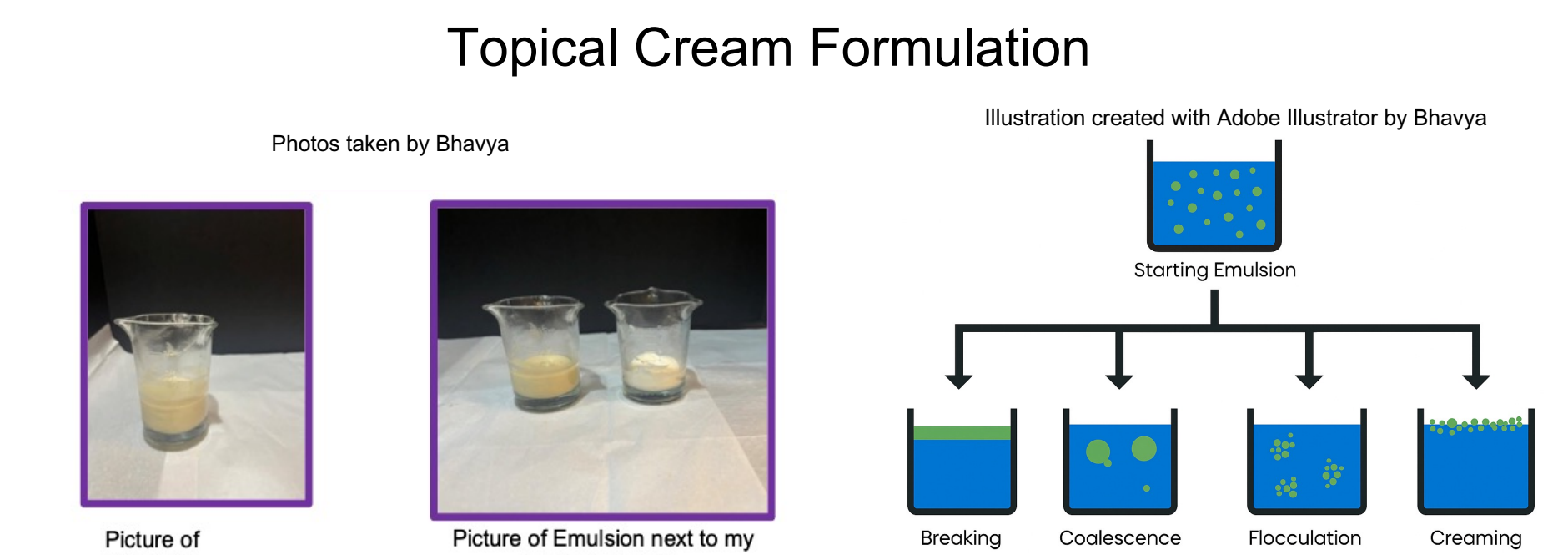
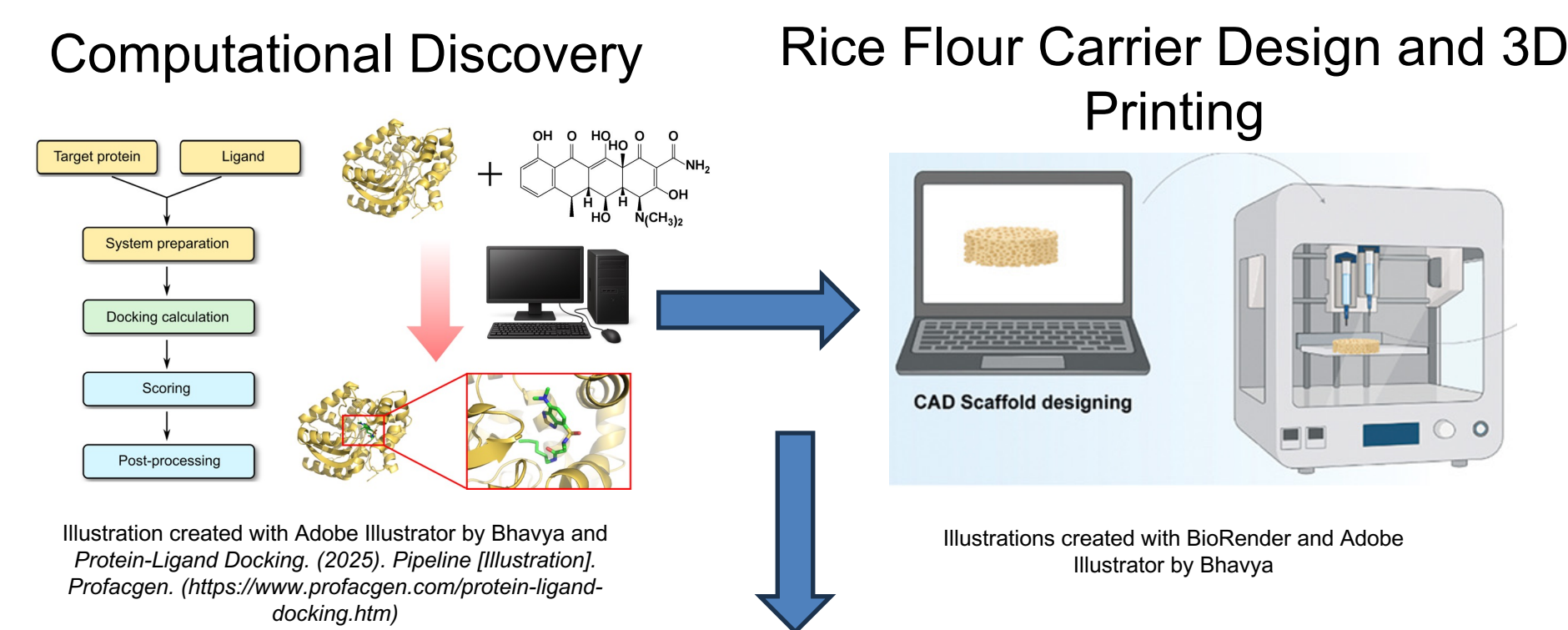
DV

