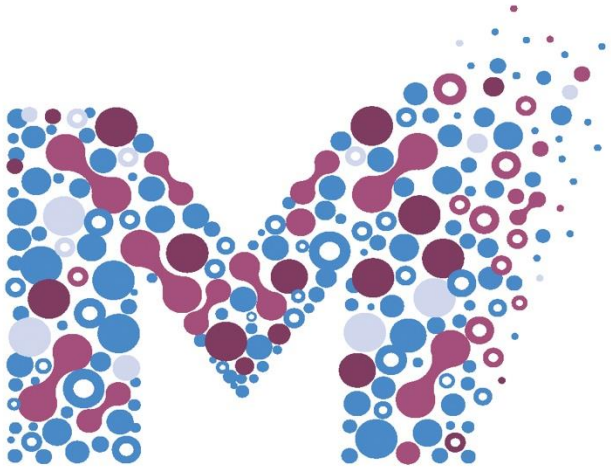
MEASLES
ANALYTICS HUB

LAUNCH EVENT

27 November 2024



MEASLES
ANALYTICS HUB

Caroline Trotter

Introduction

About the Measles Analytics Hub

MEASLES ANALYTICS HUB

- The Measles Analytics Hub is hosted by the **Vaccine Impact Modelling Consortium (VIMC)**
- **VIMC** is an international community of modellers providing high-quality estimates of the public health impact of vaccination, to inform and improve decision making
- VIMC was awarded a supplementary grant by the Gates Foundation earlier this year to focus additional activity on measles modelling and analytics

VACCINE IMPACT MODELLING CONSORTIUM

Aim of the Measles Analytics Hub

The aim of the Measles Analytics Hub is to enhance the measles modelling ecosystem by:

1. Facilitating technical discussions and innovation in measles modelling and analytics
2. Improving communication and collaboration between modelers and stakeholders to deliver research with policy impact
3. Being inclusive of colleagues in high measles burden countries

Aim of this meeting

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This is our first step in building a community of practice.

The aim of this meeting is to generate enthusiasm for and engagement with the Measles Analytics Hub

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Professor Bryan Grenfell

Measles models: a brief history of contagion

Measles as the ‘C. elegans’ of epidemiological dynamics

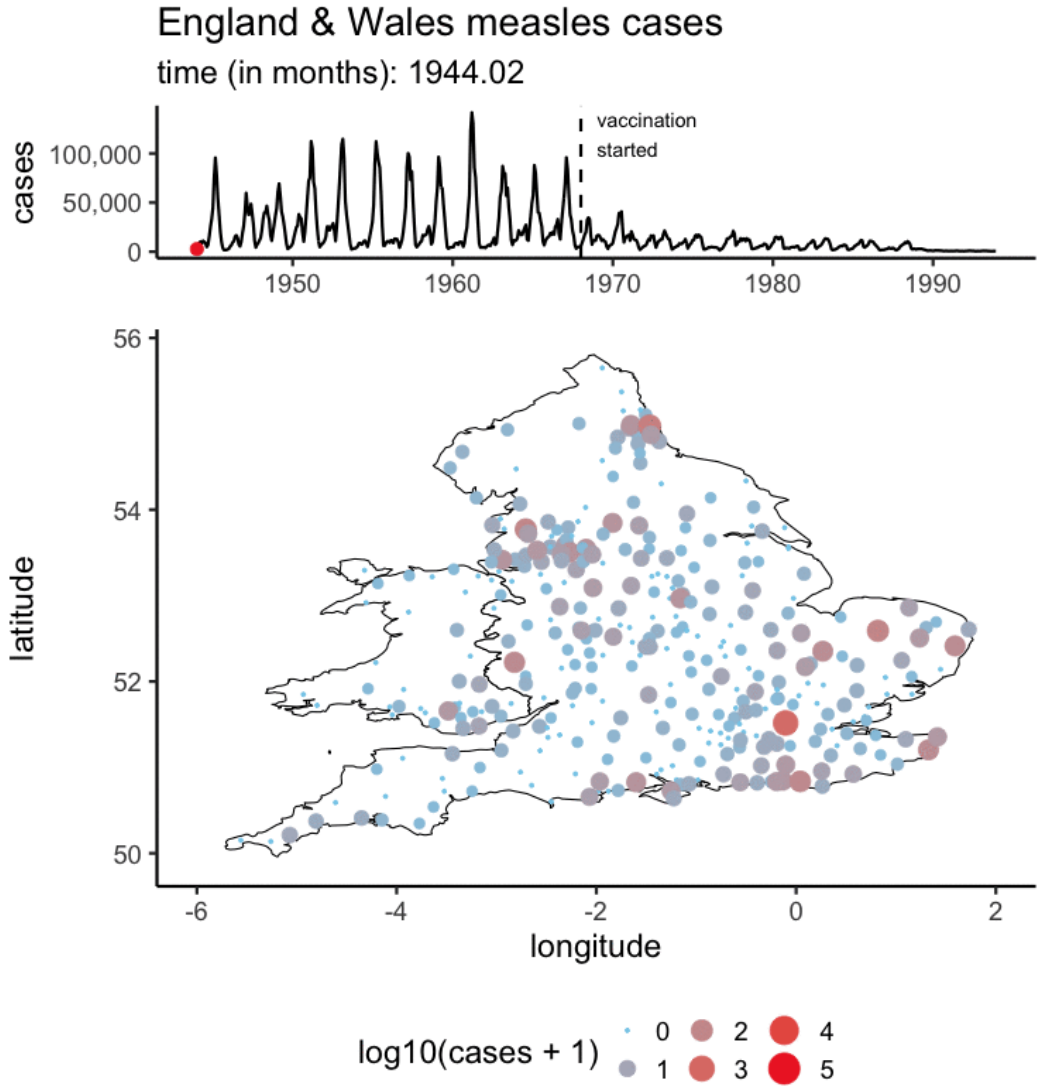
PRINCETON
UNIVERSITY

Bryan T Grenfell

Department of Ecology and Evolutionary Biology &
Princeton School of Public and International Affairs

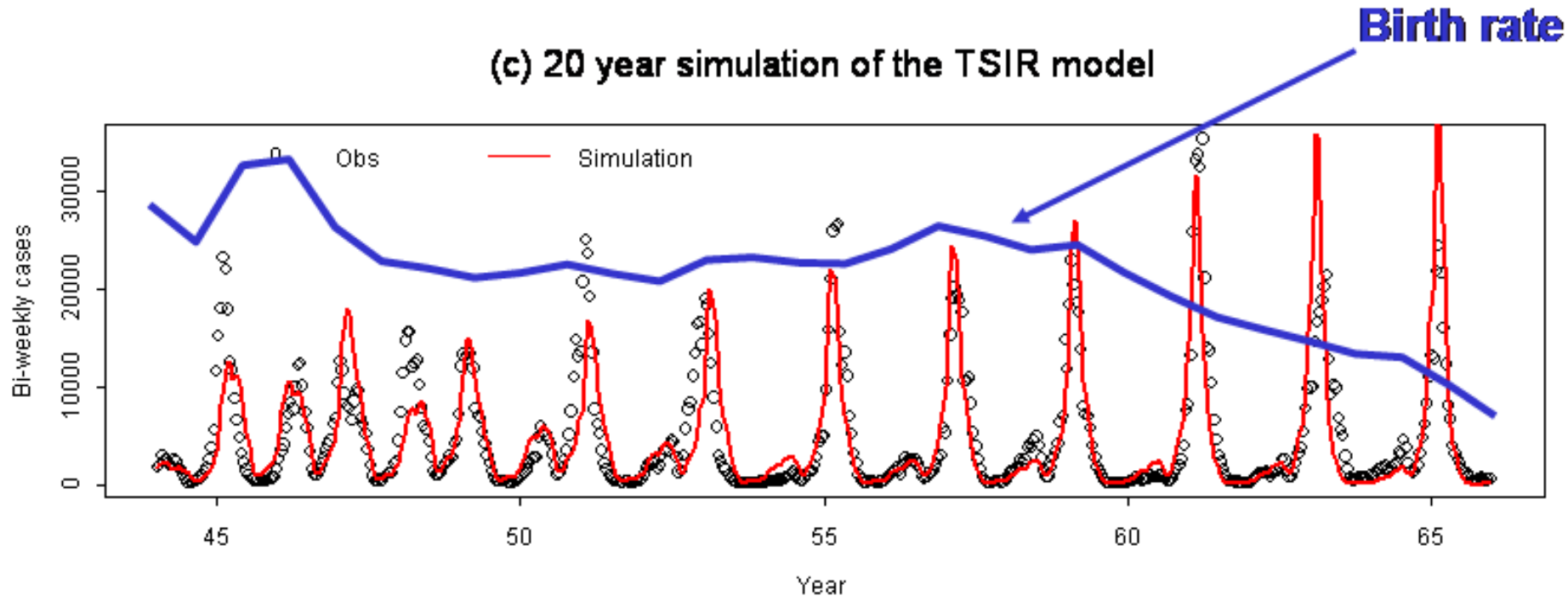
Data and early research

- Brownlee (1918): **measles periodogram: cycles due to pathogen changes, not susceptible dynamics?**
- But..
- Panum: **Faroes epidemic in 1846: pathogen life history,**
  - **high contagiousness**
  - **Lifelong immunity**
- Leads to



