

**NTD**  
**MODELLING**  
**CONSORTIUM**



## **Highlight report on NDMC VL-Workshop at IIT Bombay**

Ananthu James and Luc Coffeng





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# About this document

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## Purpose

- Present the summary of the workshop to inform NTDMC secretariat, BMGF NTD team (India), and NDMC (India)

## Target audience

- NDMC and the workshop participants

## Team & roles

- Dr. Luc Coffeng (Asst. Prof., Erasmus MC) & Dr. Ananthu James (Postdoc, Erasmus MC): conceptualization, development, and execution
- Prof. Sake de Vlas (Erasmus MC), Prof. Graham Medley (LSHTM), Prof. Deirdre Hollingsworth (Oxford): conceptualization





# Executive Summary

- **Time:** August 30 - September 1, 2023
- **Workshop link:** <https://sites.google.com/view/ntd-workshop/home?authuser=0>
- **Funding:** NDMC
- **Topic for training:** Visceral leishmaniasis (VL)
- **Instructors:** Dr. Luc Coffeng & Dr. Ananthu James
- **Language of the scripts in training material:** R
- **Participants who attended the workshop:** 16
- **Topics for the talks of stakeholders and NDMC members:** VL, LF, and (one talk on) machine-learning
- **To follow up post-workshop:** NTDMC support for NDMC work on LF





# Overview

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## What

As per the needs of NDMC, Dr. Coffeng and Dr. James conducted a workshop for **2.5 days** at IIT Bombay in India, spanning ~11 hours of lectures and practical/interactive sessions, with the remaining time dedicated for talks from stakeholders and NDMC members.

## Why

NDMC wants to start working on NTD modelling. They appreciated the NTDMC expertise in this domain to be shared with them. For this purpose, it was mutually agreed that we would run a workshop in India.

## How

- Initial plan developed in March 2023
- Workshop content and structure finalized by August 2023
- **Twenty participants**, with either a masters-level quantitative background or research experience in modelling, were selected by NDMC.
- Goal: provide participants with a learning experience on how to formulate a model-answerable research question, and how to use or adapt an existing compartmental model for this.
- Optional workshop outcome: publication in collaboration with participants
- Four **stakeholders** from India agreed to be speakers for the event.





# Workshop details



**NDM/C**  
HEALTH ANALYTICS WORKSHOP ON MODELLING OF NEGLECTED TROPICAL DISEASES

**Date:** August 30 - September 1, 2023  
**Venue:** Seminar Hall, 2nd Floor, All India Inst. of Medical Sciences, New Delhi

**August 30**

- 08:30 am - 09:00 am: Registration
- 09:00 am - 10:00 am: Breakfast
- 10:00 am - 11:00 am: Session 1: Introduction to the workshop and overview of the program
- 11:00 am - 12:00 pm: Session 2: Overview of the workshop and overview of the program
- 12:00 pm - 01:00 pm: Lunch
- 01:00 pm - 02:00 pm: Session 3: Overview of the workshop and overview of the program
- 02:00 pm - 03:00 pm: Session 4: Overview of the workshop and overview of the program
- 03:00 pm - 04:00 pm: Session 5: Overview of the workshop and overview of the program
- 04:00 pm - 05:00 pm: Session 6: Overview of the workshop and overview of the program
- 05:00 pm - 06:00 pm: Session 7: Overview of the workshop and overview of the program
- 06:00 pm - 07:00 pm: Session 8: Overview of the workshop and overview of the program
- 07:00 pm - 08:00 pm: Session 9: Overview of the workshop and overview of the program
- 08:00 pm - 09:00 pm: Session 10: Overview of the workshop and overview of the program

**August 31**

- 08:30 am - 09:00 am: Registration
- 09:00 am - 10:00 am: Breakfast
- 10:00 am - 11:00 am: Session 11: Overview of the workshop and overview of the program
- 11:00 am - 12:00 pm: Session 12: Overview of the workshop and overview of the program
- 12:00 pm - 01:00 pm: Lunch
- 01:00 pm - 02:00 pm: Session 13: Overview of the workshop and overview of the program
- 02:00 pm - 03:00 pm: Session 14: Overview of the workshop and overview of the program
- 03:00 pm - 04:00 pm: Session 15: Overview of the workshop and overview of the program
- 04:00 pm - 05:00 pm: Session 16: Overview of the workshop and overview of the program
- 05:00 pm - 06:00 pm: Session 17: Overview of the workshop and overview of the program
- 06:00 pm - 07:00 pm: Session 18: Overview of the workshop and overview of the program
- 07:00 pm - 08:00 pm: Session 19: Overview of the workshop and overview of the program
- 08:00 pm - 09:00 pm: Session 20: Overview of the workshop and overview of the program

