Arvinth **Shanmugam**

Post-Baccalaureate Research Fellow, WSAI, IIT Madras

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Education

July 2025 | **Indian Institute of Technology Madras** — **GPA: 8.77/10**
Aug 2020 | Integrated B.S. & M.S. in Biological Sciences, Specialization in Computational Biology — *Class Rank: 4*
Last 2 years : 9.53/10

Research Experience

Present | **Post Baccalaureate Researcher | Wadhwani School of Data Science & AI** [🌐] — **IITM, Chennai, India**
Jul 2025 | *Advisors: Prof. Nirav Bhatt, Prof. Ganesh Ramakrishnan*
Research Topics: Mechanistic Disease Modeling [C2], ML & AI for Sparse and Unstructured Data [S1, W2]
› Recipient of a merit-based research fellowship ($600/month), awarded to exceptional graduates

June 2025 | **Master's Research Thesis | National Disease Modeling Consortium** [🌐] — **IITB, Bombay, India**
July 2024 | *Advisors: Prof. Nirav Bhatt, Prof. Ganesh Ramakrishnan*
Research Topics: ODE-Based Transmission Modeling, Parameter Estimation & Optimal Control [J4,C1, P2,P1]
› Nominee for Batch of 1979 Award for the best Dual Degree Project Thesis in Biological Sciences

Feb 2025 | **Undergraduate Research Thesis | Centre for Public Health Kinetics** [🌐] — **Remote**
Dec 2024 | *Advisors: Dr.Sunil Sazawal, Prof. Nirav Bhatt*
Research Topics: Continuous-Time-Multi-State Markov Modeling [J3], Mixed Effects Modeling [J2]

July 2024 | **Research Intern | Artificial Intelligence and Robotics Laboratory** [🌐] — **IISc, Bangalore, India**
May 2024 | *Advisor: Prof. Suresh Sundaram*
Research Topics: Dynamical Systems Modeling, Neural-Network Function Approximation, Control

April 2023 | **Undergraduate Researcher | Team Avishkar** [🌐] — **IITM, Chennai, India**
Sept 2021 | *Advisors: Prof. Satya Chakravarthy, Prof. Muruganandam T.M*
Research Topics: Non-Linear Dynamics Modeling, Parameter and State Estimation, Adaptive Control

Publications

J = Journal

[J.4] **Impact of HPV testing for Cervical Cancer Screening in India: A National & Subnational Modelling Study** [🔗]
S Arvinth, Rashmi Tiwari, S Vishnu Tej, Piyush Sawarkar, Prerna Bhalla, Shekar Sivasubramanian, Ajit Rajwade, Ganesh Ramakrishnan✉, Nirav Bhatt✉
In the final stages of manuscript preparation (Planned for submission to Lancet Global Health.), medRxiv

[J.3] **Markov Modelling for Estimating Transition Probabilities for Malnutrition During the First Two Years of Life**
Nirav Bhatt†, **S Arvinth**†, Rasheda Khanam†, Naveed Iqbal†, Sayan Das, Md. Shafiqul Islam, Waqasuddin Khan, Usha Dhingra, Salahuddin Ahmed, Farzana Bashir, Tulika Sinha, Nabidul Haque Chowdhury, Farrukh Qazi, Arup Dutta, Arunangshu Dutta Roy, Samiah Kanwer, Saikat Deb, Dipak Mitra, Salman Usmani, Innocent Nyalala, Diwakar Mohan, Muhammad Imran Nisar, Rajiv Bahl, Sachiyo Yoshida, Fyezah Jehan✉, Abdullah H. Baqui✉, Sunil Sazawal✉
Journal of Global Health (Reviewed, Revised, and Resubmitted) [**JoGH'2025**]

[J.2] **Understanding Child Growth Patterns in First Two Years of Life: A SITAR Analysis of AMANHI-ACT Cohorts**
Sunil Sazawal†✉, Nirav Bhatt†, Rasheda Khanam†, Naveed Iqbal†, **S Arvinth**, Salahuddin Ahmed, Samiah Kanwar, Sayan Das, Abrarul Haque Asif, Farrukh Qazi, Arup Dutta, Md. Shafiqul Islam, Waqasuddin Khan, Pavan Kumar S, Nabidul Haque Chowdhury, Najeeb Rehman, Saikat Deb, Dipak Mitra, Farzana Bashir, Mayassa Ally, Diwakar Mohan, Fyezah Jehan, Rajiv Bahl, Sachiyo Yoshida, Muhammad Imran Nisar, Abdullah H. Baqui, Usha Dhingra
Journal of Global Health (Reviewed, Revised, and Resubmitted) [**JoGH'2025**]

[J.1] **At what probability of occult pelvic nodal disease does pelvic radiotherapy become beneficial?**
Srinivas Chilukuri*, Sham Sundar, **S Arvinth** et al.
International Journal of Radiation Oncology, Biology, Physics (Under Review) [**IJROBP'2026**]

Working Papers

S = Working Paper

[S.2] **Structured Opportunistic Prostate Cancer Screening in Urban India: A Modelling Study for Low- and Middle-Income Countries**
Srinivas Chilukuri✉, Sham Sundar, **S Arvinth**, Nirav Bhatt
Working Paper