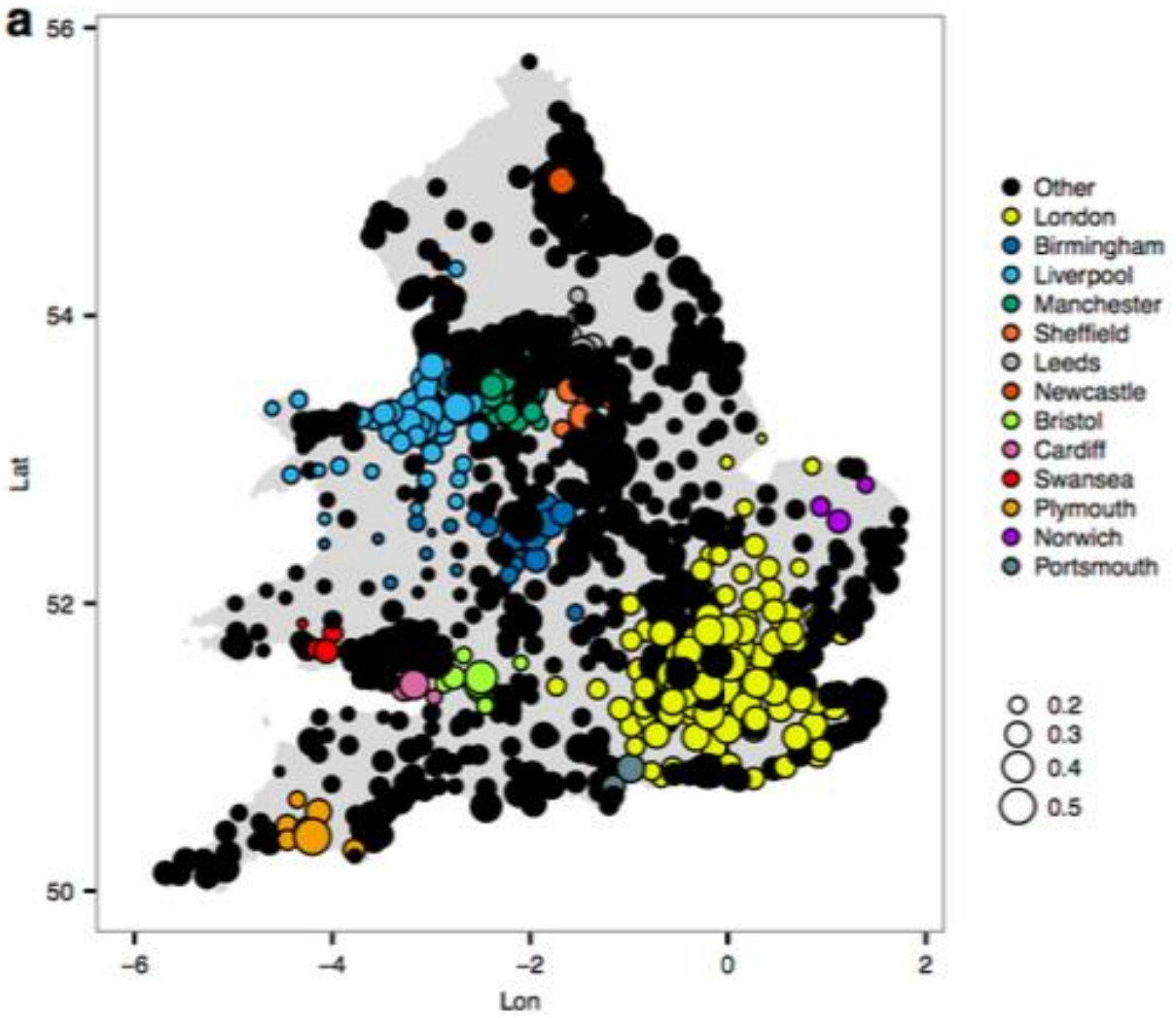
Mechanistic models: the S->I->R family

- **vaccination age structure**: Anderson and May; Dietz
- **vaccination and the honeymoon period**; dynamics and birth rate; Mclean
- **seasonal forcing of epidemics**: Fine and Clarkson, Schenzle
- **measles and chaos**: Schaffer, Olsen, Sugihara and May Ferrari, Dalziel:
- **Data and models**: inference. Bjornstad, Finkenstadt, Grenfell, King, Ionides
- **Agent-based models and emergent simplicity**



Measles in space and time

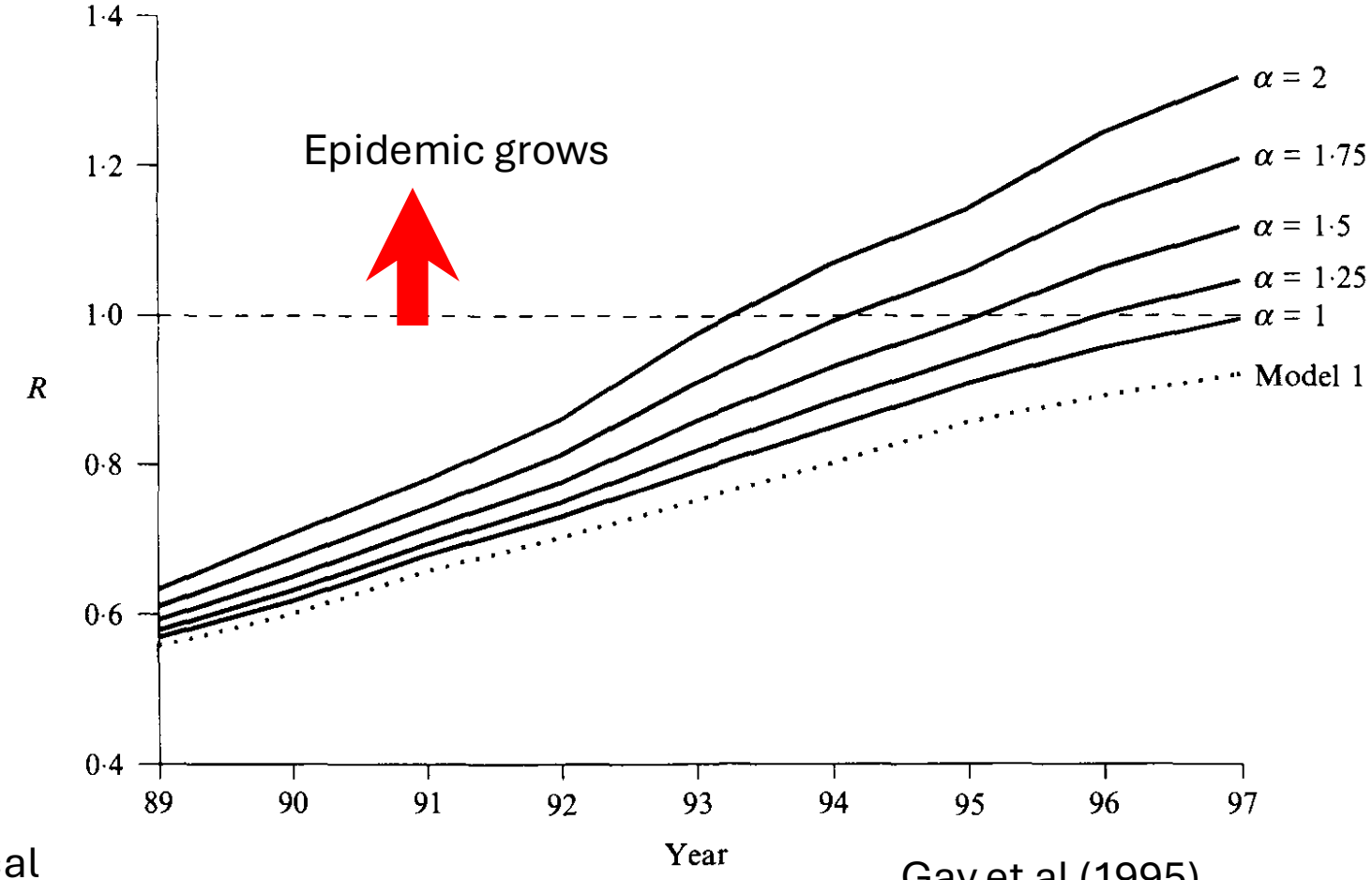
- **Gravity models**: Cliff, Haggett, Smallman-Raynor, Zia, Grenfell Bjornstad
- **Competing risks**: Lau, Grenfell, Bjornstad
- **Stochastic dynamics and local persistence**: Bartlett, Black



