



# **Synthetic Peptide-based Antigens for Control of Emerging and Re-emerging Infectious Disease Entities (SPACERIDE)**

**Salvador Eugenio C. Caoili, MD, PhD**

Biomedical Innovations Research for  
Translational Health Science (BIRTHS) Laboratory  
Department of Biochemistry and Molecular Biology  
College of Medicine, University of the Philippines Manila

# Why synthetic peptides? Logic, ethics & science!

- ▶ **Unsustainable** healthcare status quo: reactive, inequitable, **xenobiotic**-based
- ▶ **Sustainable** healthcare alternative: proactive, inclusive, **immunity**-based
- ▶ Synthetic peptides: prototypical **peptidic** agents (peptides + proteins: **antibodies**/other immune mediators) to diagnose/treat/prevent disease



# SUSTAINABLE DEVELOPMENT GOALS



Figure 1: Sustainable Development Goals ([https://commons.wikimedia.org/wiki/File:Sustainable\\_Development\\_Goals.png#/media/File:Sustainable\\_Development\\_Goals.svg](https://commons.wikimedia.org/wiki/File:Sustainable_Development_Goals.png#/media/File:Sustainable_Development_Goals.svg))

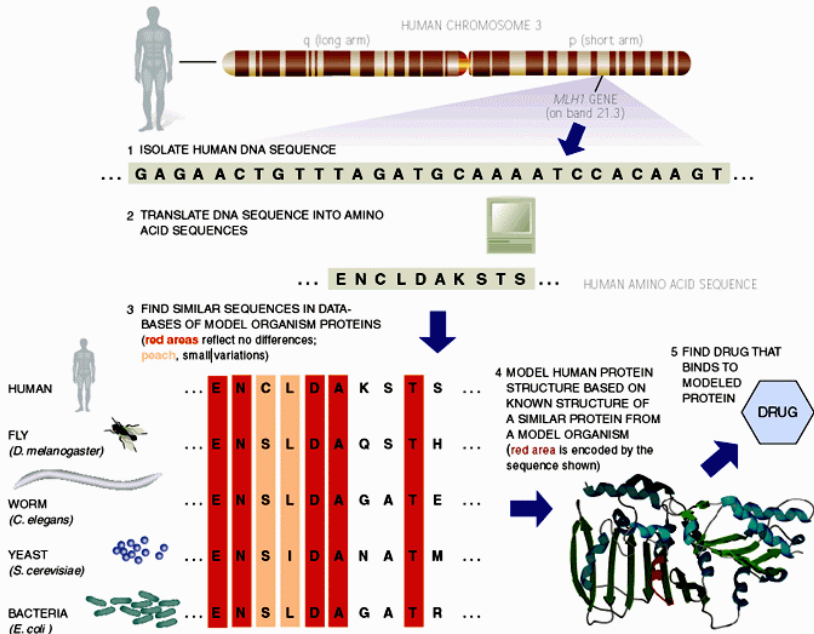


Figure 2: Bioinformatics-aided drug discovery circa 2001 (<http://papers.gersteinlab.org/e-print/whatis-imia/text.pdf>)

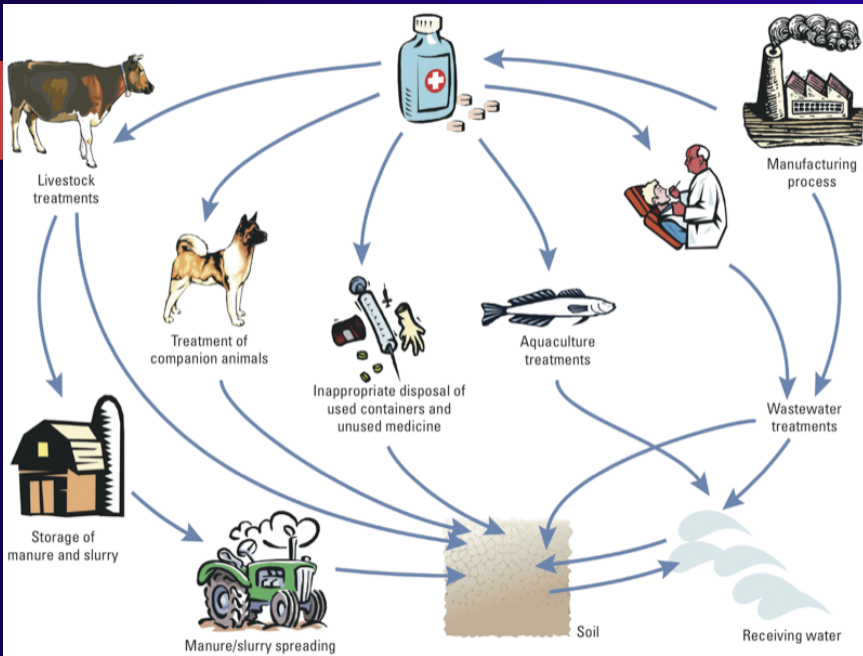


Figure 3: Drug in wider context (<http://ehp.niehs.nih.gov/wp-content/uploads/2012/09/ehp.1104477.g001.png>)

