

Travel vaccines: infections –including COVID – that can make a trip particularly memorable

Refresher Course for Family Physicians: December 6th, 2022

Brian J Ward

Infectious Diseases Division
RI-MUHC

British Travel Blogger Visits 91 Countries In Search Of The World's Worst Toilet — And He Says He's Found It

By Kaleena Fraga | Checked By Cara Johnson
Published September 23, 2022





Conflict of Interest Statement (Last 5 Years)

Position in Pharma	Medical Officer for Medicago Inc. (Oct 2011 - present)
Consulting	Novartis review panel for infectious complications of DMTs MSSS, US Dept of Justice (Vaccine Compensation Programs)
Contracts	Vaccine trials for virtually all companies
Shared Awards	CIHR-Industry grant (Medicago) Shared CQDM grant (Medicago, Laval U)
Occasional Speakers Honoraria	Pfizer, Sanofi Pasteur, Novartis
Investments	None

LEARNING OBJECTIVES

Review recent changes in vaccines used for travellers, including SARS-COV-2 vaccines

Describe changing vaccine environment

The participants should gain in their understanding of vaccine use in travellers



Sources of Health Info Diversifying

I PULLED YOU OVER BECAUSE YOU'RE NOT WEARING YOUR SEATBELT. IN ADDITION YOU'RE OVERWEIGHT, EAT TOO MUCH FAST FOOD, DON'T EXERCISE ENOUGH AND PROBABLY SMOKE.



Influenza is the Most Common Vaccine-Preventable Disease in Travellers

MIT Mathematics



International Society of Travel Medicine
Promoting healthy travel worldwide
Established 1991

Journal of Travel Medicine, 2016, 1–10
doi: 10.1093/jtm/taw078
Review

Review

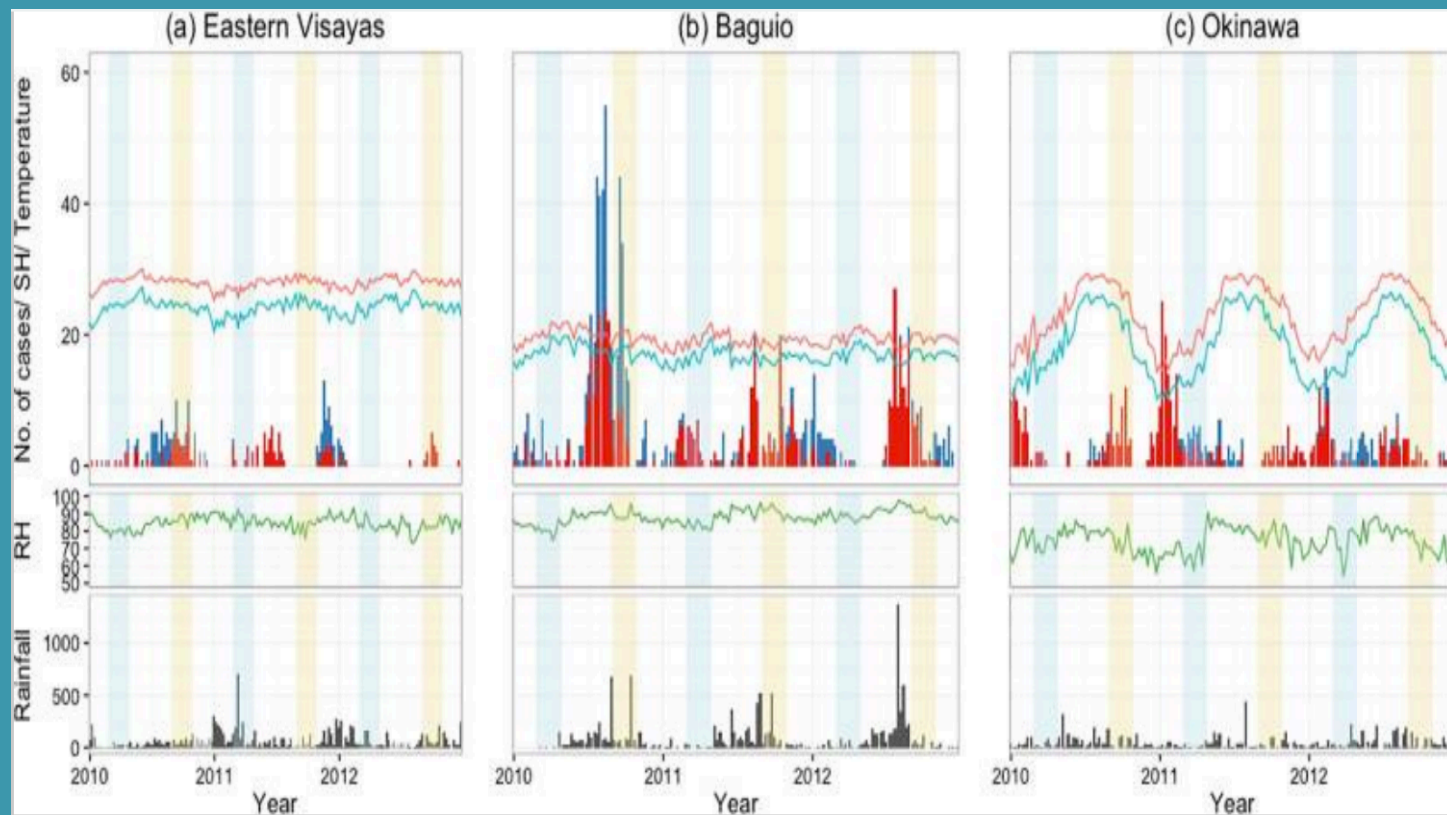
Travellers and influenza: risks and prevention

M. Goeijenbier, MD, PhD,¹ P. van Genderen, MD, PhD,¹ B. J. Ward, MD, PhD²,
A. Wilder-Smith, MD, PhD,^{3,4} R. Steffen, MD, PhD,⁵ and
A. D. M. E. Osterhaus, DVM PhD^{6,7}

- Long stay travellers (>30 days) & VFRs at increased risk
- Attack rates between 6.3-8.9% have been reported
- In 2009, ~3% of travellers exposed to pdmH1N1 fell ill
- Travel to East & South Asia 7x greater risk of influenza

Seasonality Less Well-Defined in Non-Temperate Regions of the World

Circulation of Influenza in 3 regions of the Philippines (2010-12)