The power of serology

- **Age-heterogeneities:** Black, Grenfell and Anderson
- **Outbreak risk prediction:** Gay, Miller et al; Winter and Metcalf

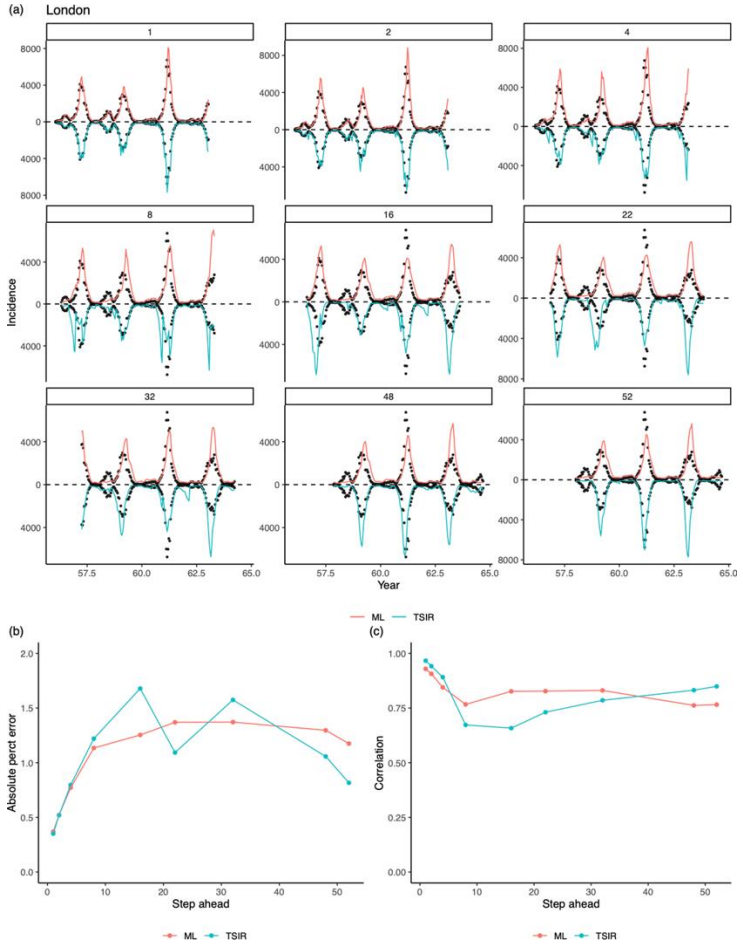
A global immunological Observatory? Metcalf, Mina



Gay et al (1995)

Machine learning, prediction, social forces..

- **AI and prediction**: Proctor, Madden, Lau, Grenfell, Metcalf et al.
  - Important of ‘semi mechanism’ (‘physics-inspired’)
- **Modeling vaccine hesitancy and behavior change** Salathe and Bonhoeffer; Bauch; Gastanaduy, Wallace, Grenfell et al
- **Polymicrobial impacts: immune amnesia,** Mina. **Dissemination of methods**



Programmatic applications of measles models

Scenario Modelling

- Impact of vaccination activities (routine, SIA, outbreak response, etc)
- Inform SIA timing, age, and spatial targets
- Inform age of first dose
- Impact of school entry vaccination
- Impact of vaccine vial size
- Inform elimination timeline
- Assessment of cost to cases averted tradeoffs
- Impact of new technologies (e.g., microarray patches, MAPs)
- Impact of demographic features

Epidemiological (and/or Spatial) Inference Modelling

- Estimate measles burden
- Estimate CFR
- Estimate SIA effectiveness
- Estimate Reff, R0, FOI
- Estimate susceptibility profiles
- Characterize immunity levels necessary for elimination
- Mapping vaccination coverage and timing
- Estimate routine vs SIA dose correlation

Risk Modelling

- Estimate outbreak risk given vaccination clustering
- Estimate outbreak risk given immunity gaps
- Inform triggering of vaccination campaigns
- Predict outbreaks

...and more

Cutts et al. 2020 Vaccine

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Dr Natasha Crowcroft

Changing Public Health Policy: Congenital Rubella Syndrome (CRS) Prevention

Dr. Natasha S. Crowcroft,
Senior Technical Adviser Measles and Rubella, World Health Organization
Inaugural Director, Centre for Vaccine Preventable Diseases, Adjunct Professor DLSPH and Senior Fellow Massey College, University of Toronto

World Health Organization | IVB

WHO recommendations on measles vaccine 80% coverage threshold for Rubella Containing Vaccine (RCV) introduction

2000: Countries can introduce RCV if:

- They can achieve routine first dose measles-containing vaccine (MCV1) **coverage level of ≥80%**

2010: Countries should introduce RCV if:

- They can achieve coverage level of **≥80% through either routine MCV1 or in follow-up campaigns**, AND
- They conduct a **wide age-range campaign** (1-14 years) prior to introduction

2020: Updated Rubella Position Paper

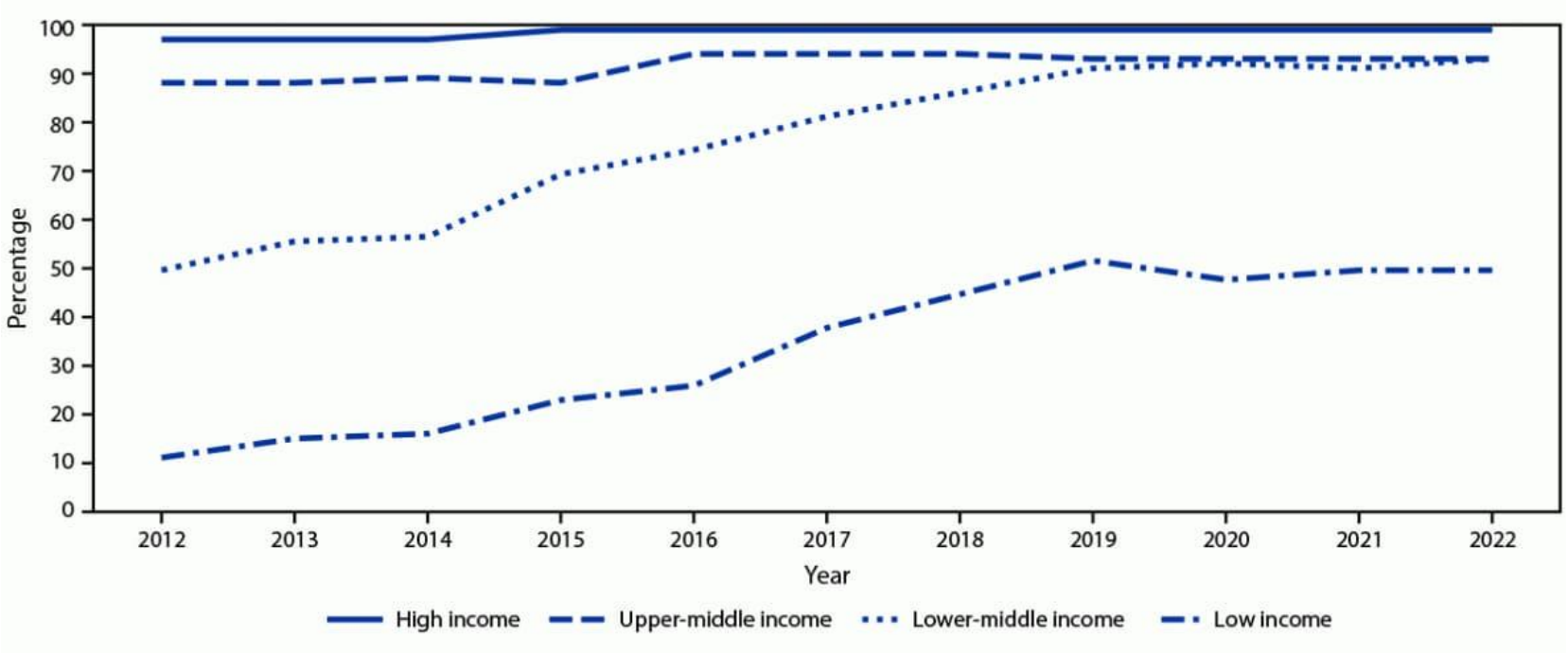
- 2010 recommendations were maintained

The problem: 80% coverage threshold is a barrier to Rubella Containing Vaccine (RCV) introduction, causing ongoing inequity

~32,000 children born annually by 2019 with Congenital Rubella Syndrome (CRS)[1]

Most infants with CRS are born in countries with no RCV

98% infants with CRS are born in low income or low middle income countries[2]



Percentage of countries with RCV in routine immunization schedule by World Bank income group 2000-22

Sources:

1. Vynnycky E, et al. Estimates of the global burden of Congenital Rubella Syndrome, 1996-2019. Int J Infect Dis. 2023 Dec;137:149-156

2. Ou AC et al. Progress Toward Rubella and Congenital Rubella Syndrome Elimination — Worldwide, 2012–2022. MMWR Morb Mortal Wkly Rep 2024;73:162–167

World Health Organization | IVB

Status of Rubella Containing Vaccine (RCV) introduction

Globally, 19 countries yet to introduce RCV as of 2024

Country	Meets criterion	Implementation planned
Afghanistan	**No**	No
Central African Republic	**No**	No
Chad	**No**	No
Djibouti	**No**	No
Ethiopia	Pending	No
Equatorial Guinea	**No**	No
Gabon	**No**	No
Guinea	**No**	No
Liberia	Pending	No
Niger	Pending	No
Madagascar	**No**	No
Somalia	**No**	No
South Sudan	**No**	No

- 6 countries planning implementation*
- 3 countries' eligibility is **pending**
- 10 countries **do not reach the 80% threshold**:
  - Measles containing vaccination coverage (first dose) 41-76%
  - All rely on measles follow-up campaigns to prevent outbreaks
  - All would benefit from a wide age-range measles-rubella (MR) vaccine introduction campaign for **measles prevention**

*Implementation ongoing in 2024 in Mali, South Africa and Sudan. Planned in Guinea Bissau 2024, Nigeria and DRC 2025

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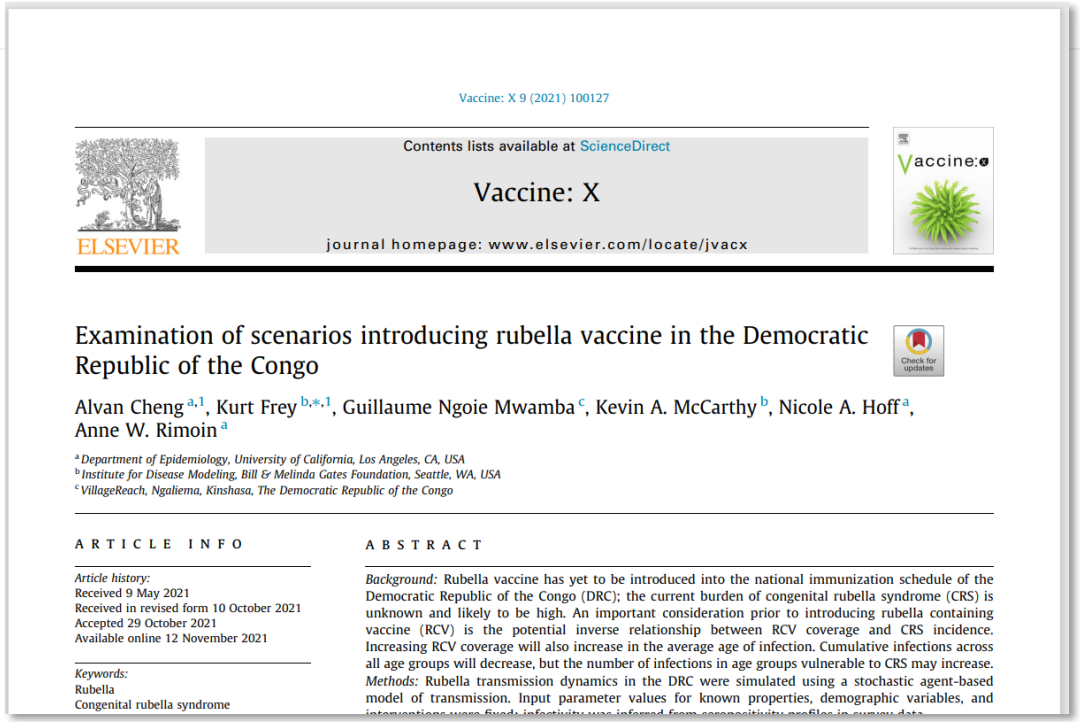
80% threshold known to be conservative for several years



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Contents lists available at ScienceDirect

Vaccine: X

journal homepage: www.elsevier.com/locate/jvacx

Examination of scenarios introducing rubella vaccine in the Democratic Republic of the Congo

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[b] Institute for Disease Modeling, Bill & Melinda Gates Foundation, Seattle, WA, USA
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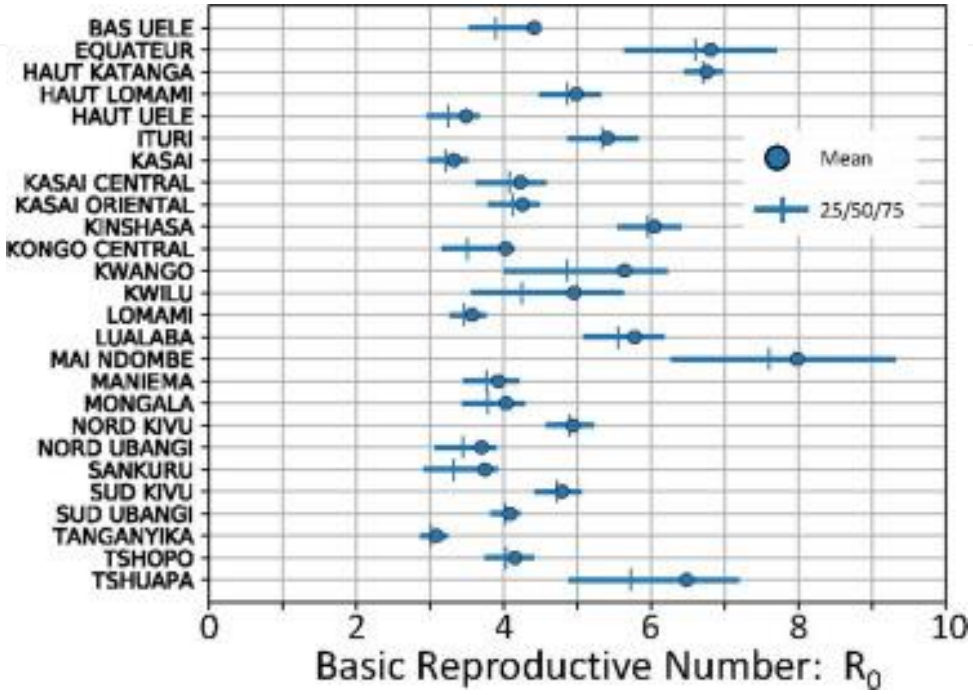
ABSTRACT

Background: Rubella vaccine has yet to be introduced into the national immunization schedule of the Democratic Republic of the Congo (DRC); the current burden of congenital rubella syndrome (CRS) is unknown and likely to be high. An important consideration prior to introducing rubella containing vaccine (RCV) is the potential inverse relationship between RCV coverage and CRS incidence. Increasing RCV coverage will also increase in the average age of infection. Cumulative infections across all age groups will decrease, but the number of infections in age groups vulnerable to CRS may increase. *Methods:* Rubella transmission dynamics in the DRC were simulated using a stochastic agent-based model of transmission. Input parameter values for known properties, demographic variables, and



Cheng et al: "Continued endemic transmission is only plausible when routine immunization coverage is **less than 40%** and follow-up supplemental immunization activities have poor coverage **for decades**."

Cheng A et al Examination of scenarios introducing rubella vaccine in the Democratic republic of Congo. Vaccine X 9 (2021) https://www.sciencedirect.com/science/article/pii/S2590136221000449?via%3Dihub https://doi.org/10.1016/j.jvacx.2021.100127.

How to change policy? Persistence, willingness to think differently about a problem, and a burning platform help

World Health Organization | IVB

The Measles & Rubella Partnership – Rubella Task Team

The Measles & Rubella Partnership (M&RP) supports implementation of the global Measles Rubella Strategic Framework through a global partnership

The M&RP Rubella Task Team - experts from all partner organizations and modelers from the Vaccine Impact Modeling Consortium

Goal: to determine how to reduce Congenital Rubella Syndrome (CRS) burden and **inequity**

Objectives to:

1. Reduce current and projected future increases in CRS burden
2. Avoid future paradoxical increase in CRS
3. Enable rubella elimination
4. Align with Immunization Agenda 2030 goals to accelerate Rubella Containing Vaccine (RCV) introduction and other programmatic goals and objectives

Push back during the process – important to listen

"**This is too high risk** – if you get it wrong it could undermine all vaccination"

- Imperative to make a very robust evidence-based case for the policy change

"**I don't believe in modeling**"

- Include different types of evidence to support the modeling results

"I don't believe these countries can implement campaigns – **this won't work**"

- Provide evidence and narrative from credible sources that these countries can do it

"M&RP is an **advocacy group** – what you are saying is not credible"

- Be clear about roles, careful with language, include field colleagues

"**What is the question for SAGE**? Is this about policy or implementation?"