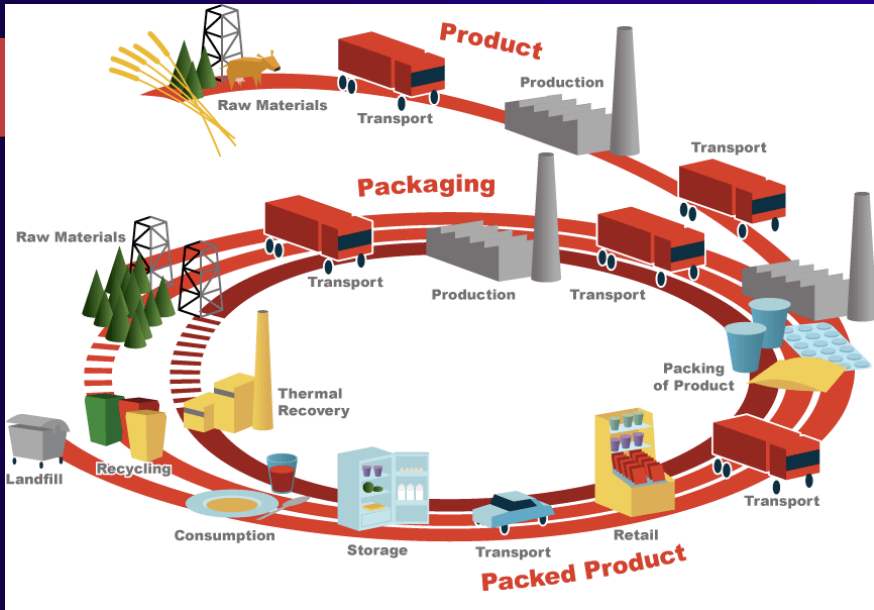


Figure 4: Life cycle assessment framework for industrial (e.g., food and pharmaceutical) products ([https://www.cflex.com/fileadmin/cflex.com/sustainability/corporate-social-responsibility/Life\\_Cycle/Life\\_Cycle\\_Assessment.gif](https://www.cflex.com/fileadmin/cflex.com/sustainability/corporate-social-responsibility/Life_Cycle/Life_Cycle_Assessment.gif))

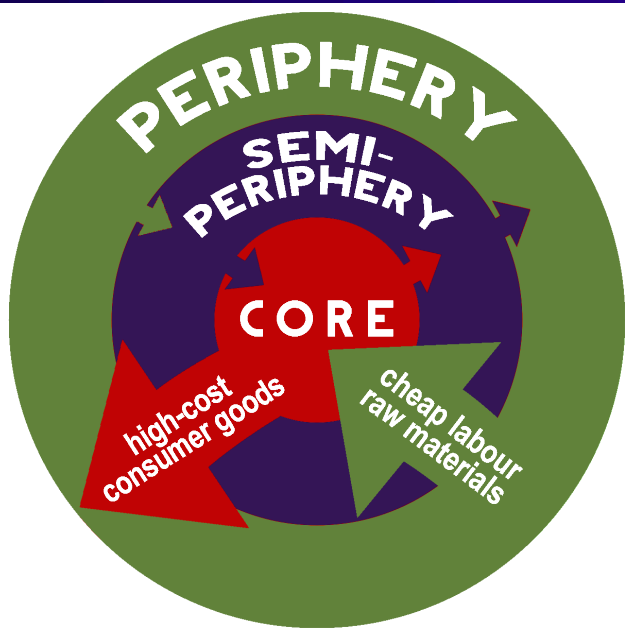


Figure 5: World system according to Wallerstein et al.  
([https://upload.wikimedia.org/wikipedia/commons/6/6b/Wallerstein%27s\\_Core-periphery\\_model.png](https://upload.wikimedia.org/wikipedia/commons/6/6b/Wallerstein%27s_Core-periphery_model.png))