Constants

1. Rice Flour Carriers
 1. 1x1 cm sized
 2. 2x2 cm sized
 3. 3x3 cm sized
 4. 4x4 cm sized
1. Permeability
 1. Evaporation Rate
 2. % Volume Change over time

1. Cream Quantity,
2. Membrane Brand,
3. Amount of Cream Applied
4. Antibiotic Dosage Capacity
5. Duration Tested
6. Length of Intervals Between Measurements, measured in minutes

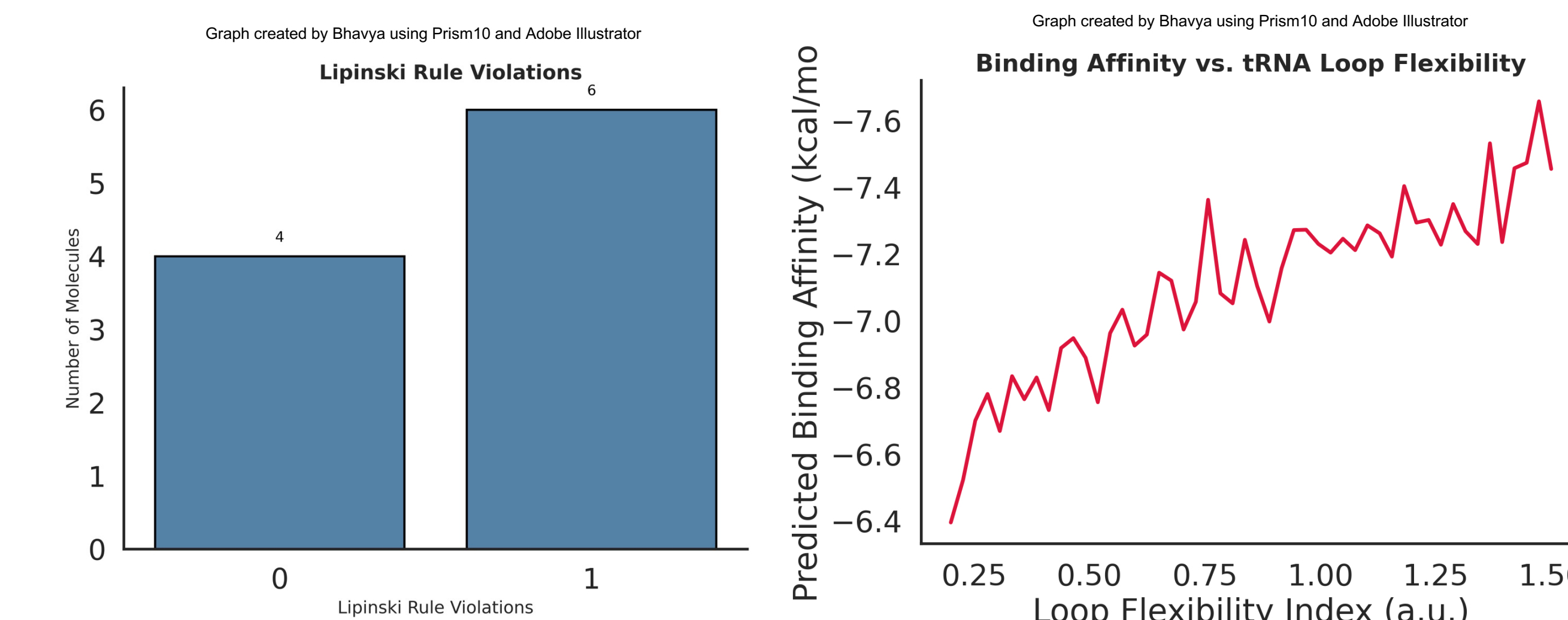
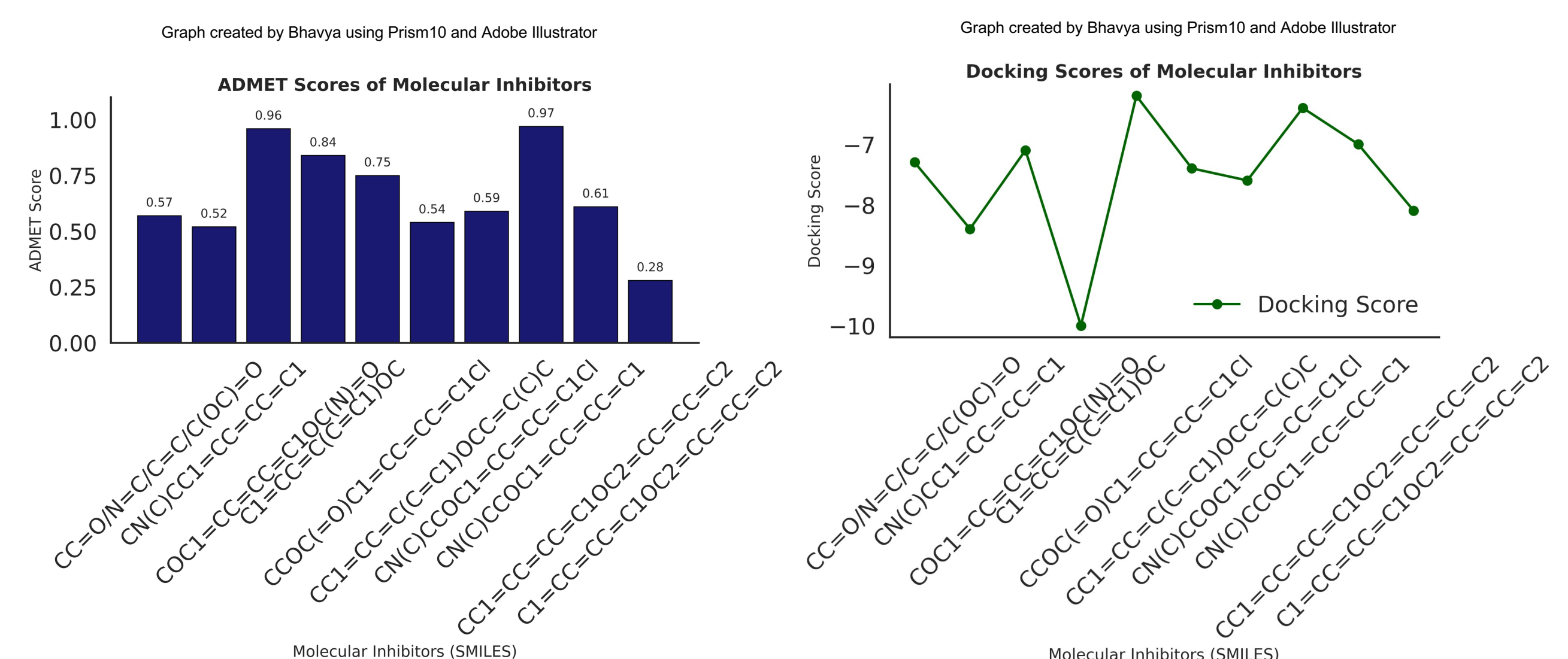
EXPERIMENTAL SETUP