- The question is **only** whether to drop the 80% threshold for rubella vaccine introduction.
- **No change** to other policy recommendations - wide age-range campaigns at introduction and regular follow up campaigns until countries reach at least 90% routine coverage.
- Changed the title of the session from "Rubella" to "**CRS Prevention**" to focus on **equity (values)**

Outcome

Programmatic and modeling evidence presented together support Universal Rubella Vaccine Introduction in the remaining countries:

- Routine Immunization coverage is currently sufficient to prevent paradoxical effect in **most countries;** RI plus campaigns prevent paradoxical effect in **all countries**.

In September 2024 SAGE recommended Universal Rubella Containing Vaccine (RCV) introduction. As a result:

- Tens of thousands of infants per year will **not be born with CRS**, and projected future increases in CRS will be prevented
- Rubella elimination in the African and Eastern Mediterranean regions is now possible
- Measles Rubella wide age range catch campaigns will prevent many deaths from measles

With acknowledgement of the M&RP Rubella Task Team and co-presenters at SAGE:

Dr. Balcha Masresha (WHO AFRO),
Dr. Muhammad Farid (WHO EMRO),
Professor Matt Ferrari (Penn State), Professor Emilia Vynnycky (UK HSE), Professor Amy Winter (UGA), Dr. Kurt Frey (IDM),
Laura Zimmerman (US CDC)

All the other members of the Rubella Task Team
Gavi: Marguerite Cornu, Arunima Khanduri, Stephen Sosler; BMGF: Kendall Krause, Ex-CDC: Susan Reef CDC: Christine Dubray, James Goodson, Emma Lebo, Gavin Grant, Richard Luce, Jim Alexander, Cynthia Hatcher, Kimberly Dautel, Melissa Dahlke, Robert Perry, Chris Hsu, Mark Papania, Michelle Morales, Pratima Raghunathan; WHO: Patrick O'Connor

Thank you!

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Dr Sudhir Khanal

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Modeling exercise to support resetting target date for MR elimination in WHO South-East Asia Region- Testimonial from SEARO

LAUNCH EVENT

27 November 2024

Background

- WHO South-East Asia Region committed to eliminate measles and rubella by 2023. (11 countries)
- An independent external review conducted in 2021 concluded that the Region is offtrack
- Significant momentum was achieved and five countries (45% of the countries) achieved measles and rubella elimination by 2023.
- WHO SEARO was under pressure to maintain the momentum and reset a target date
- Needed a balance evidence-based approach- not to far away to lose the momentum or not to unrealistic close date
- WHO HQ guided SEARO to a community of modellers –VIMC to find a solution

Modelling work and outcome for programmatic use

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- The team of **modelers worked closely with SEARO team** to develop realistic scenarios based on regional situation contemplating possible questions from countries
- Output were easy to understand, gave a range and level of effectiveness and efficiency
- Output of scenario present in a regional consultation meeting (2023) to experts, all Member States and based on the scenarios countries choose target dates with most efficient and highest impact scenario
- As a result, the region adopted a new target date for measles and rubella elimination in SEAR which was endorsed by the Regional Committee in 2024 and strategies developed accordingly

Key takeaways

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- Sound methodology- experts challenged the methodology but finally agreed to it considering the inherent limitation of modeling
- Quick turn around time- so that the relevance of data remained
- Easy to understand input and output of Modeling exercise – the intended audience , in this case the EPI program managers were able to easily understand the input and outputs (translate in program terms) and useful to build trust.
- Outputs made more sense programmatically for each country and thus increased the uptake

Acknowledgements

- VIMC team – Dr Matt Ferrari and Dr Amy Winter in particular who travelled to SEARO to explain the process to countries and experts
- WHO HQ for the linkage
- Member States, experts and partners on measles and rubella in WHO SEA Region for sharing data and engaging in the consultation.

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Professor Matt Ferrari

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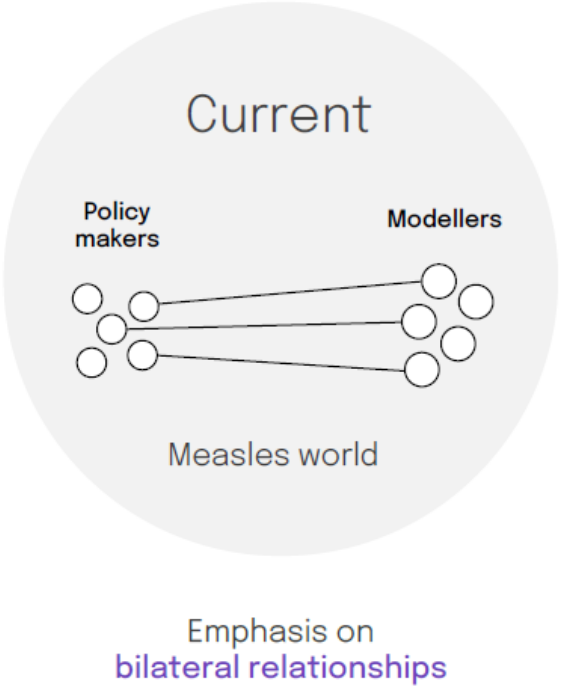
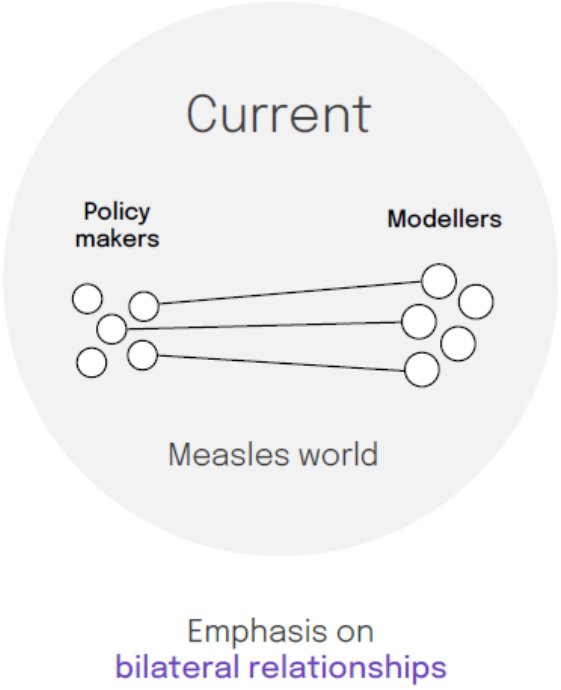
Value for the Community
Value for the Participants

The Old Model



Bilateral engagement facilitated through grant funding or existing relationships

The Old Model



There have been many successes:

1. 2019 evaluation of feasibility of elimination
2. SEARO support
3. Applications to Gavi
4. Ad hoc country consultations
5. Re-evaluation of 80% rule for rubella introduction

A Community of Practice

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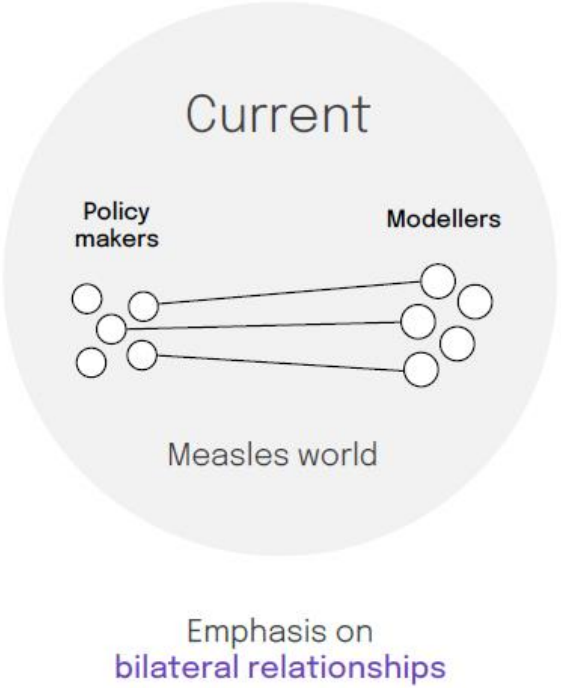
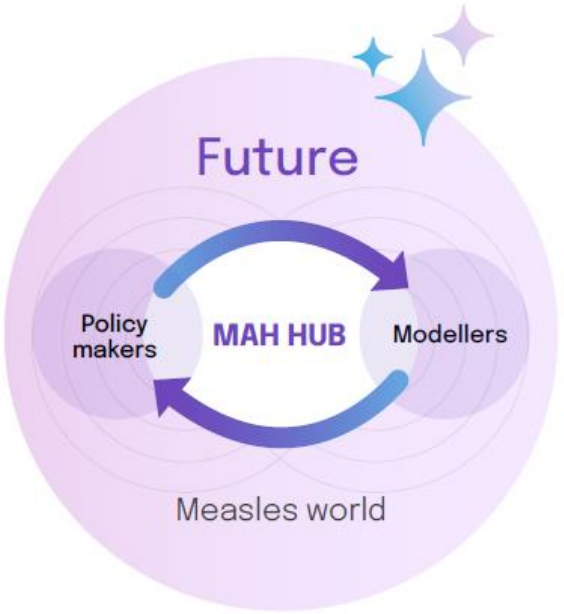


Emphasis on
bilateral relationships



Emphasis on a
community of practice

"share a concern or a passion for something they do and learn how to do it better as they interact regularly."