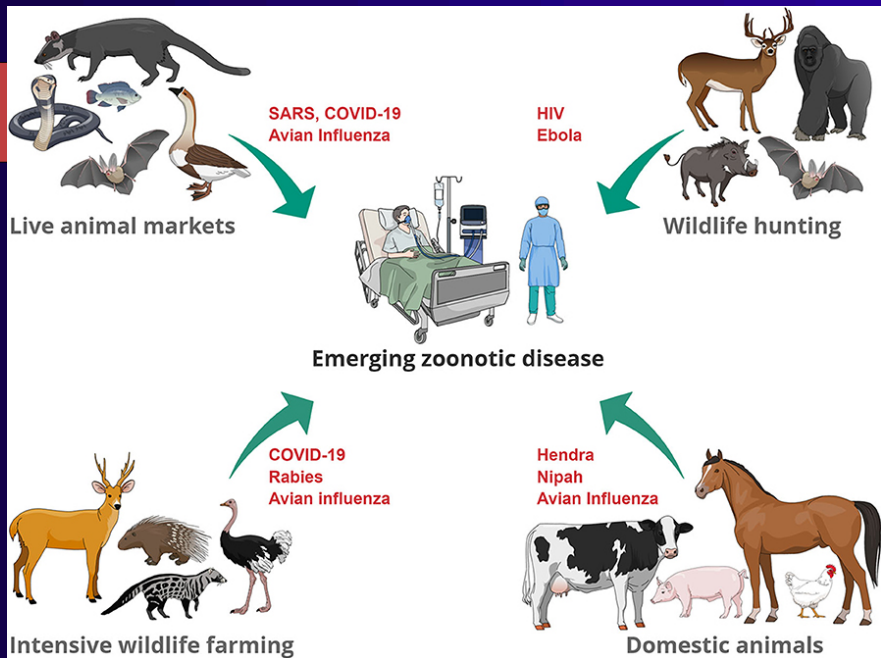
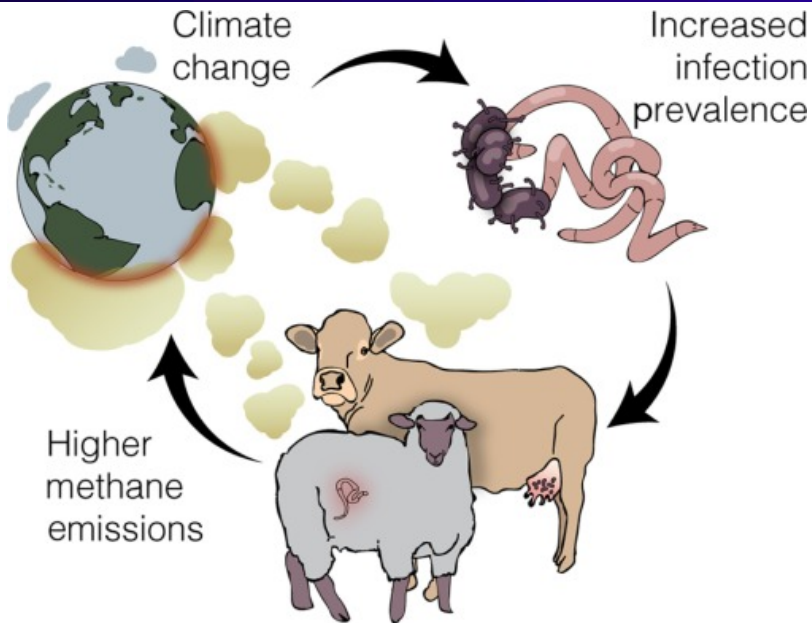


Figure 6: Animal-human interface: true frontline (<https://doi.org/10.3389/fvets.2020.582743>)





Trends in Ecology & Evolution

Figure 7: Vicious circle of climate change and disease spread: example (<https://doi.org/10.1016/j.tree.2020.08.012>)



*Image from [openflights.org](https://openflights.org)*

Figure 8: Global aviation network (<https://stacks.cdc.gov/view/cdc/25958>)

COVID-19  
convalescent  
patients



Isolation of monoclonal antibodies

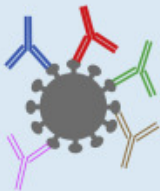


Anti-NTD neutralizing  
antibodies



Anti-RBD VH3-53  
neutralizing antibodies

Neutralization

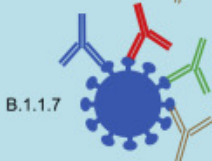


Prototype

Sensitive

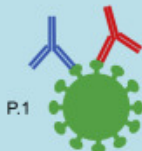


Mink  
cluster 5

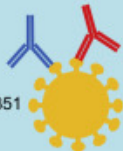


B.1.1.7

Resistant



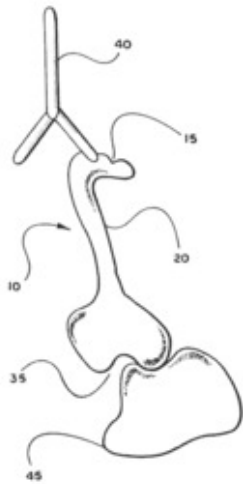
P.1



B.1.351

SARS-CoV-2 variants

Figure 9: Antibodies vs. pathogen variants (<https://doi.org/10.1016/j.celrep.2021.109385>)



**Fig. 2**

## Altermune Linker

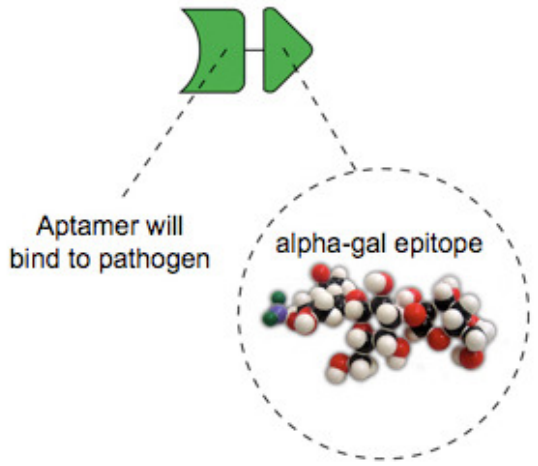


Figure 10: Immunological adaptor to redirect antibody, for chemically programmable immunity (<http://www.karymullis.com/img/altermune1.jpg>)