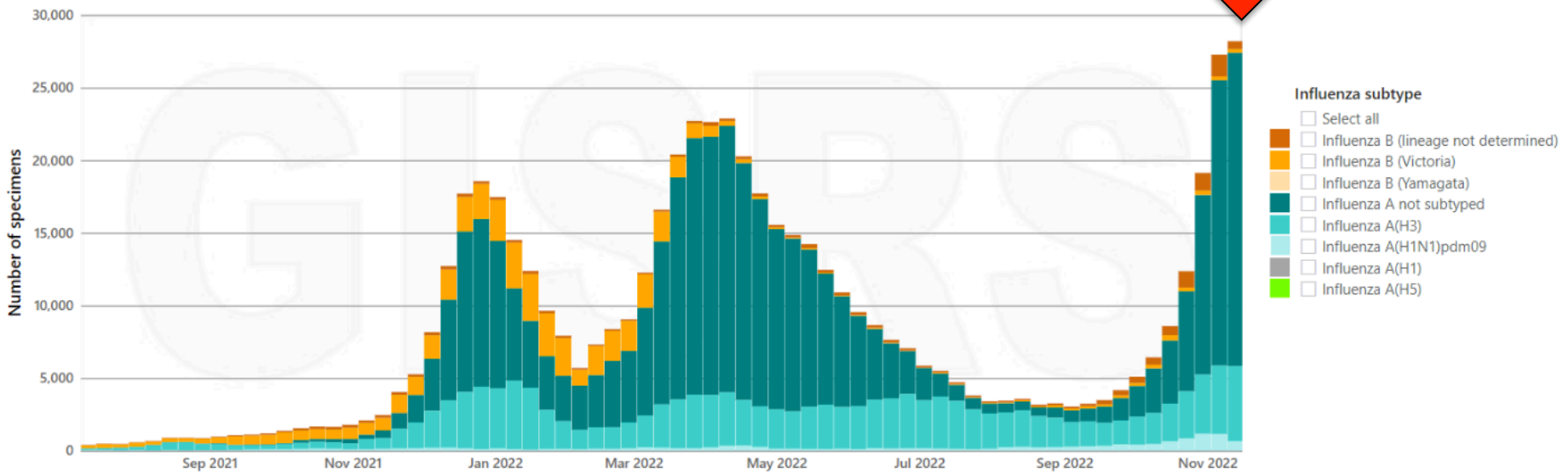
Influenza Has Come Roaring Back Globally

Southern hemisphere had severe 2022 season

Northern hemisphere → early and severe 2022-23 season

Viral ecology: B_{Yamagata} strains appear to have disappeared

Number of specimens positive for influenza by subtype globally



Data source: FluNet (www.who.int/toolkits/flunet). Global Influenza Surveillance and Response System (GISRS)

Data generated on 25/11/2022

Measles

**>350,000 cases and
>140,000 deaths in 2018**

>860,000 cases in 2019

??? cases in 2020, 2021 → 2022



COVID-19 is increasing the risk of measles outbreaks.

Almost 41 countries have already put off, or may put off, their measles campaigns for 2020 or 2021 due to the COVID-19 pandemic. This increases the risk of bigger outbreaks around the world, including the United States.

NEWS FEATURE · 07 APRIL 2020 · CLARIFICATION 09 APRIL 2020

Why measles deaths are surging – and coronavirus could make it worse

The world's most contagious virus has killed thousands in the Democratic Republic of the Congo, and 23 countries have suspended measles vaccination campaigns as they cope with SARS-CoV-2.

**61 million doses
Of measles vaccine
'missed' during COVID**

Impact of SARS-COV-2 on Other Vaccines

Increases in other Vaccine-Preventable Diseases can be Anticipated

HUMAN VACCINES & IMMUNOTHERAPEUTICS

2021, VOL. 17, NO. 2, 400-407

<https://doi.org/10.1080/21645515.2020.1804776>



Taylor & Francis
Taylor & Francis Group

Vaccines and routine immunization strategies during the COVID-19 pandemic

Ener Cagri Dinleyici , Ray Borrow, Marco Aurélio Palazzi Safadi , Pierre van Damme, and Flor M. Munoz

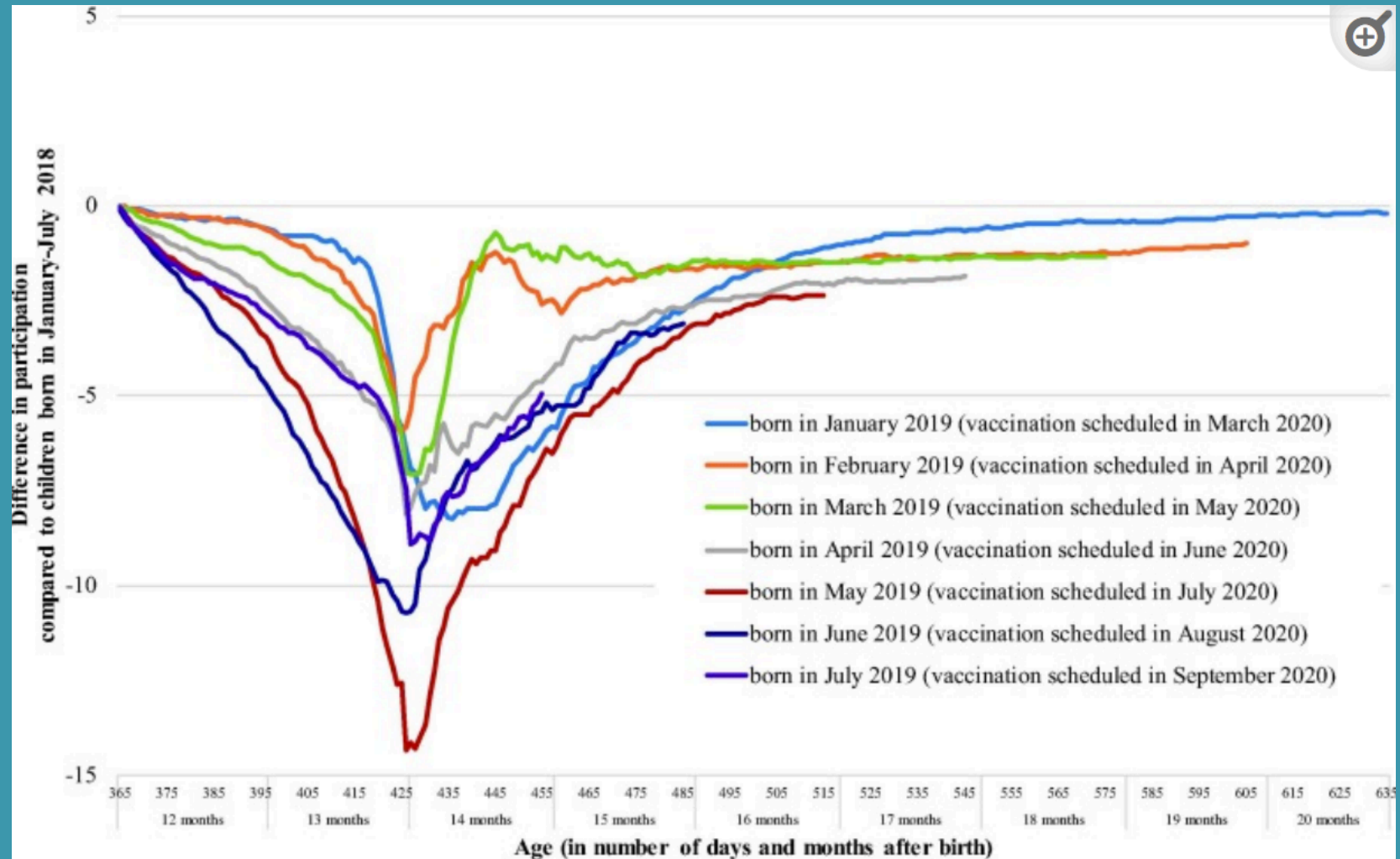
Department of Pediatrics, Eskisehir Osmangazi University Faculty of Medicine, Eskisehir, Turkey Vaccine Evaluation Unit, Public Health England, Manchester, UK Department of Pediatrics, Santa Casa De São Paulo, School of Pediatrics, São Paulo, Brazil Centre for the Evaluation of Vaccination, Vaccine & Infectious Disease Institute, University of Antwerp, Antwerp, Belgium Departments of Pediatrics and Molecular Virology and Microbiology, Baylor College of Medicine, Houston, TX, USA