A Community of Practice

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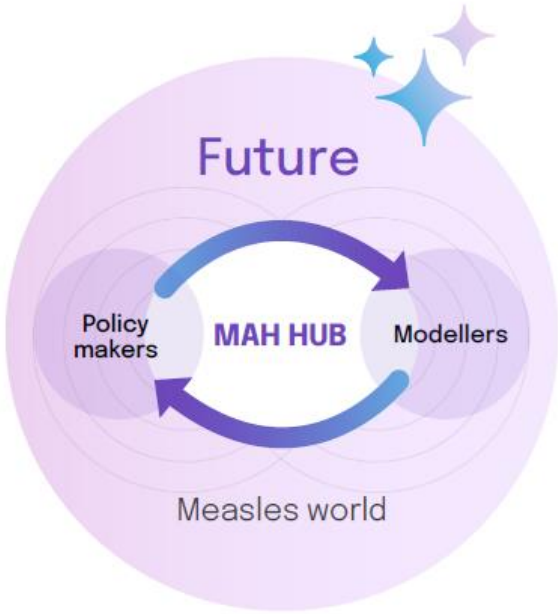
1. Build the Community
2. Provide Resources
3. Learn From Each Other

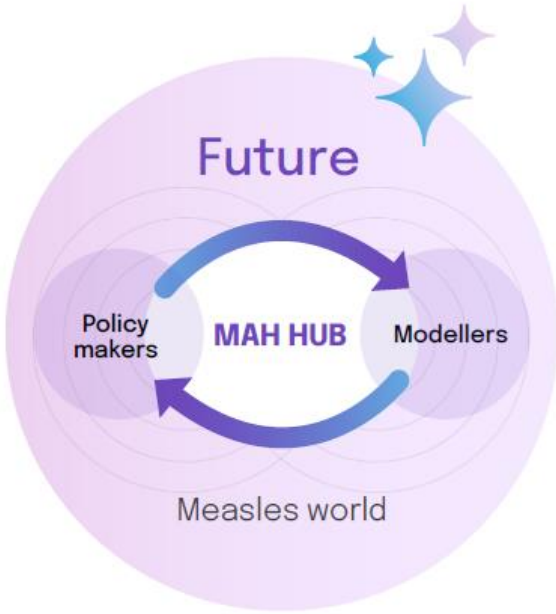


Emphasis on a community of practice

Build the Community

We need to start somewhere. The participants on this call are that start.

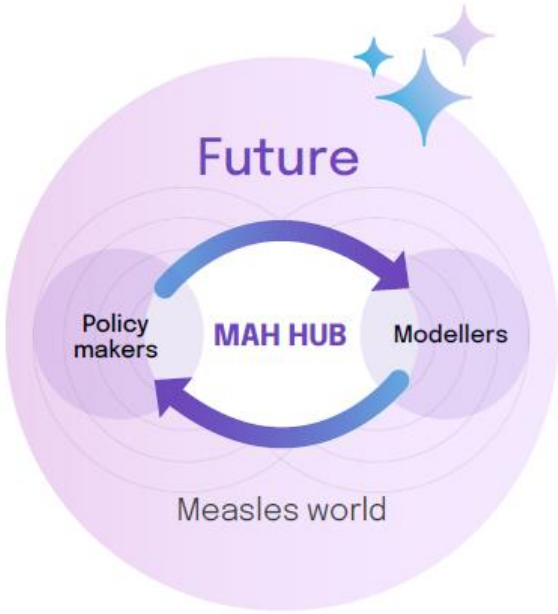
Researchers from measles and rubella endemic countries are under-represented in the measles modeling community. Our goal is to facilitate integration of those scholars.



Emphasis on a
community of practice

Provide Resources

1. Information
2. Funding
3. Data
4. Best Practices
5. Recognition



Emphasis on a
community of practice

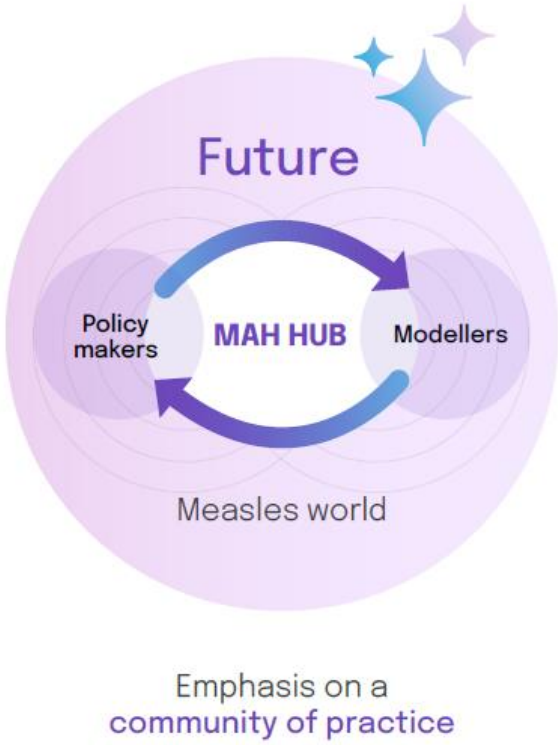
Provide Resources

1. Information

   Meetings and announcements to identify major policy shifts that could impact the broader measles research agenda.

   Access to publications and reports.

   Research opportunities.

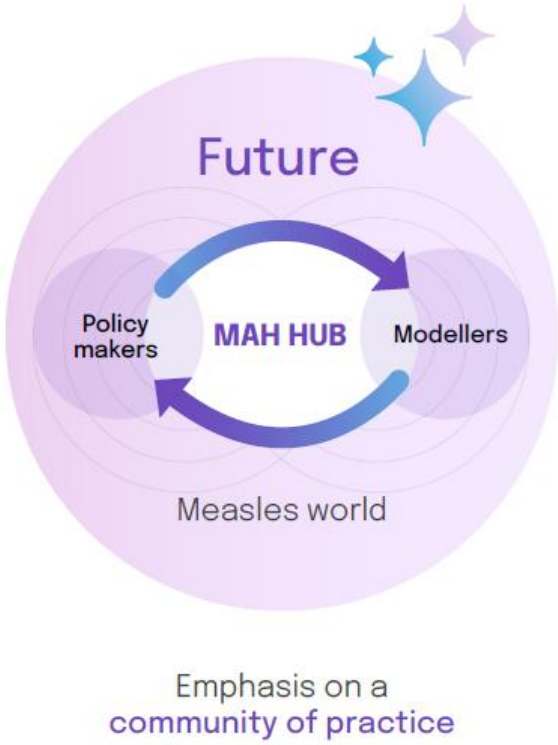


Provide Resources

1. Information
2. Funding

   RfPs to support modelling projects and engagement with policy community.

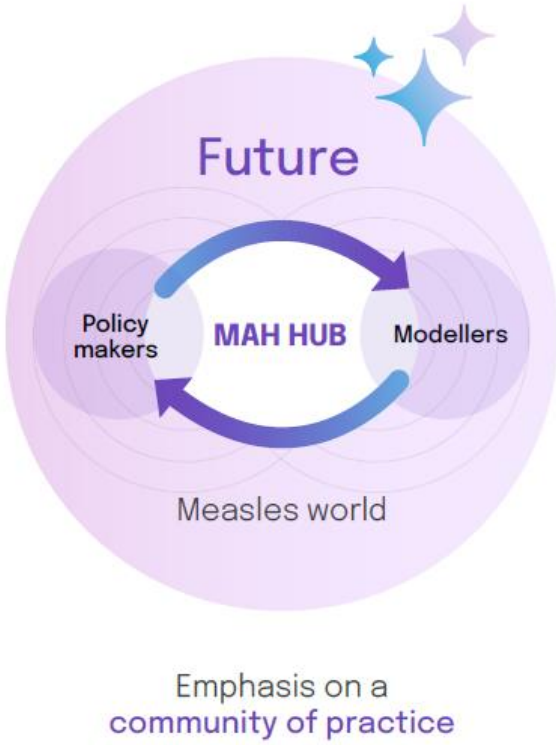
   Collaboration and mentoring.