Programmable Immune Response

Programming Agents

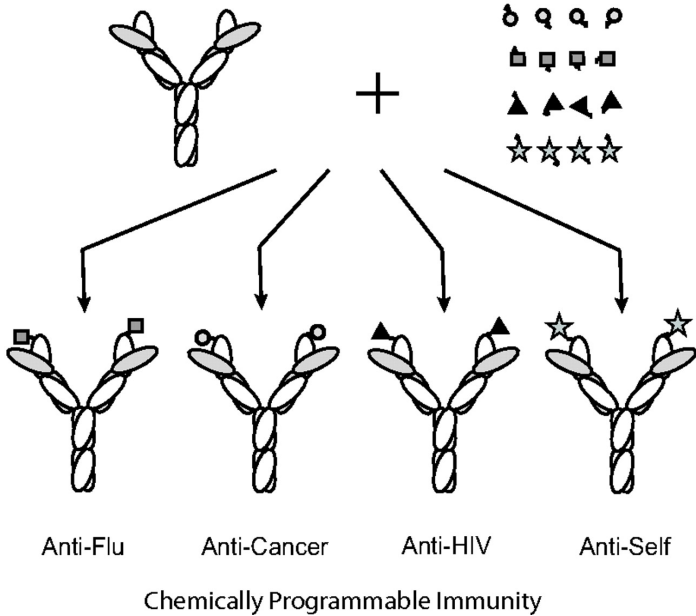


Figure 11: Chemically programmable immunity vs. various targets (<https://doi.org/10.1073/pnas.0900147106>)

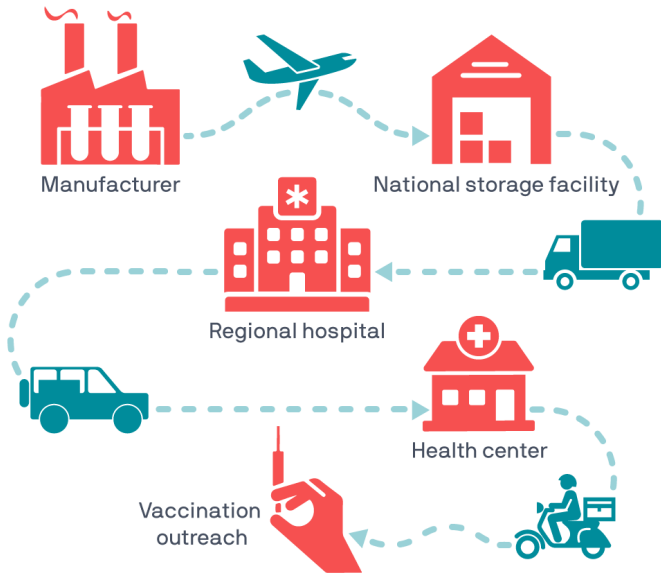


Figure 12: Cold chain for vaccines, antibodies, other biologicals/pharmaceutical products, etc.: resource-intensive yet fragile (<https://www.path.org/articles/vaccine-cold-chain-q/>)

## Dissolving microneedle patch

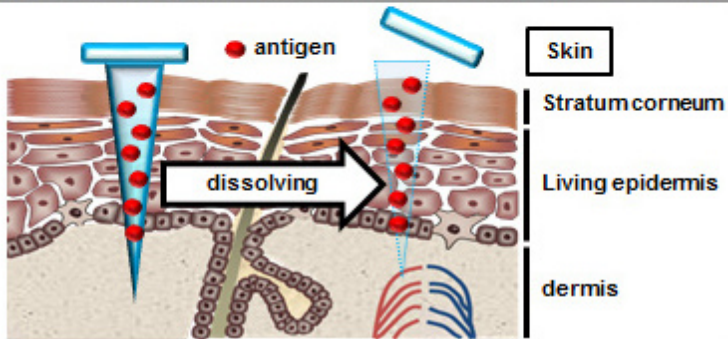
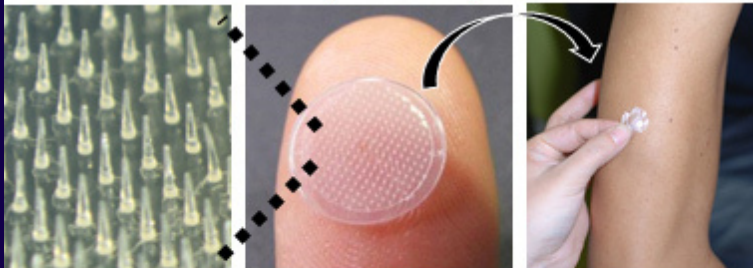
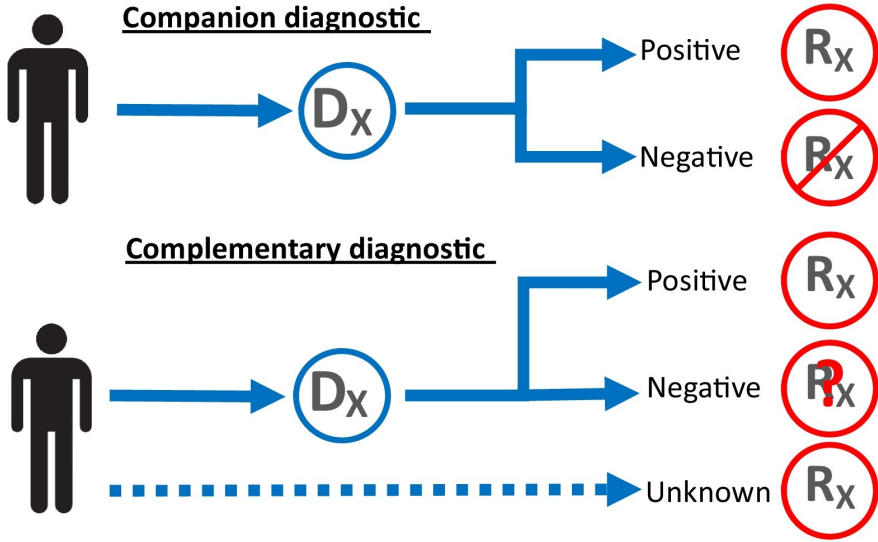