**September 1**

- 08:30 am - 09:00 am: Registration
- 09:00 am - 10:00 am: Breakfast
- 10:00 am - 11:00 am: Session 21: Overview of the workshop and overview of the program
- 11:00 am - 12:00 pm: Session 22: Overview of the workshop and overview of the program
- 12:00 pm - 01:00 pm: Lunch
- 01:00 pm - 02:00 pm: Session 23: Overview of the workshop and overview of the program
- 02:00 pm - 03:00 pm: Session 24: Overview of the workshop and overview of the program
- 03:00 pm - 04:00 pm: Session 25: Overview of the workshop and overview of the program
- 04:00 pm - 05:00 pm: Session 26: Overview of the workshop and overview of the program
- 05:00 pm - 06:00 pm: Session 27: Overview of the workshop and overview of the program
- 06:00 pm - 07:00 pm: Session 28: Overview of the workshop and overview of the program
- 07:00 pm - 08:00 pm: Session 29: Overview of the workshop and overview of the program
- 08:00 pm - 09:00 pm: Session 30: Overview of the workshop and overview of the program



# Background of the registered participants

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- 20 participants, all with some quantitative and/or modelling background
  - 55% with at least a PhD in a quantitative field
  - 65% with prior experience in mathematical modelling
- Majority (65%) comfortable with R, and 30% used it for modelling
  - 5 have no experience with R, but do know Python, Matlab, or C/C++
- 85% familiar with infectious diseases, 30% with NTDs, and 15% with VL
- Strong motivation to apply workshop teachings immediately
- 16 participants were present during workshop (non-attendance of 4 due to health reasons)



# Workshop materials and the preparation

- The materials were prepared by Dr. James and Dr. Coffeng in ~3 months:
  - A series of plenaries, break-outs, and interactive discussion session
  - R-scripts for modelling VL-transmission dynamics
  - Participants were provided with detailed instructions on how to view, run, and adapt the scripts so that even those who are unfamiliar with R can use them







# The workshop program

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# Day 1

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8:45 am	Introduction by Dr. Souvik Banerjee, IIT Bombay
9:00 am	Plenary talk by Dr. S. Subramanian, ICMR-VCRC
9:45 am	General introduction to VL and the elimination program in India
10:45 am	Tea break
11:00 am	Break-out (in pairs): formulating a model-answerable question
11:15 am	Developing stochastic compartmental models
12:15 pm	Break-out (groups of 4): revision of model-answerable question + development of schematic model
12:45 pm	Lunch
2:00 pm	Plenary pitches (per group) and discussion of model-answerable questions and schematics
3:30 pm	Tea break
3:45 pm	Data needs, available data, and what to do if no data + plenary discussion of each group's topic
5:00 pm	Close



## Day 2

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9:30 am	Plenary talk by Dr. Tanu Jain, NCVBDC
10:15 am	Plenary talk by Dr. Vinod P. Choudhary, NCVBDC
11:00 am	Tea break
11:15 am	Recap of Day 1 + introduction to using the <i>pomp</i> package in R + tips for sense checks and debugging
11:45 am	Break-out (same groups as day 1): run deterministic and stochastic compartmental model code and adapt it for research question
1:00 pm	Lunch
2:00 pm	Break-out (continued)
3:15 pm	Tea break
3:30 pm	Plenary presentation and discussion of group progress and challenges encountered
5.00 pm	Close



## Day 3

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9:00 am	Review of more complex modelling methods
10:00 am	Reflection on lessons learnt
10:30 am	Plenary talk by Dr. Bhupendra Tripathi, BMGF India
11:30 am	Tea break
11:45 pm	Plenary talk by Prof. Mithun Mitra, IIT Bombay
12:30 pm	Plenary talk by Prof. Ganesh Ramakrishnan, IIT Bombay
1:00 pm	Closing remarks
1:15 pm	Lunch



# Talks by stakeholders & NDMC team







# Talks by stakeholders and NDMC team

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- Dr. S. Subramanian, Formerly Scientist F at ICMR-VCRC, India – the LYMFASIM simulation model
- Dr. Tanu Jain, Director at NCVBDC, India – LF elimination program in India and opportunities for mathematical modelling
- Dr. Vinod Choudhary, Medical Officer at NCVBDC, India – VL elimination program in India and opportunities for mathematical modelling
- Dr. Bhupendra Tripathi, Country Lead at BMGF – Recent policy changes for the LF elimination program
- Prof. Mithun Mitra (co-PI for NDMC), Dept. of Physics, IIT Bombay, India – Modelling LF transmission (novel approaches)
- Prof. Ganesh Ramakrishnan (co-PI for NDMC), Dept. of Computer Science and Engineering, IIT Bombay, India – Machine learning using Python



# Summary of feedback on training sessions

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- The workshop was **very well-received** by all the 16 attendees, of whom 8 self-identified to have a sufficient and 7 a partially sufficient background for following the workshop content.
  - All were happy with the topics covered and workshop content
  - All had their expectations met after the workshop
  - All found the R-scripts well-documented
  - All found the workshop interactive enough
  - All were happy with how we addressed their questions
  - All would be happy to recommend us to others
  - Those who agreed to give rating to our workshop (14), based on the ones they attended so far, rated it to be either excellent (8) or good (6)
  - Many of them particularly appreciated the break-out sessions, involving modelling/coding activities in small groups, interactions with instructors, and presentation and delivery of Dr. Coffeng