Provide Resources

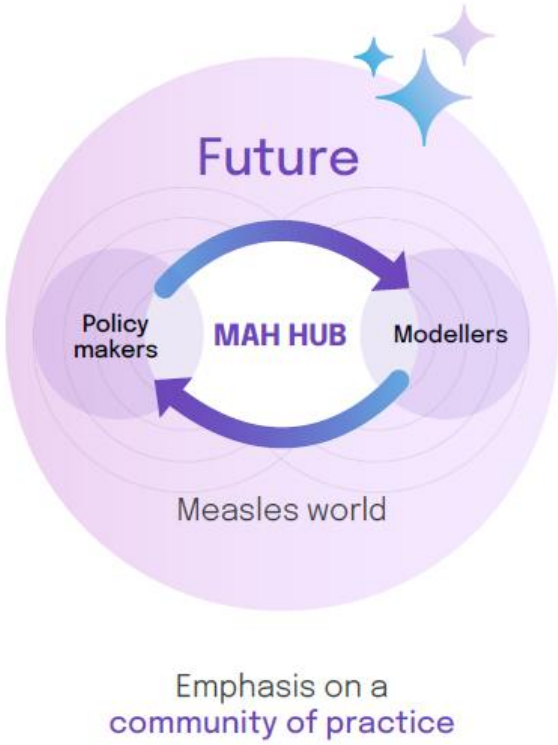
1. Information
2. Funding
3. Data

   Map key data sources, including identifying and working with partners to resolve data inconsistencies where possible



Provide Resources

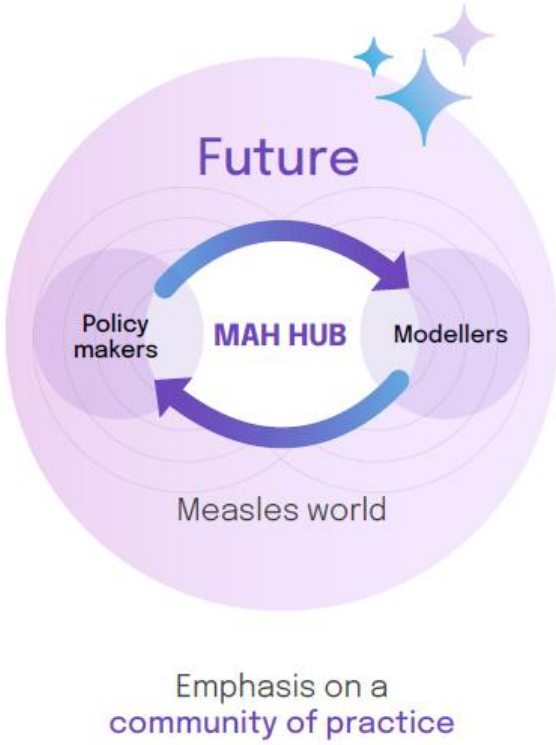
1. Information
2. Funding
3. Data
4. Best Practices
   Data access and Data Use Agreements
   Code, methodology, training curricula



Provide Resources

1. Information
2. Funding
3. Data
4. Best Practices
5. Recognition

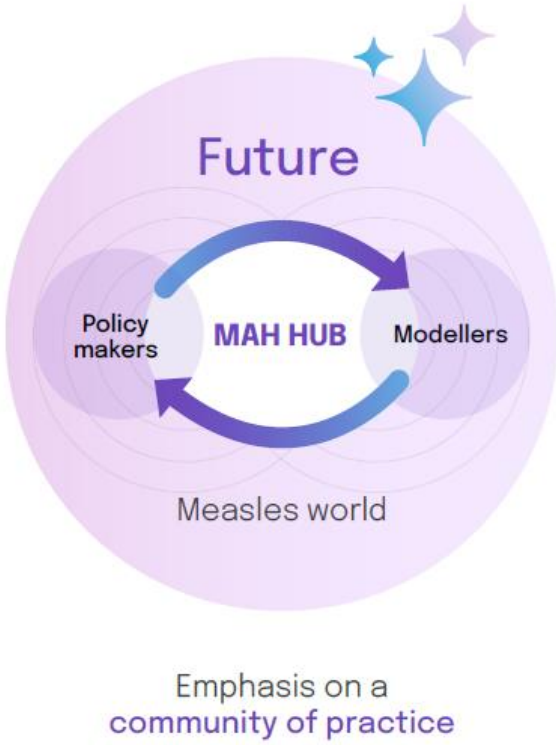
   Acknowledgement and recognition for operational and policy projects that are not recorded in peer-reviewed literature



Learn From Each Other

Quarterly meetings, with 1 in person per year. Emphasize accessibility for members from measles and rubella endemic countries.

Awareness of research activities, policy questions, and opportunities for synergies



Learn From Each Other

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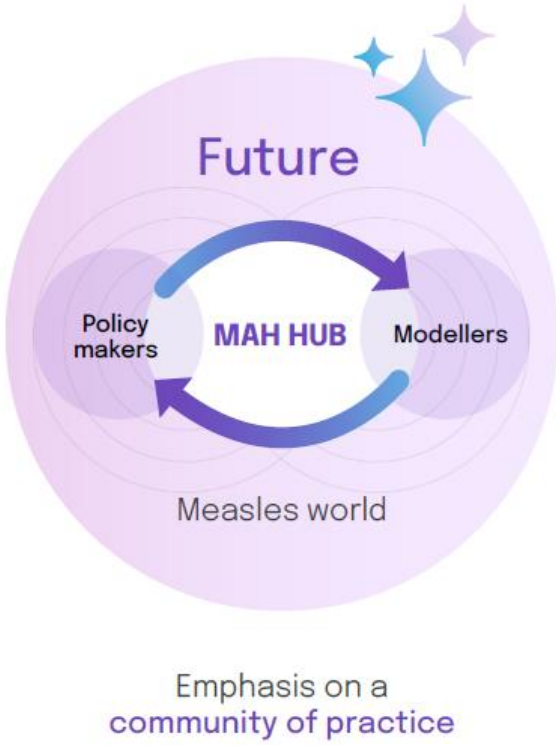
Creation of new teams and collaborations — mixing bandwidth with expertise



Learn From Each Other

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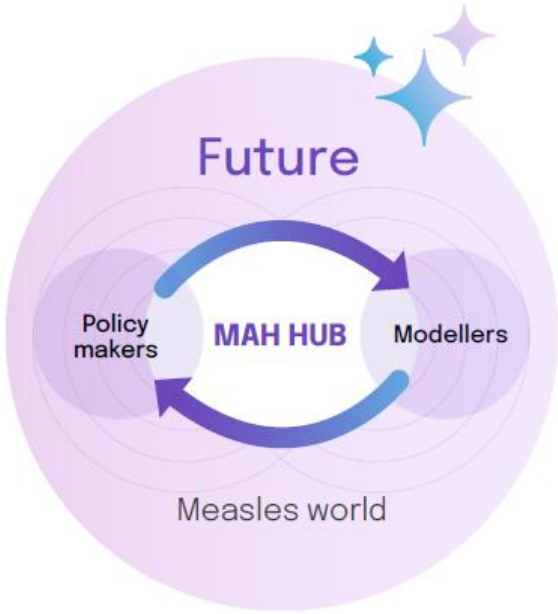
Transparency on Data Use Agreements and Contracts between academic institutions and various partners so that we're not each starting from 0 on every new project.

Accelerate the problem to solution pipeline.

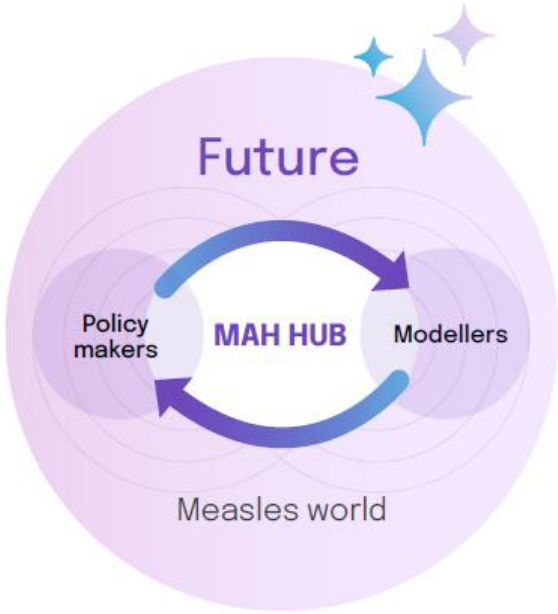


Emphasis on a community of practice

Learn From Each Other

We can provide a central voice for measles-specific statements from the research and policy community

We feel that measles *has* been a leader in evidence-based policy support, and can serve as a model for other VPDs



Emphasis on a community of practice

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Dr Ondrej Mach

Global Polio Eradication Initiative (GPEI)

Subgroup on Analysis and Modelling (SAM) of the Polio Research and Analytics Working Group (PRAG)

Lessons Learned for Measles Modelling Hub

November 27, 2024

What role does the SAM play in the partnership since it's inception in 2022?