Figure 13: Microneedle patch (<https://futurism.com/vaccines-can-now-be-delivered-via-dissolvable-patch>)



Trends in Cancer

Figure 14: Companion and complementary diagnostics (<https://dx.doi.org/10.1097/FTD.0000000000000460>)



# Key roles of synthetic peptide-based antigens

- ▶ Diagnostic reagents for detecting antibodies &/or T cells in assays
- ▶ Immunological adaptors for effecting chemically programmable immunity
- ▶ Immunogens for producing antipeptide antibodies (for antigen-detection diagnostics &/or prophylaxis/therapy)/ vaccines (for prophylaxis/therapy)

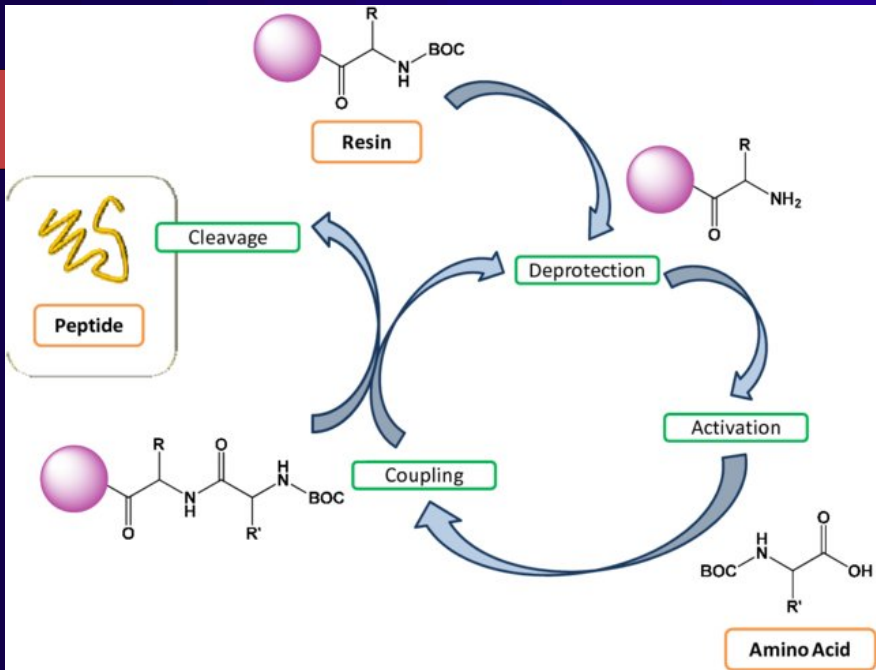


Figure 15: Solid-phase peptide synthesis (<https://dx.doi.org/10.3390/polym6020515>)

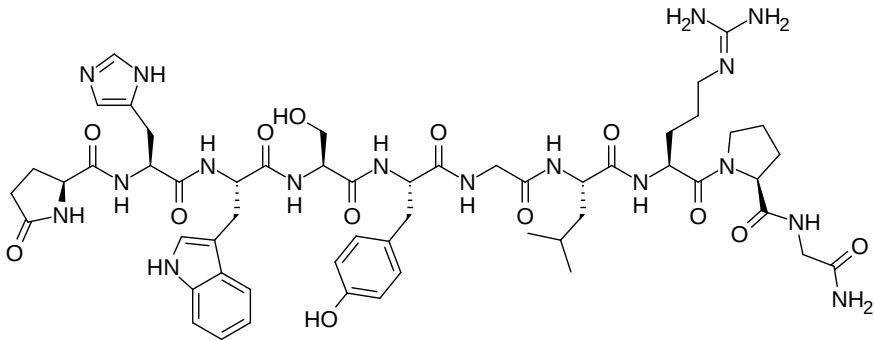


Figure 16: Gonadotropin releasing hormone: basis for peptide-based contraceptive vaccine approved for veterinary use (<https://en.wikipedia.org/wiki/Gonadorelin>)