[S.1] **Predicting the Global Distribution and Burden of HPV using Machine Learning**
Prerna Bhalla†, **S Arvinth**†, Sainath Raja, Daljeet Singh, Nirav Bhatt✉
Working Paper

Selected Oral Presentations

T = Talk (Abstract Selected by Review Committee)

Nature Conf. | **Modeling the Impact of Active HPV Testing Intervention on Cervical Cancer Burden in India**
Oct 2026 | **Short Talk** – *Meeting the Challenge of Infectious Diseases in a Changing World* **MAHE, Manipal, India**
[T.2] | Selected by the review committee as 1 of 4 short talks among ∼200 poster abstracts

BDBio | **Data-Driven Learning Framework for Spatio-Temporal Allocation of Cervical Cancer Interventions**
Jun 2026 | **Early-Career Talk** – *Symposium on Big Data Algorithms for Biology 2026* **IISc, Bengaluru, India**
[T.1] | Selected by the review committee from submitted abstracts

Conferences and Workshops

C = Conference, W = Workshop, P = Poster

[C.2] **Modeling the State-Wise Impact of HPV Vaccination and Screening on Cervical-Cancer Outcomes in India**
S Arvinth, Rashmi Tiwari, Prerna Bhalla, Ajit Rajwade, Ganesh Ramakrishnan, Nirav Bhatt✉
International Conference on Modelling and Health Informatics for Public Health (Accepted) [**ICMIPH'25**]

[C.1] **Optimal Active HPV screening strategy for reducing HPV infections and Cervical Cancer in LMICs**
Rashmi Tiwari†, **S Arvinth**†, S Vishnu Tej, Piyush Sawarkar, Prerna Bhalla, Shekar Sivasubramanian, Ajit Rajwade, Ganesh Ramakrishnan✉, Nirav Bhatt✉
Infectious Disease Modeling Conference 2024, Bangkok, Thailand [**IDM'24**]

[W.2] **Develop Machine Learning Models to predict HPV prevalence using Meta-Data** [🔗]
Nirav Bhatt, Prerna Bhalla, **S Arvinth**, Sainath Raja, Daljeet Singh
Workshop on Core Modeling Frameworks and Open-Source Tools by the Institute of Disease Modeling (IDM)

[P.2 , P.1] **HPV Screening Strategy for Reducing HPV Infections and Cervical Cancer using Optimal Control** [🔗]
S Arvinth, Rashmi Tiwari, S Vishnu Tej, Piyush Sawarkar, Prerna Bhalla, Shekar Sivasubramanian, Ajit Rajwade, Ganesh Ramakrishnan✉, Nirav Bhatt✉
WSAI Annual Research Showcase 2025 & AI/ML in Process Systems Engineering 2025 [**WSAI-ARS'25**, **AI/ML in PSE**]

Workshop Organization

[W.1] **Workshop on Role of Technology for Advancing Women's Health in India**
Nirav Bhatt, Prerna Bhalla, **S Arvinth**, Akash Chakraborty
Speakers: Prof. Krithika Rangarajan, Prof. Vijayalakshmi Ramshankar, Prof. Rupsa Bhattacharjee, Dr. Oshima Sachin et. al.

Select Research Projects

Modelling Vaccination, Screening & Treatment for Cervical Cancer Elimination in India NDMC IITB
Advisors: Prof. Nirav Bhatt, Prof. Ganesh Ramakrishnan

- Built 36 state- and UT-specific age-stratified compartmental models (16 age bands), each calibrated to the ICMR-NINE cervical cancer incidence and mortality data (2012–2025), capturing over four-fold variation in burden across India.
- Integrated girls' HPV vaccination, HPV-DNA screening with cytology triage and severity-specific treatment, and ran scenarios varying coverage, target age and start year, alone and combined, for all 36 states and UTs through 2100.
- Simulated WHO 90-70-90 targets, showing that combined vaccination and screen-and-treat reaches elimination about 17 years sooner than vaccination alone (2044 vs. 2061 in India), with up to a decade's variation across states.
- Identified high-burden states requiring intensified screening or catch-up vaccination to meet the WHO elimination threshold, informing state-specific intervention priorities for allocating limited vaccines, HPV tests and treatment.

Predicting Global HPV Burden from Sparse and Unstructured Data using Machine Learning NDMC IITB
Advisors: Prof. Nirav Bhatt, Prof. Ganesh Ramakrishnan

- Curated a 75-year, multi-country dataset of ∼600 epidemiological, sociodemographic and health-system covariates to estimate HPV prevalence over time in low- and middle-income countries where direct measurements are scarce.
- Built cross-validated machine-learning models that generated time-resolved HPV and CIN prevalence estimates for 192 countries, including those with no direct measurements, and presented the results at the IDM workshop.
- Assembled a corpus of ∼150,000 research publications reporting HPV, precancer and cervical cancer data from cross-sectional, longitudinal and cohort studies worldwide, to extend prediction beyond structured tabular data.
- Developing a mixture-of-experts model that combines evidence extracted from this unstructured literature with the tabular features, leveraging large language models to improve prevalence prediction in data-scarce settings.