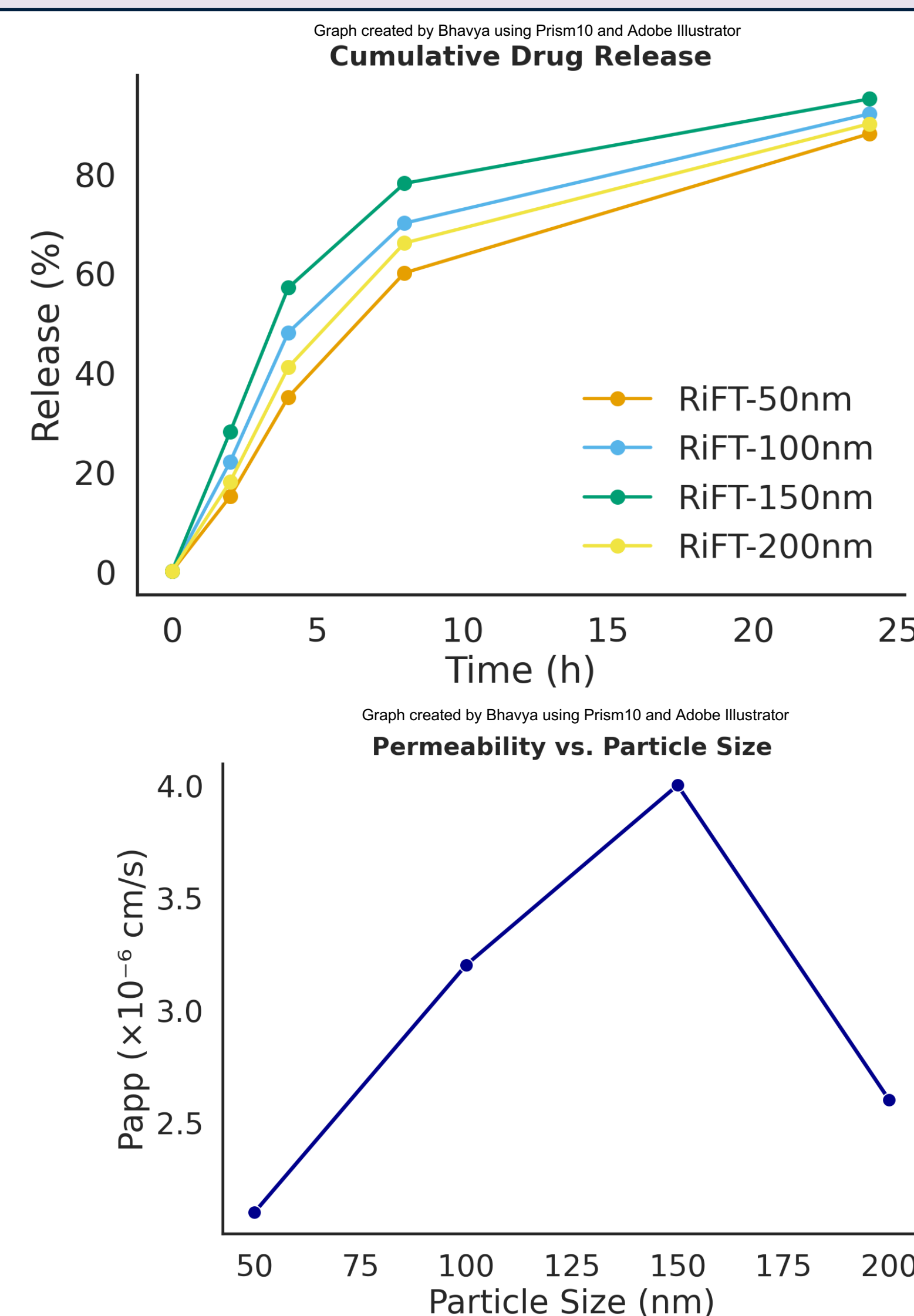
I **first** identified an **IleRS** inhibitor using Computational Docking Simulations, I **then** designed Rice Flour Carriers using CAD and Printed them, **Finally** I Incorporated the Carriers into my Cream which was made by combining two separate Emulsions