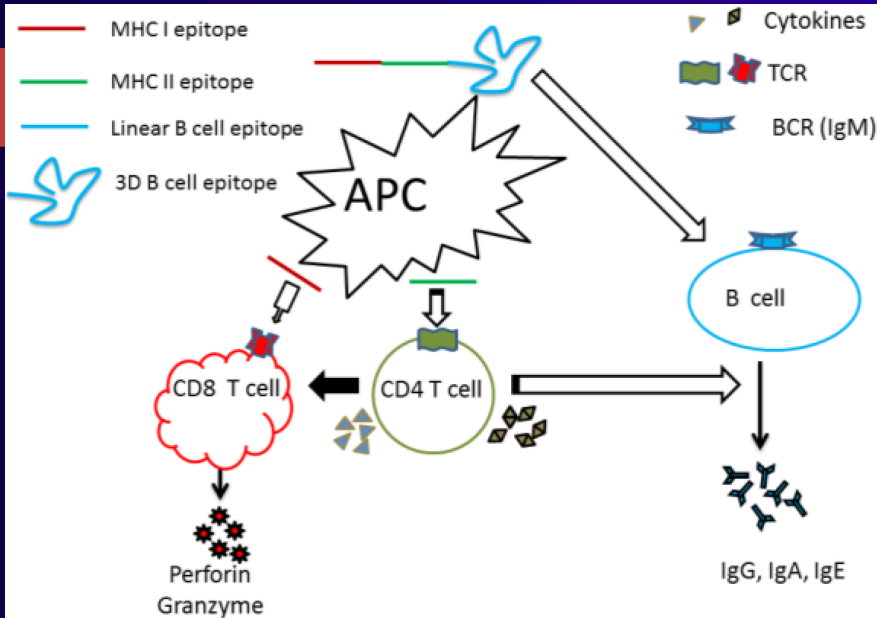


Figure 17: Peptide-based vaccine comprising various epitopes (<https://doi.org/10.3390/vaccines2030515>)

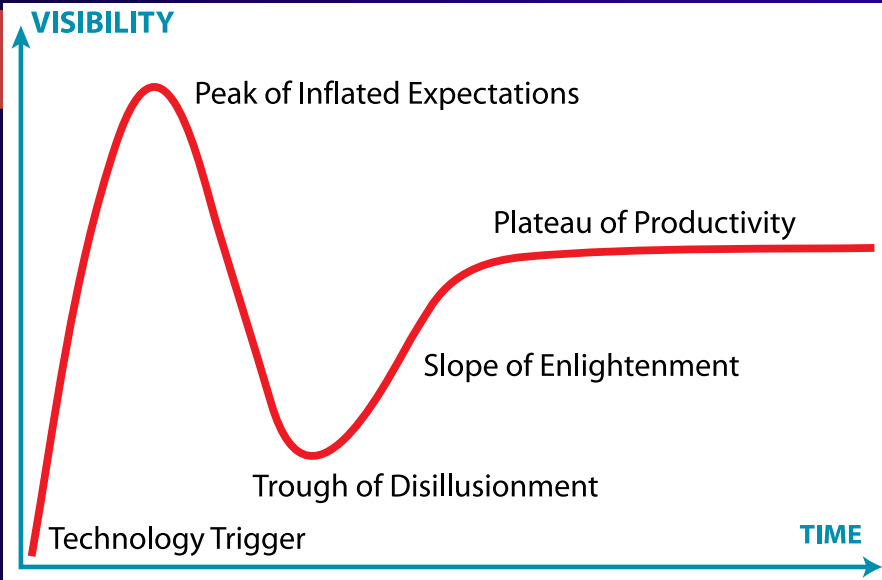


Figure 18: Gartner hype cycle ([https://upload.wikimedia.org/wikipedia/commons/9/94/Gartner\\_Hype\\_Cycle.svg](https://upload.wikimedia.org/wikipedia/commons/9/94/Gartner_Hype_Cycle.svg))

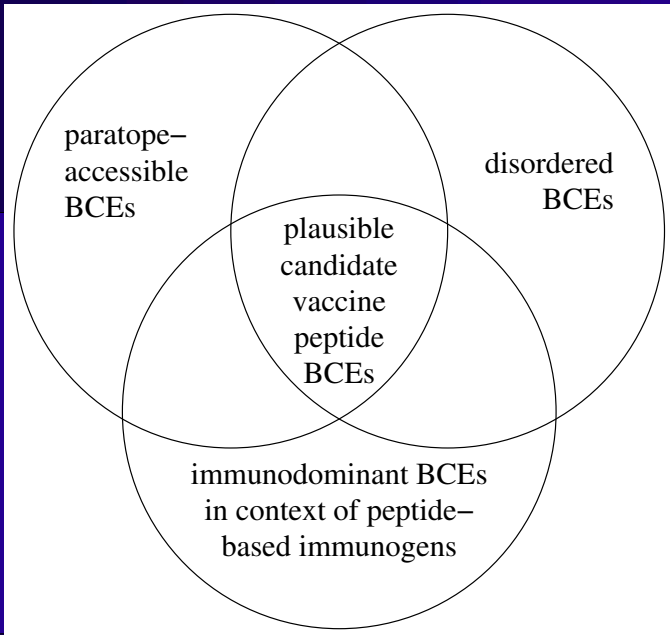


Figure 19: Identifying B-cell epitopes (BCEs) for vaccine peptides (<https://dx.doi.org/10.3389/fimmu.2022.908459>)