ABSTRACT

Severe acute respiratory syndrome coronavirus 2 related disease (COVID-19) is now responsible for one of the most challenging and concerning pandemics. By August 2020, there were almost 20 million confirmed cases worldwide and well over half-million deaths. Since there is still no effective treatment or vaccine, non-pharmaceutical interventions have been implemented in an attempt to contain the spread of the virus. During times of quarantine, immunization practices in all age groups, especially routine childhood vaccines, have also been interrupted, delayed, re-organized, or completely suspended. Numerous high-income as well as low- and middle-income countries are now experiencing a rapid decline in childhood immunization coverage rates. We will, inevitably, see serious consequences related to suboptimal control of vaccine-preventable diseases (VPDs) in children concurrent with or following the pandemic. Routine pediatric immunizations of individual children at clinics, mass vaccination campaigns, and surveillance for VPDs must continue as much as possible during pandemic.

Impact of SARS-COV-2 on Other Vaccines

What Price Will Be Paid Long-Term?



Short term impact of the COVID-19 pandemic on incidence of vaccine preventable diseases and participation in routine infant vaccinations in the Netherlands in the period March-September 2020. Middeldorp M, et al. Vaccine. 2021. PMID: 33478793

Meningococcus



<https://www.meningitis.ca/about-meningitis/meningococcal-disease>

Currently available vaccines:

- Quadrivalent conjugate vaccine (A, C, Y, W135)
- Two relatively new meningococcus B vaccines

Two MenB Vaccines Available in Canada

Bexsero™ - factor H-binding protein (fHbp) from the B sub-family, *Neisseria* NadA and NHBA) and PorA

Trumenba™ - bivalent vaccine targeting human factor H binding proteins from A and B families

- These vaccines really hurt
 - >70% have really sore arms
 - predicted to be effective
 - based on antibody levels
 - rate 0.33/100,000 in Canada



Meningitis C
now actively
circulating in
'Meningitis Belt'

Polio Viruses

Type 3 and wild-type Type 2
largely eradicated

However, outbreaks of Vaccine-Derived Polio Virus
continue due to reversion of oral polio vaccine

THE LANCET

Lancet 2019; 394: 148–58

The safety and immunogenicity of two novel live attenuated monovalent (serotype 2) oral poliovirus vaccines in healthy adults: a double-blind, single-centre phase 1 study

Pierre Van Damme, Ilse De Coster*, Ananda S Bandyopadhyay, Hilde Revets, Kanchanamala Withanage, Philippe De Smedt, Leen Suykens, M Steven Oberste, William C Weldon, Sue Ann Costa-Clemens, Ralf Clemens, John Modlin, Amy J Weiner, Andrew J Macadam, Raul Andino, Olen M Kew, Jennifer L Konopka-Anstadt, Cara C Burns, John Konz, Rahnuma Wahid, Christopher Gast*

UN condemns brutal killing of eight polio workers in Afghanistan



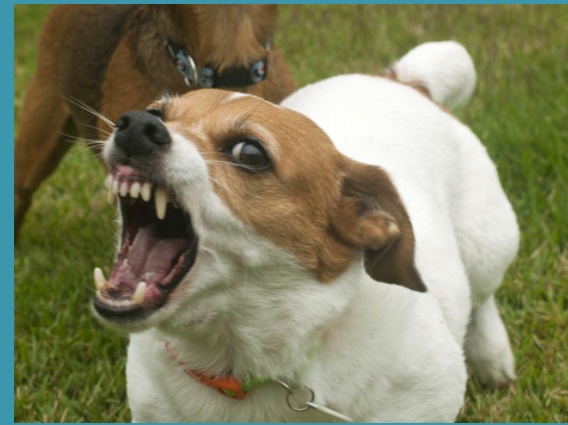
© UNICEF/Frank Dejongh | A child is vaccinated against polio, in Kandahar, Southern Afghanistan. (file)

<https://news.un.org/en/story/2022/02/1112612>



Rabies Risk in Travelers

Pandey P et al. J Travel Med 2002;9:127



- CIWEC Travel Clinic (Nepal)
- 3 year, prospective study
- 99 non-local patients with possible exposures

Tourists 1.9/1000 person years

Expatriates 5.7/1000 person years

Trekkers 1.2/1000 person years

Women > men

Younger more likely to be bitten on head/face

Period between exposure and treatment 1.6-5 days

Pre-immunized - 56% expatriates, 21% tourists

CDC Interactive Website

<https://www.cdc.gov/rabies/resources/countries-risk.html>



Rabies

[Print](#)

Search



Rabies Status: Assessment by Country

Afghanistan

Lyssavirus ¹ free	Rabies virus free	Canine (dog) rabies free	Robust national rabies surveillance ²	Robust national rabies control program implemented ³	Vaccine Availability ⁴	RIG Availability ⁴
No	No	No	No	No	Limited Availability	Limited Availability

Yellow Fever



<http://www.sci-news.com/>

Immunogenicity of Fractional-Dose Vaccine during a Yellow Fever Outbreak — Preliminary Report