Agent–Based Modeling with `HPVsim` for State–Level HPV/Cervical–Cancer Dynamics NDMC IITB
Advisor: Prof. Nirav Bhatt

- Extended `HPVsim` for subnational stratification and assembled granular state-specific inputs on sexual partnerships, marriage, fertility, mortality, migration and condom use to build agent-based models for each Indian state.

Longitudinal Growth and Malnutrition Dynamics in Early Childhood: AMANHI-ACT Cohorts CPHK

Advisors: Dr.Sunil Sazawal, Prof. Nirav Bhatt

- **SITAR Growth-Curve Modeling (Bangladesh, Pakistan, Tanzania).**
  - Built a `SITAR` growth-modelling pipeline for 3,784 children (∼40,700 length and weight measurements). Screened 9,400+ candidate fits to select 166 final models for 83 strata (site, sex, SGA, birth weight, gestational age).
  - Quantified model uncertainty with 17,000 child-level bootstrap refits (median 72% of variance explained). Showed universal length faltering (mean HAZ -0.7 to -2.2, 55% stunted by 24 months) with no catch-up after SGA or LBW.
- **Multi-State Markov Modeling of Malnutrition Transitions.**
  - Built a nine-state continuous-time Markov model of child malnutrition on 3,772 children and 20,304 visits across Bangladesh, Pakistan and Tanzania, fitting and comparing 85 covariate and age-varying specifications.
  - Estimated transition rates, state-occupancy curves and expected months undernourished by site, sex, maternal education and birth category, with child-level bootstrap CIs and site-, interaction- and attrition-robustness checks.

Cost–Effectiveness Analysis using Markov Modeling for Opportunistic Prostate Cancer Screening Apollo

Advisors: Dr. Srinivas Chilukuri, Prof. Nirav Bhatt

- Developed a discrete–time cohort Markov model of prostate–cancer natural history and screening pathways, parameterized with urban Indian epidemiology over a 20–year horizon.
- Performed cost–effectiveness analysis from a health–system perspective, estimating costs and QALYs and reporting the incremental cost–effectiveness ratio (ICER) versus no screening.
- Conducted uncertainty analysis (deterministic and probabilistic) and scenario testing to assess robustness of clinical and economic outcomes.

Honours and Awards

- **Post Baccalaureate Fellowship, Wadhwani School of Data Science & AI** — Merit–based research fellowship ($600/month).
- **WSAI Travel Grant, 2026** — For attending the Nature Conference 2026, MAHE, Manipal, India.
- **Ministry of Railways Travel Grant (EHW 2023)** Competitive travel award ($1,200) to attend EHW 2023, Scotland.
- **Ministry of Railways Travel Grant (EHW 2022)** Competitive travel award ($1,200) to attend EHW 2022, Netherlands.
- **Amazon ML Challenge, 2024** — Team achieved **All–India Rank 130**.

Teaching

- **Teaching Assistant** — IIT Madras
  - **Introduction to Deep Learning**, Dept. of Data Science & AI [🔗] Jul–Nov 2026
    - Developed the complete lecture content (∼30 slide decks) taught by the course instructor.
    - Topics: Universal Approximation, Depth–Width Efficiency, Backpropagation & Autodiff, Normalization, Optimization & Convergence, Regularization & Double Descent, CNNs, RNNs, LSTMs, Transformers & GNNs.
  - **Genomics and Proteomics**, Dept. of Biotechnology Jan–May 2025
    - Supported a class of 50+ students; Authored and evaluated class assignment problems.
  - **Life Sciences**, Dept. of Biotechnology Jul–Nov 2024
    - Mentored and assisted a cohort of 100+ students; designed assignments, homework problems, and project briefs.
    - Organized and evaluated a team–presentation project (24 teams) using structured rubrics and written feedback.

Positions of Responsibility

- **Volunteer Teacher & Mentor, Avanti Fellows** — Puducherry, India [🌐] Aug 2021–April 2022
  - Taught Physics, Chemistry, and Math at JEE level, focusing on personalized support for under-resourced students.
  - Designed and evaluated full-length mock exams and weekly assignments; conducted feedback-driven review sessions.
  - Mentored and tracked the progress of 40 students throughout the year; 12 secured admission to IITs and NITs.
- **Lead Chief Engineer, Team Avishkar Hyperloop** — CFI, IIT Madras [🌐] Sep 2021–Apr 2023
  - Led a 72–member team across seven subsystems; oversaw technical architecture, integration, and validation; planned and executed major technical decisions.

Key Courses Undertaken

Data Science	Pattern Recognition and Machine Learning, Statistical Inference, Biostatistics, Convex Optimization
Comp. Biology	Bioinformatics, Computational Biology Lab, Computational Neuroscience, Theoretical Biophysics
Math & CS	Linear Algebra, Multivariate Calculus, Numerical Methods, Data Structures and Algorithms
Life Sciences	Quantitative and Population Genetics, Genomics and Proteomics, Molecular Biology and Biochemistry