The PRAG Subgroup for Analysis and Modeling exists to:

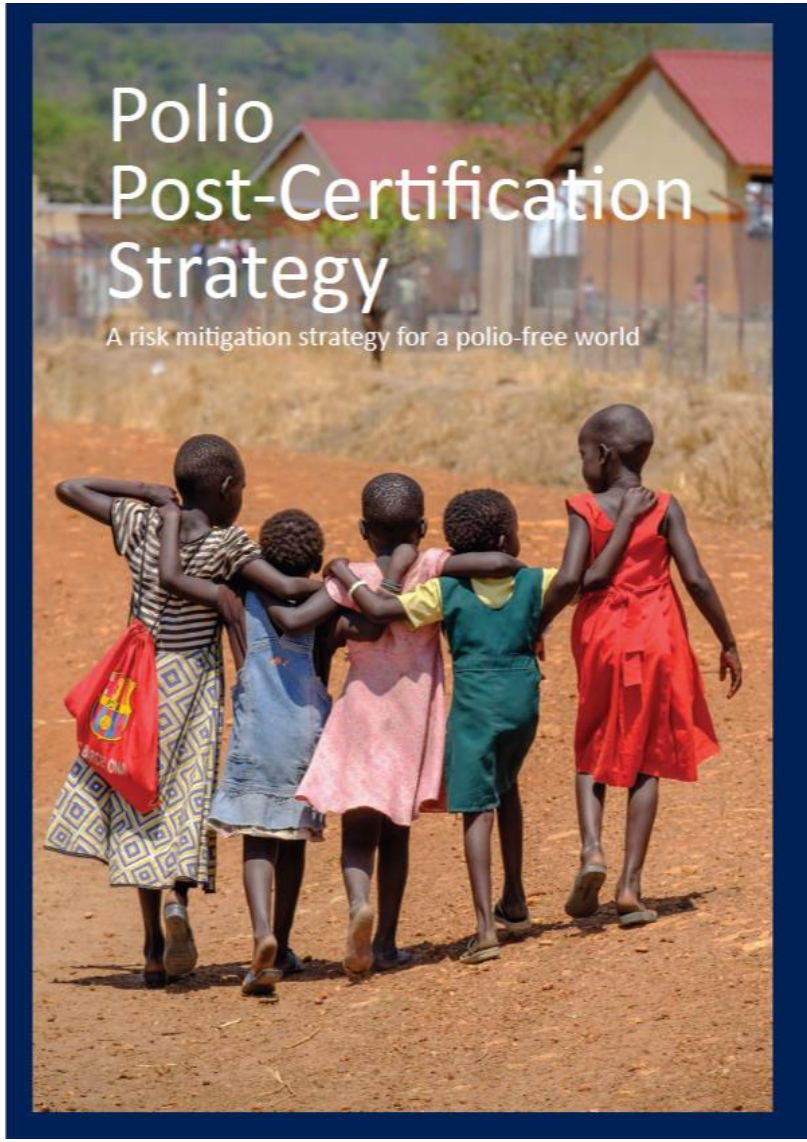
1. Support and coordinate mathematical and statistical modeling and quantitative analyses to accelerate and sustain poliovirus eradication.
2. Synthesize and standardize common outputs and address common data needs for modeling and analytical groups within the GPEI
3. **Provide a forum** for discussion of polio modeling products by different groups to address questions posed by the GPEI

bOPV Cessation Policy Framework

To achieve global polio eradication, poliovirus must be removed from populations everywhere, including the Sabin viruses contained in the oral poliovirus vaccine (OPV).

The bOPV Cessation Team (BOCeT) was created by GPEI's Strategic Committee in Jan 2023 to coordinate planning for bOPV cessation and **develop policies** for safe bOPV withdrawal

Data (epidemiological or modelling) is needed for evidence-based decision making



Example Project: Risk tiering countries for pre-cessation SIA campaigns

		RI Coverage (IHME)		ICL Estimated Risk		IDM Recommended SIAs		Categorization		
Region	Country	dpt1	dpt3	cVDPV1	cVDPV3	Maintenanc	Surge	IDM	ICL	Combinec
WPRO	PAPUA NEW GUINEA	45%	35%	0.0187	0.0065	2.13	4.26	> 1 NID	1	> 1 NID
SEARO	DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA	41%	16%	0.0034	0.0012	2.00	4.00	> 1 NID	3	> 1 NID
EMRO	SOMALIA	52%	42%	0.0578	0.0204	1.97	3.94	> 1 NID	1	> 1 NID
AFRO	CENTRAL AFRICAN REPUBLIC	54%	42%	0.1393	0.0509	1.97	3.93	> 1 NID	1	> 1 NID
EMRO	YEMEN	57%	46%	0.2012	0.0749	1.84	3.69	> 1 NID	1	> 1 NID
AFRO	GUINEA	62%	47%	0.0201	0.0070	1.80	3.59	> 1 NID	1	> 1 NID
AFRO	ANGOLA	69%	54%	0.0654	0.0232	1.59	3.19	> 1 NID	1	> 1 NID
EMRO	AFGHANISTAN	67%	60%	0.0894	0.0319	1.46	2.92	> 1 NID	1	> 1 NID
AFRO	NIGERIA	70%	62%	0.2453	0.0937	1.31	2.62	> 1 NID	1	> 1 NID
AFRO	DEMOCRATIC REPUBLIC OF THE CONGO	80%	60%	0.4623	0.1957	1.28	2.55	> 1 NID	1	> 1 NID
EMRO	SYRIAN ARAB REPUBLIC	72%	66%	0.0250	0.0087	1.27	2.54	> 1 NID	1	> 1 NID
EMRO	SUDAN	57%	51%	0.0024	0.0008	1.20	2.40	> 1 NID	3	> 1 NID
AFRO	MADAGASCAR	74%	65%	0.1167	0.0424	1.19	2.37	> 1 NID	1	> 1 NID
AFRO	GABON	73%	70%	0.0004	0.0002	1.12	2.24	> 1 NID	4	> 1 NID
AFRO	CHAD	84%	67%	0.0836	0.0302	1.12	2.23	> 1 NID	1	> 1 NID
AFRO	SOUTH SUDAN	76%	73%	0.0117	0.0041	1.03	2.07	> 1 NID	1	> 1 NID

SAM provided expert guidance to combine the results of two different SAM modelers' work to create a consensus recommendation to the bOPV Cessation working group's planning of pre-cessation campaigns

Lessons Learned: translating modeling for policy development

- Working with policy makers (Strategic Group of Experts [SAGE]) is an iterative process to define the question(s) policy makers want to answer and the modeling techniques and data available to answer the question.

- Modeling isn't always the answer and **is sometimes wrong** – many challenges facing policy makers are operational (e.g. improving campaign performance)

- Collaboration and sharing between modeling groups during SAM meetings helps improve the quality of the individual projects each modeling group is producing for GPEI.

Lessons learned: communicating modeling findings to policy makers

- **All models may be wrong, some models are useful** –It is key to help policy makers understand that all models are (over) simplifications of the world around us.
- **Share the results first** –While the detailed methods are important for some, most policy makers want to see the results and understand the importance of the findings
- **Visuals are key** – Policy makers enjoy visuals that quickly distill the results of the model
- **Expert opinion –** is important in adapting the models into reality

Polio lessons for Measles

- Collaboration and sharing between modeling groups working on the same question can create synergies and efficiencies resulting in better outputs for policy makers.

- Ensure modeling groups do not work in silos away from program staff and policy makers. –Modelers need the deep programmatic knowledge to scope their projects and check their assumptions

MEASLES
ANALYTICS HUB

Megan Auzenbergs

Measles Analytics Hub

Scientific Coordinator

- About me: VIMC measles modeler since 2020 (LSHTM team), background in modelling vaccination strategies for measles and polio programming and experience working with global consortiums of infectious disease modelers
- I will engage with measles modelers and stakeholders to identify relevant programmatic questions and manage workplans—a point of contact for the MAH and policy-focused research questions
- Expand hub membership and ensure inclusivity of modelers in high burden countries
- Facilitate the dissemination of findings

What you can expect in 2025

MEASLES ANALYTICS HUB

1. Quarterly meetings, with 1 in person.
2. Drafting of a strategic work plan
3. Requests for proposals (RfPs) issued based on strategic work plan
4. Launch of fellowships scheme to facilitate exchange of ideas and knowledge
5. Capacity building workshop(s)
6. Complete data mapping and survey of data needs and barriers to access
7. Annual reporting and publications

Follow-up actions required

MEASLES ANALYTICS HUB

- Please become an official member of the Measles Analytics Hub - fill out the survey using the QR code in the bottom right corner
- Expect communication in Early 2025
- Be in touch with any questions: **vimc-mah@imperial.ac.uk**

MEASLES
ANALYTICS HUB

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