Steve Ahuka-Mundeke, M.D., Ph.D., Rebecca M. Casey, M.B., B.S., M.P.H., Jennifer B. Harris, Ph.D., M.P.H., Meredith G. Dixon, M.D., Pierre M. Nsele, M.D., Gabriel M. Kizito, M.D., Grace Umutesi, M.P.H., Janeen Laven, B.S., Gilson Paluku, M.D., M.P.H., Abdou S. Gueye, M.D., Ph.D., Terri B. Hyde, M.D., M.P.H., Guylain K.M. Sheria, M.D., Ph.D., *et al.*

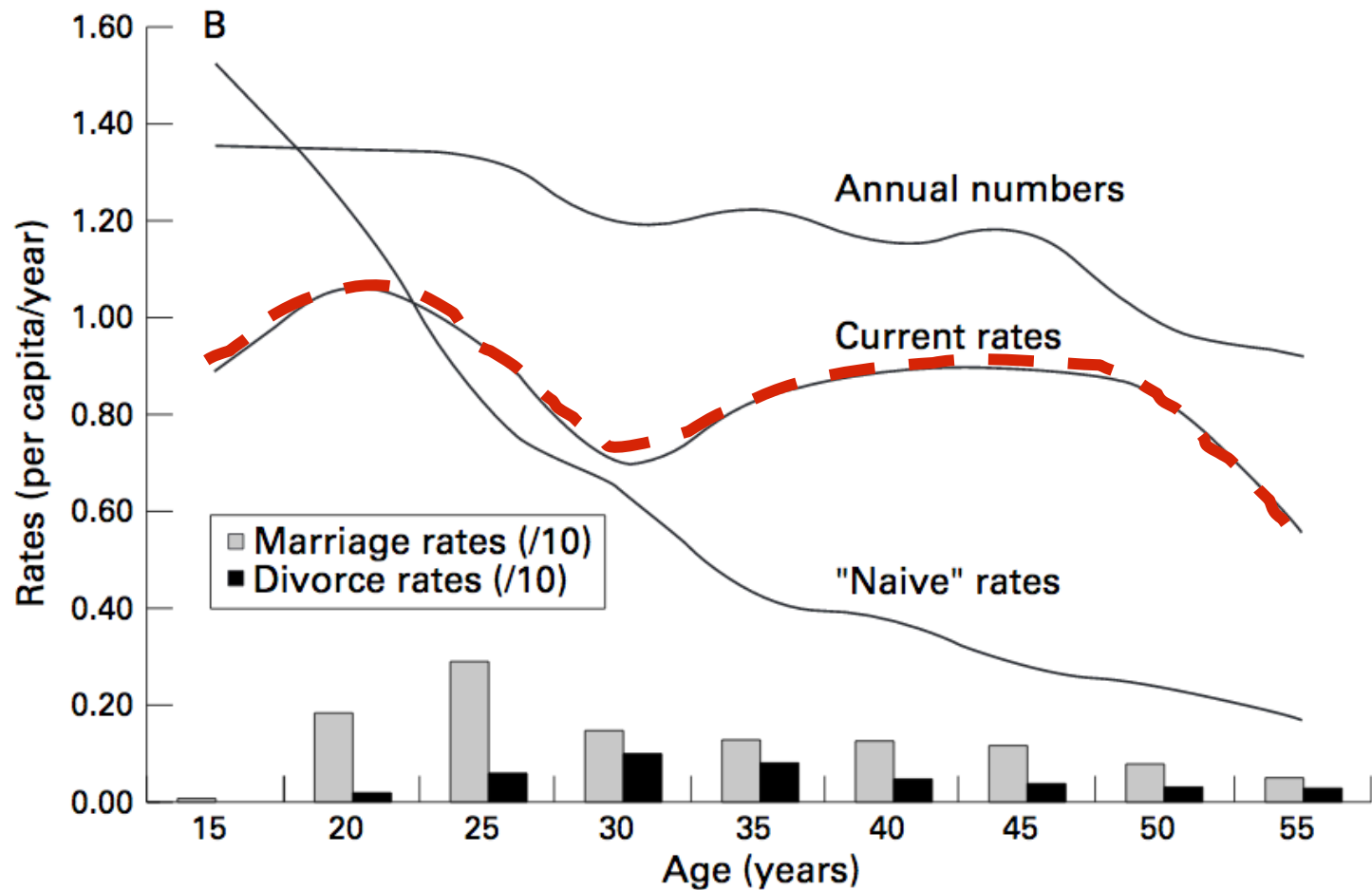
- 1/5th dose
- 98% seroconversion
- 66% sero-response

Hepatitis Viruses



Hepatitis B

Measures of Sexual Activity by Age



Hepatitis A Exposure Highly Variable

- Many countries experiencing epidemiologic transitions
- Dramatic impact on exposure to infectious diseases
- HepA antibodies (Dehli) in 50-60% of 15-35 year olds

Mathur P, Arora NK. Epidemiological transition of hepatitis A in India: issues for vaccination in developing countries. Indian J Med Res. 2008 Dec;128(6):699-704.



San Cristobal, Lima, Peru



[img177.imageshack.us/ img177/7531/54147499ea9.jp](http://img177.imageshack.us/img177/7531/54147499ea9.jp)



www.dcdiocese.org/.../MexicanFamily.JPG

Key Concepts in Immunology

The immune system has extensive redundancy and responses to infectious agents typically involve multiple components

Experiments of Nature

<i>Innate</i>	Humoral	<i>Acquired</i>
		Cellular
All organisms	Enteroviridae	Almost all viruses
• PMN	Encapsulated bacteria	Intracellular bacteria
Skin flora	• <i>S pneumoniae</i>	• mycobacteria
Yeast	• <i>H influenzae</i>	• rickettsia spp
Higher bacteria	• <i>N meningitidis</i>	• <i>S typhi</i>
• Complement	<i>Giardia lamblia</i>	• <i>Listeria</i> spp
Encapsulated bacteria		• <i>Toxoplasma</i> spp
• NK Cells		• <i>Plasmodium</i> spp
Herpesviridae		• <i>Toxoplasma gondii</i>

Hepatitis A is one of the 'numbered Enteroviruses'

Disease-Modifying Therapies & Vaccines

In An Ideal World ...