RESULTS

Trojan Horse Carrier - Computational Design Results

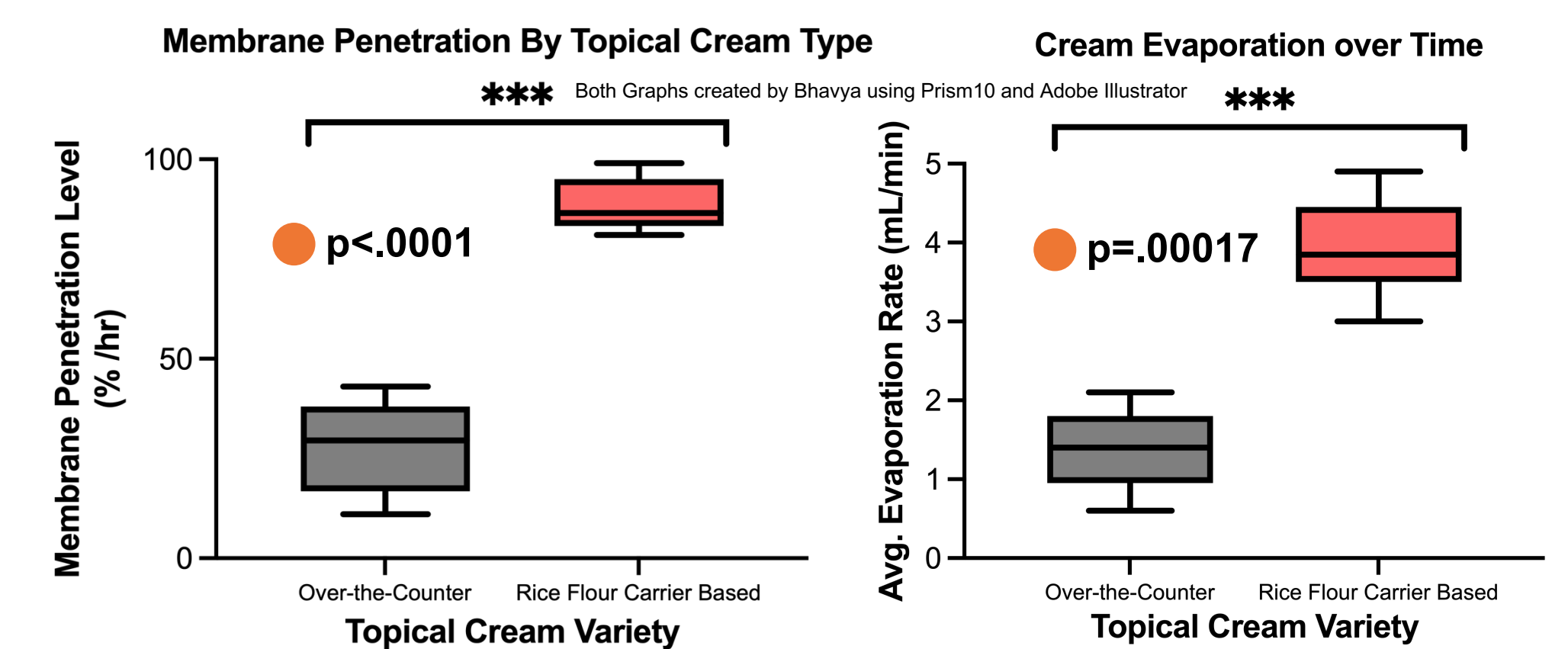


Topical Cream Performance



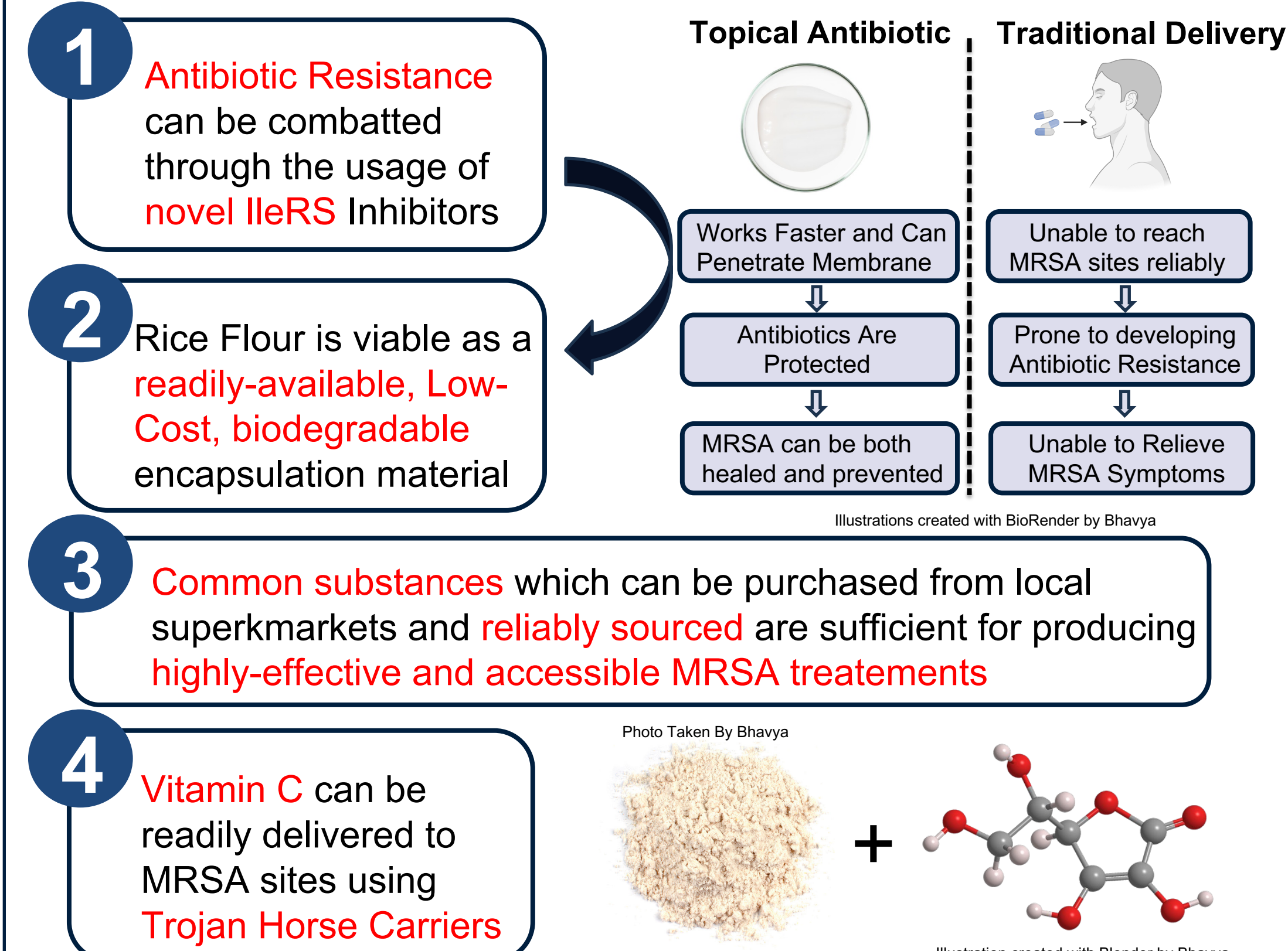
DATA ANALYSIS

Permeability Characterization with ANOVA



After conducting **ANOVA** tests, p-values indicate a **statistically significant** difference between RiFT based and existing topical solutions for MRSA which validates the **efficacy of my project**

CONCLUSIONS



APPLICATIONS

- ✓ RiFT is Useful in **low-resource settings** due to it's low manufacturing cost and simple ingredients.
- ✓ Enables **Precision Drug Delivery via Customizable 3D Bioprinting** to accomodate a wide plethora of medical needs
- ✓ **Long-Term AMR Combat via Adaptions to other infections** by switching the loaded antibiotic
- ✓ Trojan Horse Strategies can now be engineered at a **widespread level** because of biodegradable carriers
- ✓ Topical Creams which **both heal and attack MRSA** can be equitably distributed to Schools, Hospitals, and Military Bases