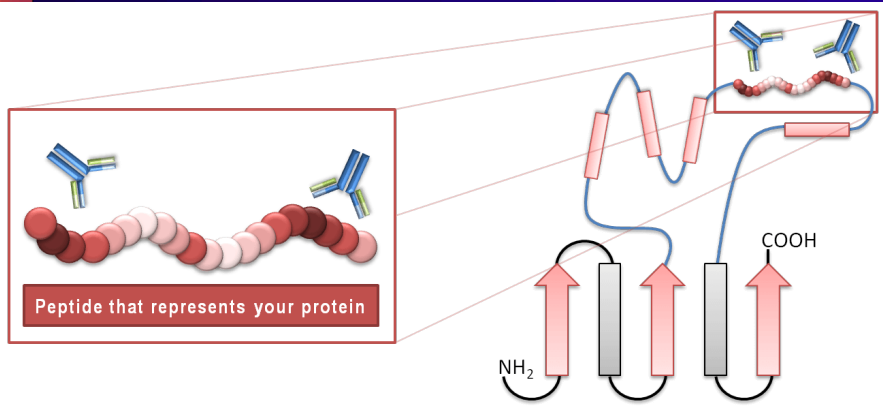


Figure 20: Peptide mimicking disordered part of protein (<https://www.dauids-bio.com/pages/antigen-peptide.html>)

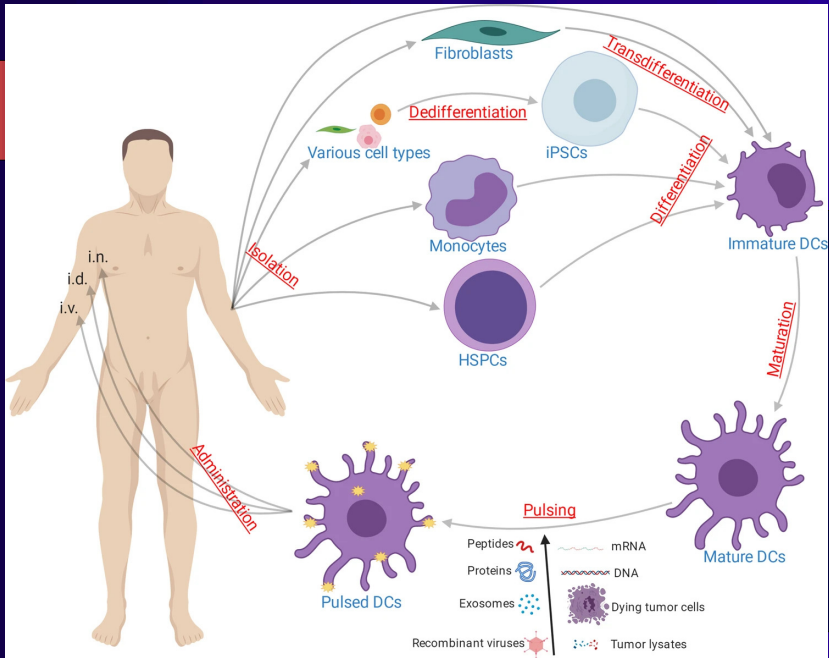


Figure 21: Ex vivo pulsed dendritic cell vaccination (<https://doi.org/10.1038/s41401-020-0415-5>)





Figure 22: From global to planetary health ([https://www.frontiersin.org/files/special%20topics/13053/thumb\\_400.jpg](https://www.frontiersin.org/files/special%20topics/13053/thumb_400.jpg))

# IMMUNE

IMMUNOLOGICAL MODELS FOR MEDICALLY USEFUL NOVEL ENTITIES

**Mission:** Harness host system and immune response to prevent/cure disease

**Goal:** Enhance control of diseases/infectious pathogens of national & global importance (e.g., TB & COVID-19)

**Strategy:** Cross-disciplinary collaboration leveraging and expanding the biomedical research ecosystem in the Philippines with global linkages

## Biomedical-Translational Research Group



Figure 23: Immunological Models for Medically Useful Novel Entities (IMMUNE) Program

# IMMUNE Proponents



Salvador Eugenio Caoili, MD, PhD  
Fresthel Monica M. Climacosa, MD, PhD  
Ruby Anne N. King, MD, PhD  
Francisco Heralde III, RN, MBA, PhD  
Kim Claudette J. Fernandez



Jose B. Nevado, Jr., MD, PhD  
Marissa M. Alejandria, MD, MSc  
Aimee Yvonne Criselle L. Aman, RCh, MD  
John Carlo B. Reyes, MD, PhD  
John Carlo M. Malabad, MD, PhD