Try to give all relevant vaccines before starting any Disease Modifying Therapy (DMT)

If this is not possible:

- try to give all single-dose vaccines & boosters at least 1 month before starting DMT
- try to give first dose of vaccine (in a series) ≥ 1 month prior to starting DMT

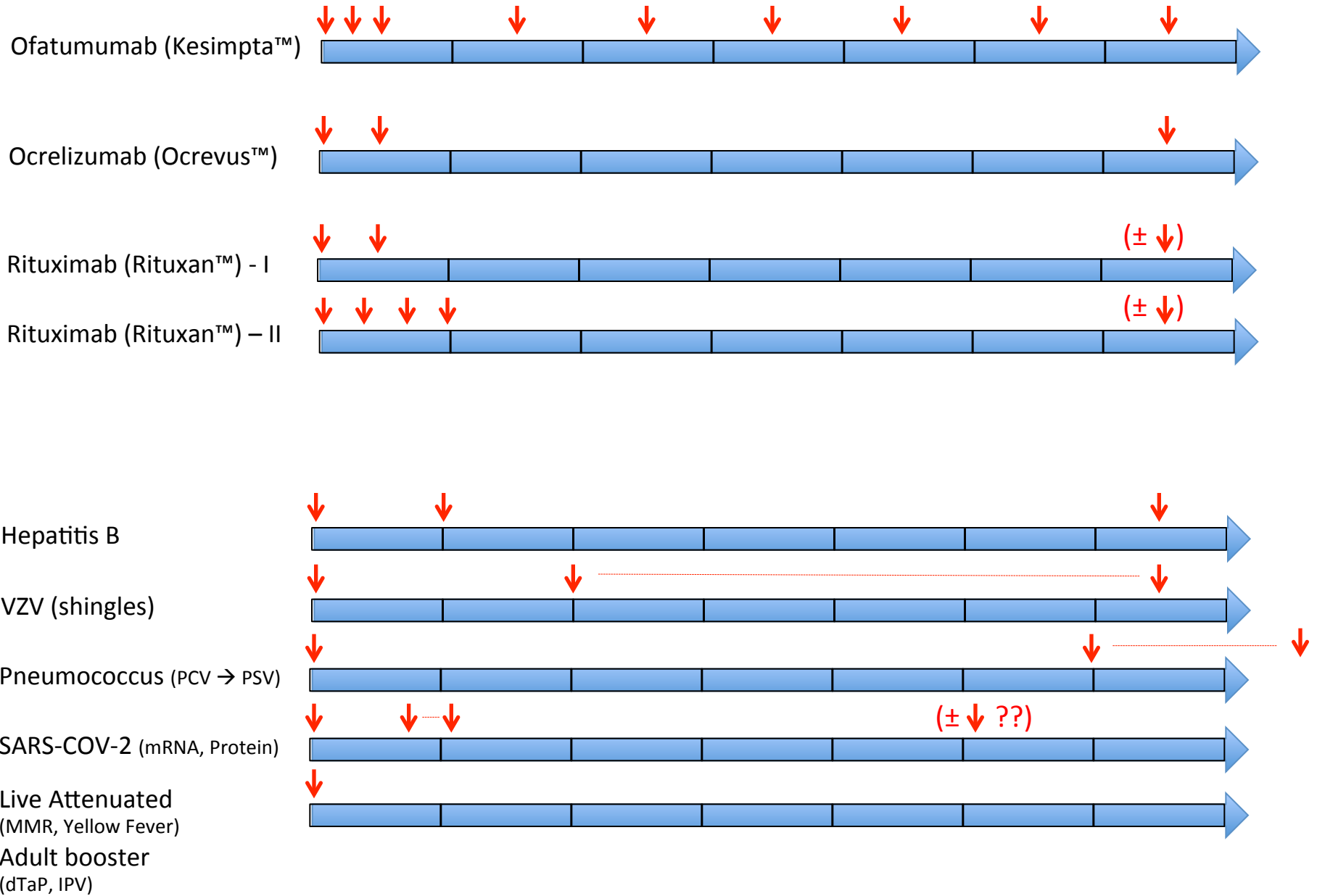
If this is not possible (ie: already taking a DMT or in the process of switching DMTs)

- consider delay of vaccination to nadir of effect (ie: > 3 months post-anti-CD20)
- consider stopping on-going DMT to permit degree of immune reconstitution
- consider DMT 'holiday' between DMTs to allow some degree of reconstitution

If this is not possible (ie: MS is aggressive/unstable)

- give the vaccines anyways (NOT live attenuated viruses)
- for critical vaccines – verify response if correlate of protection known
 - rabies vaccine for someone working as veterinarian or with bats
 - hepatitis B vaccine for sex workers, IVDU or someone working with needles
 - consider modified schedules to achieve response in those still 'negative'

Dosing Schedules for anti-CD20 Therapies



Live Vaccines

and Potential for Spread in Families

Smallpox (Vaccinia)	→	+++
Measles	→	(?)
Mumps	→	(?)
Rubella	→	(?)
Varicella	→	+
Oral Poliovirus	→	+++
Rotavirus	→	+
Nasal influenza	→	+
Yellow fever	→	(?)
Japanese encephalitis (Chinese)	→	(?)
BCG	→	+++
Oral Typhoid	→	(?)