# Lessons learned from the training process

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- Break-out/practical & interactive sessions were particularly useful for candidates
- A workshop of 2.5 days was insufficient to fully develop a research question suitable for a publication, although the learning experience of attempting it was useful
- Our approach of letting candidates work on their own ideas and figure out the limitations, by providing support and constructive criticism, led to a very positive outcome, as far as the learning process was concerned
- Integrating the presentations on the introduction to VL and the technical aspects of modelling could have been useful for candidates to remember which details are important when modelling



# CRediT

<b>Author</b>	<b>Type of Contribution</b>
Dr. Luc Coffeng (NTDMC)	Conceptualization, development, and execution
Dr. Ananthu James (NTDMC)	Conceptualization, development, and execution
Prof. Sake de Vlas (NTDMC)	Conceptualization
Prof. Graham Medley (NTDMC)	Conceptualization
Prof. Deidre Hollingsworth (NTDMC)	Conceptualization
Dr. Souvik Banerjee (NDMC)	Conceptualization and organization
NDMC Logistics Team (Dr. Suchita Nath-Sain, Sandhya Ananthnarayan, Rupali Chavan, Dr. Sarbani Belur, Dhiraj Maske)	Organization and management



## Appendix: summary of each training sessions







# Day 1, session 1: General introduction + Background

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- Presentation by Dr. Coffeng:
  - VL transmission dynamics in India
  - a few examples on the questions that models tried to answer
  - open questions



## Day 1, session 2: Break-out 1 – model answerable question

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- Candidates were asked to partner up with someone with a different expertise/background than theirs
- Each member in a group was asked to independently spend 5 minutes to formulate a research question that addresses a gap in VL-control
- Later they were asked to discuss with their partner for 10 minutes and agree on a single research problem



# Day 1, session 3: Developing compartmental models

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- Presentation by Dr. Coffeng:
  - the expectations of policy-makers/non-modellers about models
  - standard practices of reporting/developing good models (within NTDMC)
  - how to mathematically model VL and important considerations
  - presentation and explanation of an existing VL model structure, which the participants would use as a template for the remainder of the workshop



## Day 1, session 4: Break-out 2

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- Each team of two was asked to join another pair
  - We recommended that in a team of four at least two would be comfortable with R
  - There were a total of four teams
- Each group was asked to choose one model-answerable question
  - Draw a schematic representation of a compartmental model that can answer the question, based on the template model
- They were asked to have two slides, with (1) the question and (2) a schematic diagram for the model, ready by the next session (post-lunch)



# Day 1, session 5: Interactive session based on the break-outs

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- 3 minutes for presenting the slides by one candidate per group
- Followed by ~20 minutes for discussion on each presentation
  
- Presented ideas (in their original formats) from 4 groups:
  1. Impact of HIV-VL co-infection
  2. Optimising allocation of a limited budget across two types of interventions (IRS and case detection)
  3. Migration of susceptible and asymptomatically infected individuals from a VL-endemic community to a non-endemic population
  4. Labour-related migration of PKDL individuals to a non-endemic population / work force that is exposed to sandflies





# Day 1, session 6: Data-needs and available data

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- Short presentation by Dr. Coffeng:
  - the available data for VL
  - challenges in data access and ways of dealing with lack of data
  
- Later, each group was asked to talk about -
  - the kind of data that would be required for their model
  - and how that data could be obtained



## Day 1, closing

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- Candidates were provided with our R-scripts for VL transmission dynamics and the necessary details to work with them



# Day 2, session 1: Recap of day 1

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- Led by Dr. Coffeng:
  - revisited the contents of Day 1
  - addressed the questions from participants



## Day 2, session 2: Break-out session

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- Initially, a short presentation by Dr. Coffeng, for preparing candidates to use the R-scripts we provided
- Using the template scripts we provided, candidates were asked to do the following:
  - adapt the deterministic and stochastic model code for their research question
  - produce two slides including a plot illustrating a (preliminary) answer to their question



## Day 2, session 3: Interactive review of model-building

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- Participants presented the slides they prepared, followed by a discussion. The topics from each groups:
  1. HIV-VL co-infection
  2. Optimising allocation of a limited budget across two types of interventions (IRS and case detection)
  3. Migration of all except symptomatic individuals from a VL-endemic to a non-endemic population (*this was a modified plan compared to their idea on Day 1, as they revised it based on our feedback*)
  4. Labour-related migration of PKDL individuals to a non-endemic population / work force that is exposed to sandflies





# Day 3, session 1: Interactive review of model-building

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- Presentation by Dr. Coffeng:
  - on more complex modelling methods with examples
  - introducing candidates to an advanced script we provided for modelling interventions



## Day 3, session 2: Reflection and lessons learned

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- Dr. James clarifying the most common issues faced by candidates so far to a wider audience
  - Why are death terms added to the susceptible compartment? Answer: to keep the population size constant (this is an assumption), all deaths are replaced by births
- Dr. Coffeng highlighting the main points covered so far in the workshop:
  - Involve stakeholders and domain experts when developing a model
  - The importance of defining a model-answerable question
  - Developing models is an iterative process, commonly involving revision of the model and sometimes even the research question
  - Use of a schematic representation for communicating with non-modellers
  - Key tips and sense checks while developing models