Ahmad Reza F. Mazahery, PhD  
Javier Lozano, PhD  
Ranelle Janine L. Asi



Heidie Cabanos, MSc, PhD



Sullian S. Naval, MD  
Treat May S. Sayo, MD



Crist John M. Pastor, MSc, PhD



Leonardo Jr. A. Guevarra, MSc



Ma. Teresa A. Barzaga, MD  
Victoria Basa-Dalay, MD  
Florecita Ludivina B. Tesoro-Solis, MD

Figure 24: IMMUNE Program proponents & institutional affiliations

# IMMUNE PROGRAM PARADIGM AND COMPONENT PROJECTS

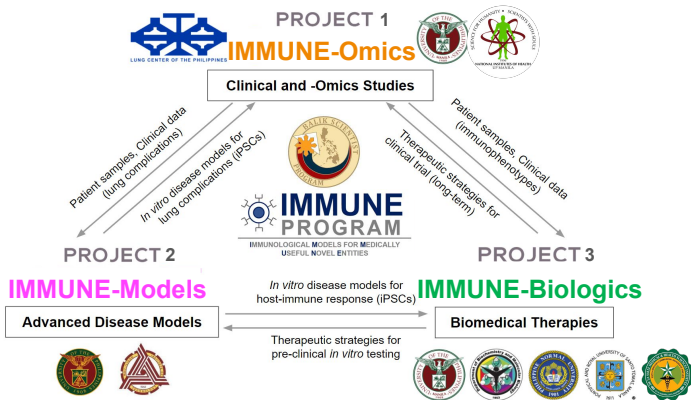
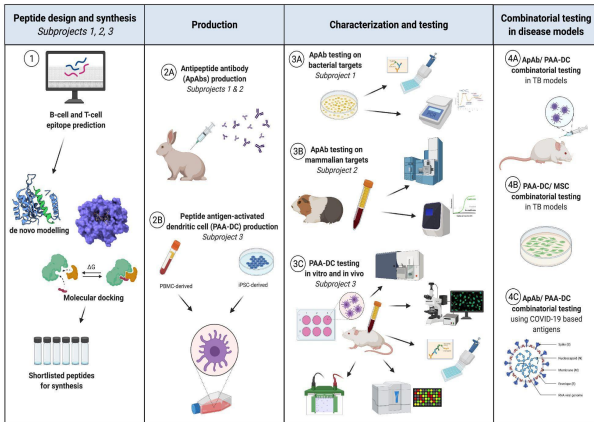
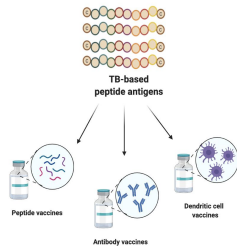


Figure 25: IMMUNE Program paradigm & projects: omics + models + biologics

# IMMUNE-Biologics Methodology



## Newer therapeutic approaches against TB



## Potential outcomes

- Panel of TB and COVID-19 peptide antigens, antibodies, and biomarkers
- Antibody-based prophylactic treatment and cell-based vaccine against TB

Figure 26: IMMUNE-Biologics project methodology: SPACERIDE in action

# BIRTHS: immunocentric approach to health R&D

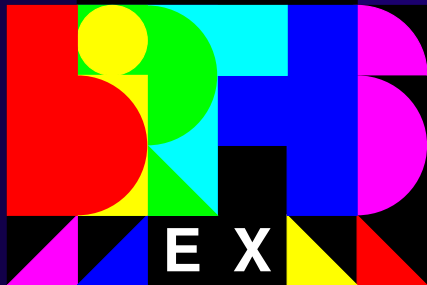
- ▶ Computationally aided dev't of **sustainable technologies** for health: **peptidic agents** (peptides/proteins: **antibodies**/other immune mediators) to diagnose/treat/prevent disease
- ▶ **Synthetic peptides/human blood** as raw materials for R&D (e.g., toward **synthetic peptide-based vaccines**)

# Selected publications

- ▶ Caoili SEC (2022) Comprehending B-cell epitope prediction to develop vaccines and immunodiagnosics. *Frontiers in Immunology* 13:908459
- ▶ Caoili SEC (2022) Prediction of variable-length B-cell epitopes for anti-peptide paratopes using the program HAPTIC. *Protein & Peptide Letters* 29(4):328–339
- ▶ King RAN, Climacosa FMM, Santos BMM, Caoili SEC (2020) A human erythrocyte-based haemolysis assay for the evaluation of human complement activity. *Alternatives to Laboratory Animals* 48(3):127–135
- ▶ Climacosa FMM, King RAN, Santos BMM, Caoili SEC (2020) Development and characterization of polymeric peptides for antibody tagging of bacterial targets. *Protein & Peptide Letters* 27(10):962–970
- ▶ Caoili SEC (2018) Antibodies, synthetic peptides and related constructs for planetary health based on green chemistry in the Anthropocene. *Future Science OA* 4(3):FSO275



V I V A



E X

V I V O

# Biomedical Innovations Research for Translational Health Science

Thank You!