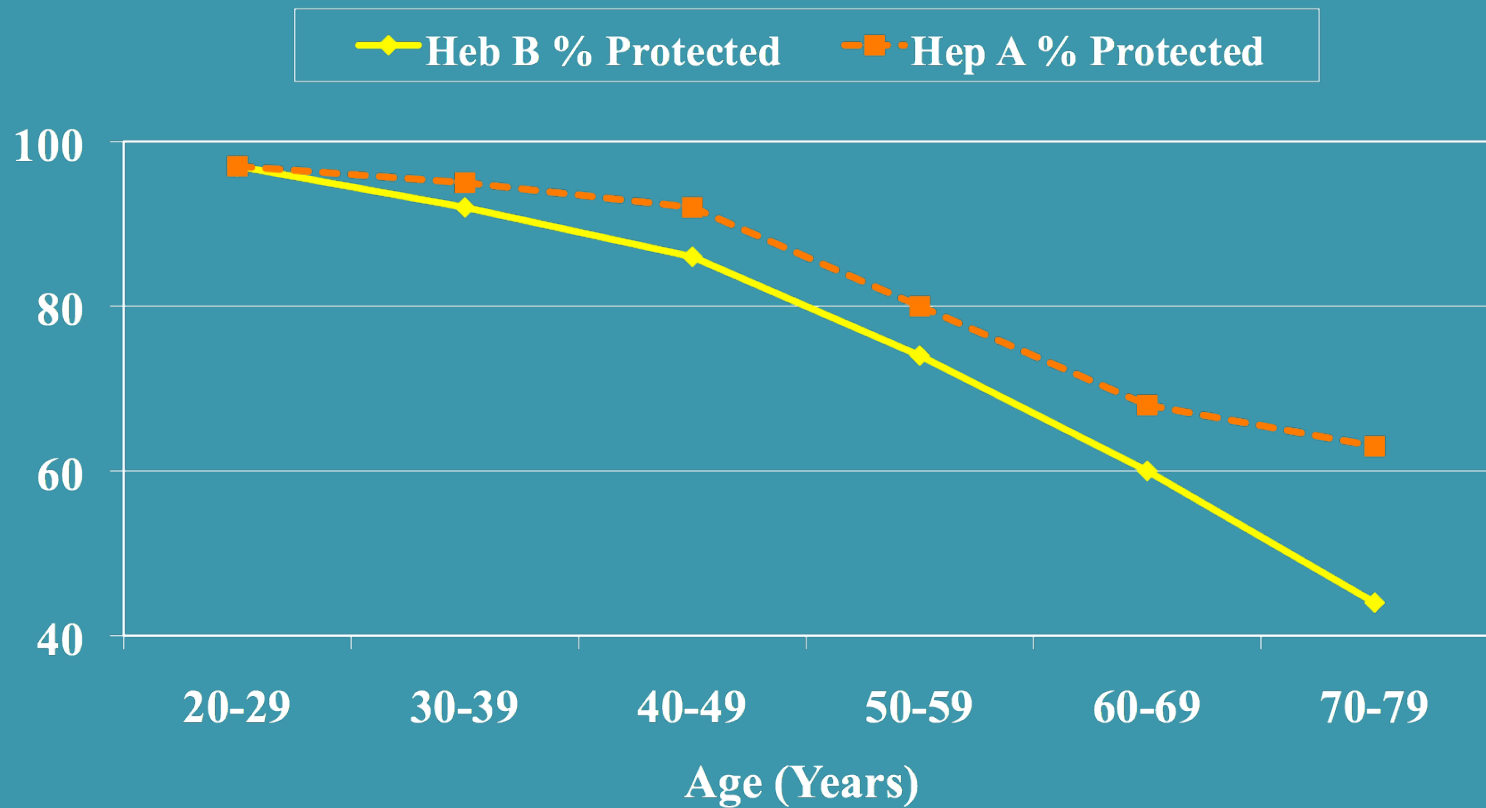
Elderly Travellers Increasing



flyingcompanions.com.au



Age-related Declines in Efficacy for Hepatitis Vaccines



Sjogren MH, AJM 2005;118:34S-39S Fisman D, et al Clin Inf Dis 2002;35:1368-75

Meydani, et al. JAMA 1997; 277:1380-86 Wolters, et al. Vaccine 2003;21:3623-28

Direct to Customer Marketing

Twinrix™



**BOB AND KAREN'S
RESORT GAME WITH
EVERYTHING**

Every year thousands of overseas travelers become ill from hepatitis A and B, diseases transmitted through food, water, blood and anyone who is a carrier. That includes the ice in your pine colada, the fruit salad you had for lunch or even the water who served it to you. If your vacation plans take you to Mexico or the Caribbean, don't take chances with hepatitis A and B. Twinrix is the only vaccine that provides protection against both hepatitis A and B in a single series of vaccinations. Ask your doctor if Twinrix is right for you, or go to travelsafety.com for more information.

DON'T RISK IT, TWINRIX.

TWINRIX
Hepatitis A Inactivated &
Hepatitis B (Recombinant) Vaccine

behance.net

Dukoral™



www.travellersdiarhea.com

IN CASE OF

DIARRHEA APOCALYPSE



Incidence of ETEC Diarrhea in Travellers

TABLE 2

Summary pathogen prevalence and diarrhea incidence among US military and similar populations by region and overall
Geographic region

	Sub-Saharan Africa*	Latin American and Caribbean	Middle East N. Africa	Southeast Asia	Summary estimate) (99% CI)
Pathogen prevalence (%)/number of studies	n = 2	n = 7	n = 13	n = 12	
ETEC	16, 17	29.1	28.3	13.3	22.2 (16.9–27.5)
EAEC	4	6.0	16.8	12.4	13.3 (7.7–18.9)
Campylobacter	0, 2	2.6	1.2	23.9	9.9 (5.4–14.5)
Norovirus	13	9.0	7.1	9.2	8.4 (4.0–12.8)
Shigella	9, 33	6.2	7.1	3.8	6.6 (3.4–9.7)
Salmonella	1, 9	3.0	1.4	11.1	5.0 (3.1–6.9)
Rotavirus	1, 36	5.6	1.5	3.4	3.9 (1.6–6.2)
Multiple pathogens	4, 13	7.0	9.3	15.9	11.2 (7.4–15.1)
No pathogens identif.	48, 50	52.9	46.3	40.2	45.6 (38.6–52.5)

Incidence (95% CI)/number of studies	n = 2	n = 5	n = 13	n = 12	
Active surveillance	–	29.9 (6.7–53.1)	24.3 (7.3–41.2)	37.3 (18.7–55.8)	28.9 (16.2–41.5)
Passive surveillance	3.0, 8.0	10.8 (2.5–19.1)	5.3 (3.6–7.1)	6.2 (4.7–7.8)	6.2 (4.9–7.4)

* Pathogen prevalence (if tested) and incidence for each of two studies reported (unpooled).

Cohort study and self-report surveys.

report s

*Incidence, etiology, and impact of diarrhea among long-term travelers
(US military and similar populations): a systematic review.
Riddle MS et al. Am J Trop Med Hyg 2006;74:891.*

Dukoral

Good Cholera Vaccine

Underwhelming for Travel Diarrhea



www.travellersdiarrhea.com

Benefits

- Safe vaccine
- Available orally
- Up to 60-70% efficacy¹ vs ETEC
- Most effective vs 'severe' ETEC

Costs/Risks

- ETEC incidence in TD ~22%
- ~10% of TD severe
- Protection lasts for 3 months
- Need 2 doses (1 week apart)

(30% get TD) • (20% incidence) • (70% efficacy) = 4%

Vaccination with Dukoral against travelers' diarrhea (ETEC) and cholera.

Jelinek T, Kollaritsch H. Expert Rev Vaccines. 2008;7:561.

Typhoid & HAV+Typhoid

Typhoid: Two vaccines available

- Live oral (Ty21a) and inactivated (Vi)
- Equally effective (ineffective)
- Start at ~70% efficacy and declines (<50% at 4 yrs)
- Particularly stupid food choices can overwhelm
- Probably use too much of this vaccine
- Use for long-term, low-budget & VFR travel

HAV+ Typhoid

- Make certain that both vaccines indicated
- Often not available

Turning Tides ...

The 'Shoe' is Increasingly on the Other Foot



Good vaccines now being produced that **we** (in wealthy countries) don't have easy access to ...

Several Travel Vaccines Now Available in Other Countries but NOT Canada



China

Attenuated JE Vaccine
Enterovirus 71 Vaccine



Australia

Chimeric JE Vaccine



Globally

Hemisphere-specific flu Vaccines



Dengue & Malaria Vaccines

Takeda's Biologics License Application (BLA) for Dengue Vaccine Candidate (TAK-003) Granted Priority Review by U.S. Food and Drug Administration

November 22, 2022 | [Vaccines](#)

- ***TAK-003 is Being Evaluated for the Prevention of Dengue Disease Caused by Any Dengue Virus Serotype in Individuals 4 Years Through 60 Years of Age***



Malaria Vaccines



<http://www.sanaria.com/>



Ruth Nussenzweig

- irradiated sporozoites

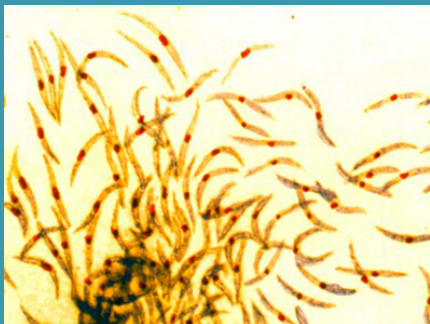
Protective immunity produced by the injection of x-irradiated sporozoites of *Plasmodium berghei*. Nussenzweig RS et al. *Nature*. 1967 Oct 14;216(5111):160-2.

Stephen Hoffman/Ripley Ballou

Immunity to malaria and naturally acquired antibodies to the circumsporozoite protein of *Plasmodium falciparum*. Hoffman SL, ... Ballou WR et al. *N Engl J Med*. 1986 Sep 4;315(10):601-6.

RTS-S(GSK)

Grow sporozoites (Sanaria)



World's First Malaria Vaccine ...

RTS,S/AS01 (RTS,S): Mosquirix™ from GSK

World Health Organization Approves First Malaria Vaccine

The vaccine could prevent the deaths of tens of thousands of children in sub-Saharan Africa each year.



By Don Rauf

October 11, 2021

- Modest efficacy
- 30% reduction in severe cases
- Needs 4 doses in young children to achieve this level of protection



Called Mosquirix, the vaccine produced by GlaxoSmithKline Biologicals has been in development since the mid-1980s.

Joseph Odour/AP/Shutterstock

The 2nd Malaria Vaccine May be Much Better

R21+Matrix M

THE LANCET

Efficacy and immunogenicity of R21/Matrix-M vaccine against clinical malaria after 2 years' follow-up in children in Burkina Faso: a phase 1/2b randomised controlled trial

Mehreen S Dattoo, Hamtandi Magloire Natama*, Athanase Somét†, Duncan Bellamy†, Ousmane Traoré, Toussaint Rouamba, Marc Christian Tahita, N Félix André Ido, Prisca Yameogo, Daniel Valia, Aida Millogo, Florence Ouedraogo, Rachidatou Soma, Seydou Sawadogo, Faizatou Sorgho, Karim Derra, Eli Rouamba, Fernando Ramos-Lopez, Matthew Cairns, Samuel Provstgaard-Morys, Jeremy Aboagye, Alison Lawrie, Rachel Roberts, Innocent Valéa, Hermann Sorgho, Nicola Williams, Gregory Glenn, Louis Fries, Jenny Reimer, Katie J Ewer, Umesh Shaligram, Adrian V S Hill‡, Halidou Tinto‡*

- Children 5-17 months of age in Burkina Faso received 3 doses
- Overall ~78% efficacy in 12 month follow-up

EV71 & Vaccines

- Major cause: HFMD in Asia/SE Asia
- Causes a range neurologic disease including aseptic meningitis, encephalitis and polio-like syndrome



HFMD Cases Deaths

2014	2,820,000	508
2015	1,610,000	118



- Vaccines developed by Sinovac, Beijing Vigoo and the Kumming Institute based on C4 virus (97-99.7% na homology)
- Formalin Rx, whole virion + alum (90%/80% VE HFMD/paralysis)
- Three Phase III trials (2 doses 4 weeks apart in kids 6 – 36 months)

Japanese Encephalitis Vaccines



<https://wwwnc.cdc.gov/travel/diseases/japanese-encephalitis>

Quality: Pre-Qualified status in 2013/2014

Safety: Good – in general

Access: Currently only by seeking out
vaccine in destination country

Protection if Vaccinated on Arrival?



EV71

Probably not – need 2 doses
? some protection after 1st dose



Japanese Encephalitis

Almost certainly – only 1 dose needed
Modified disease possible
Risk primarily rural



Influenza

Some protection likely at 1 week
Best protection at 2 weeks

Where to Access These Vaccines?



Large Tourist Hotels

Grand Hotel, Xuyen Moc District,
Ba Ria-Vung Tau Province - Vietnam



Embassies & Consulates

Typically have a list of clinics and
hospitals with 'expanded' services



The A to Z of healthy travel

IAMAT, Travax and other International Service Providers

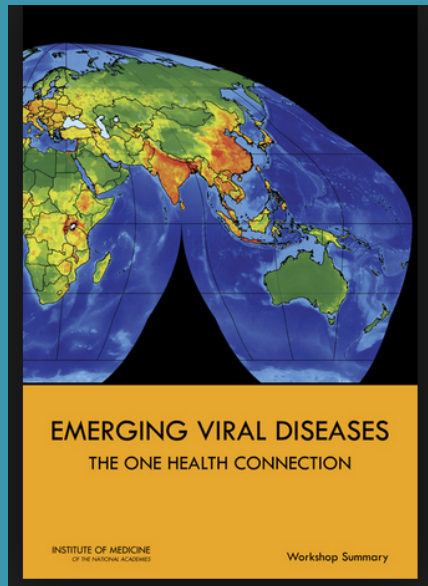
List of local medical advisors & service providers

2014-2015 Ebola Response was a Mess

- Absence of global leadership
- Parochial/Nationalistic funding decisions
- Dithering & overlapping objectives



(Global Collaboration for Infectious Diseases Research)



AN R&D BLUEPRINT FOR ACTION TO PREVENT EPIDEMICS

FUNDING & COORDINATION MODELS FOR PREPAREDNESS AND RESPONSE
MAY 2016



CEPI New vaccines for a safer world



Prioritization Efforts

Emerging Infections with Pandemic Potential

Rules

Exclude HIV, TB, Malaria
Exclude influenza, Dengue

Chikungunya

Lassa

Rift Valley Fever

CCHF

Congo Crimean
Hemorrhagic Fever

Marburg

SARS

MERS

SFTS

Severe Fever with
Thrombocytopenia Syndrome

Ebola

Nipah

Zika



What's Next?

More malaria vaccines
More dengue Vaccines

CEPI Targets

- Ebola
- MERS
- Zika/Chikungunya

Parasite Vaccines

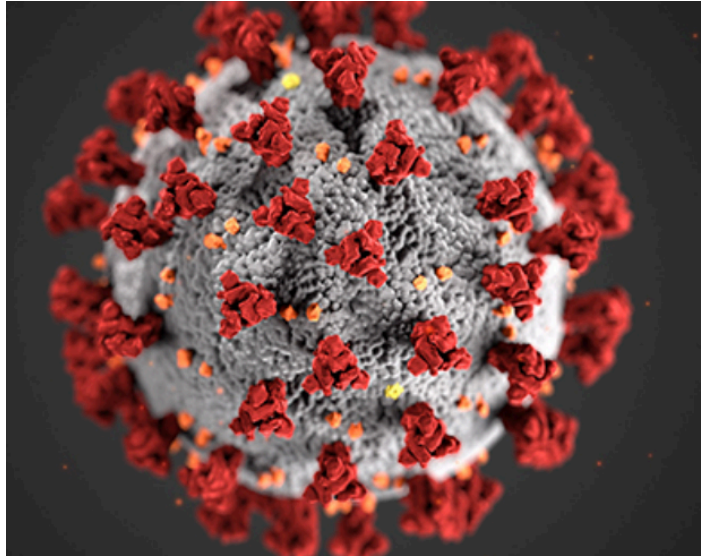
- Hookworm, *Schistosoma mansoni*, giardiasis



RESEARCH ARTICLE

In a randomized trial, the live attenuated tetravalent dengue vaccine TV003 is well-tolerated and highly immunogenic in subjects with flavivirus exposure prior to vaccination

Stephen S. Whitehead^{1‡}, Anna P. Durbin^{2‡}, Kristen K. Pierce³, Dan Elwood², Benjamin D. McElvany³, Ellen A. Fraser³, Marya P. Carmolli³, Cecilia M. Tibery², Noreen A. Hynes², Matthew Jo², Janece M. Lovchik², Catherine J. Larsson³, Elena A. Doty³, Dorothy M. Dickson³, Catherine J. Luke¹, Kanta Subbarao¹, Sean A. Diehl^{3*}, Beth D. Kirkpatrick^{3*}



SARS-COV-2 & Travel

- it's actually SARS-COV-2 that 'travels'
- recommendations for 'travel' the same as for those staying at home
- main concern → restricted movement

SARS-COV-2 & Travel



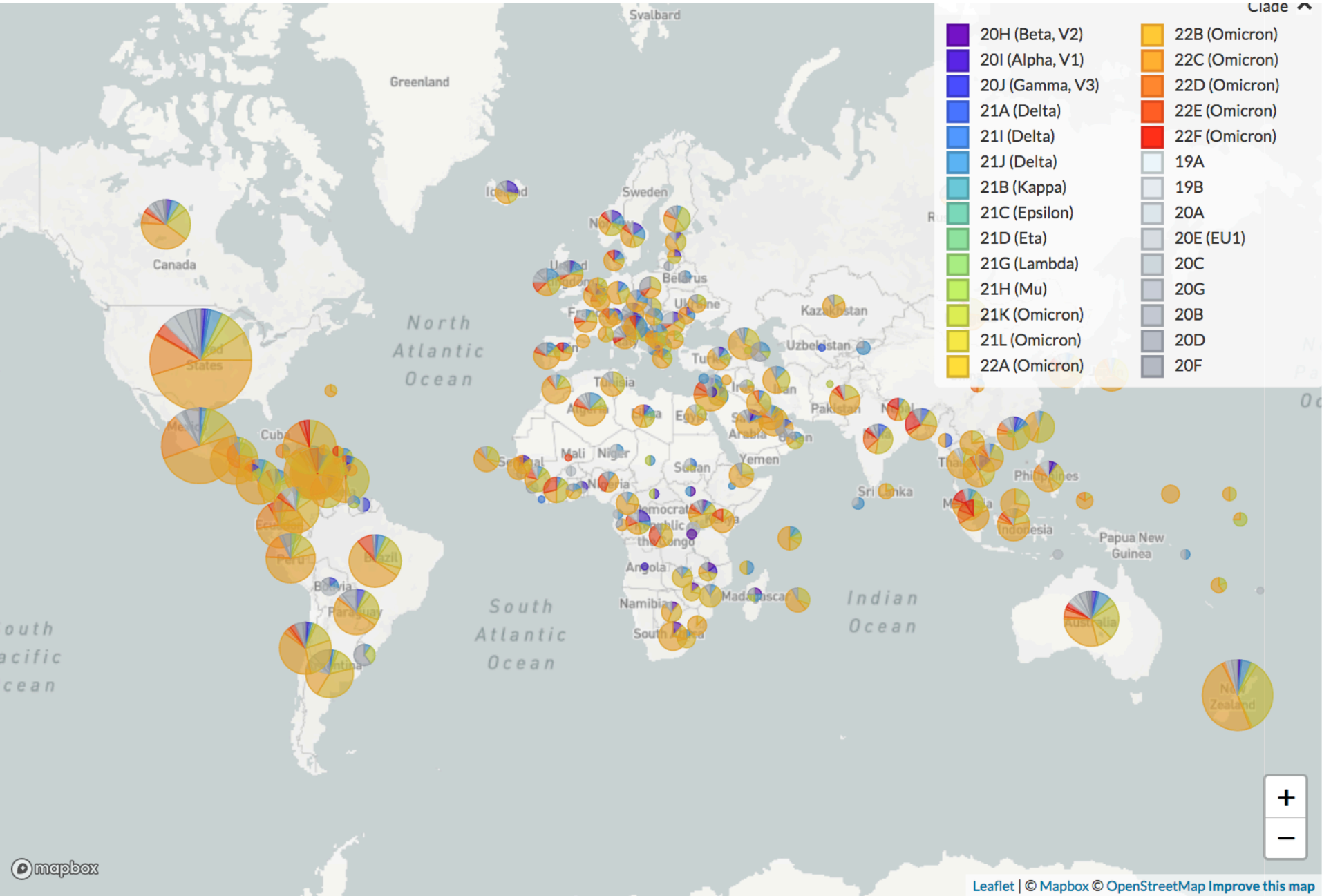
Hard to control exposures while travelling

The Hajj

- Religious obligation
- 1.8 million (2001)
 - 63% Arab countries
 - 30% non-Arab Asia
 - 5% other African
 - 2% other
- Al Haram - 356,000 sq meters - 1 million pilgrims
- Madinah - 165,000 sq meters - 750,000 pilgrims
- Meningococcal epidemics (carriage as high as 80%)
- 2000 → Spread of W135 serotype around globe



Geography of Variants (Nov 2022)



Blossoming of Variants

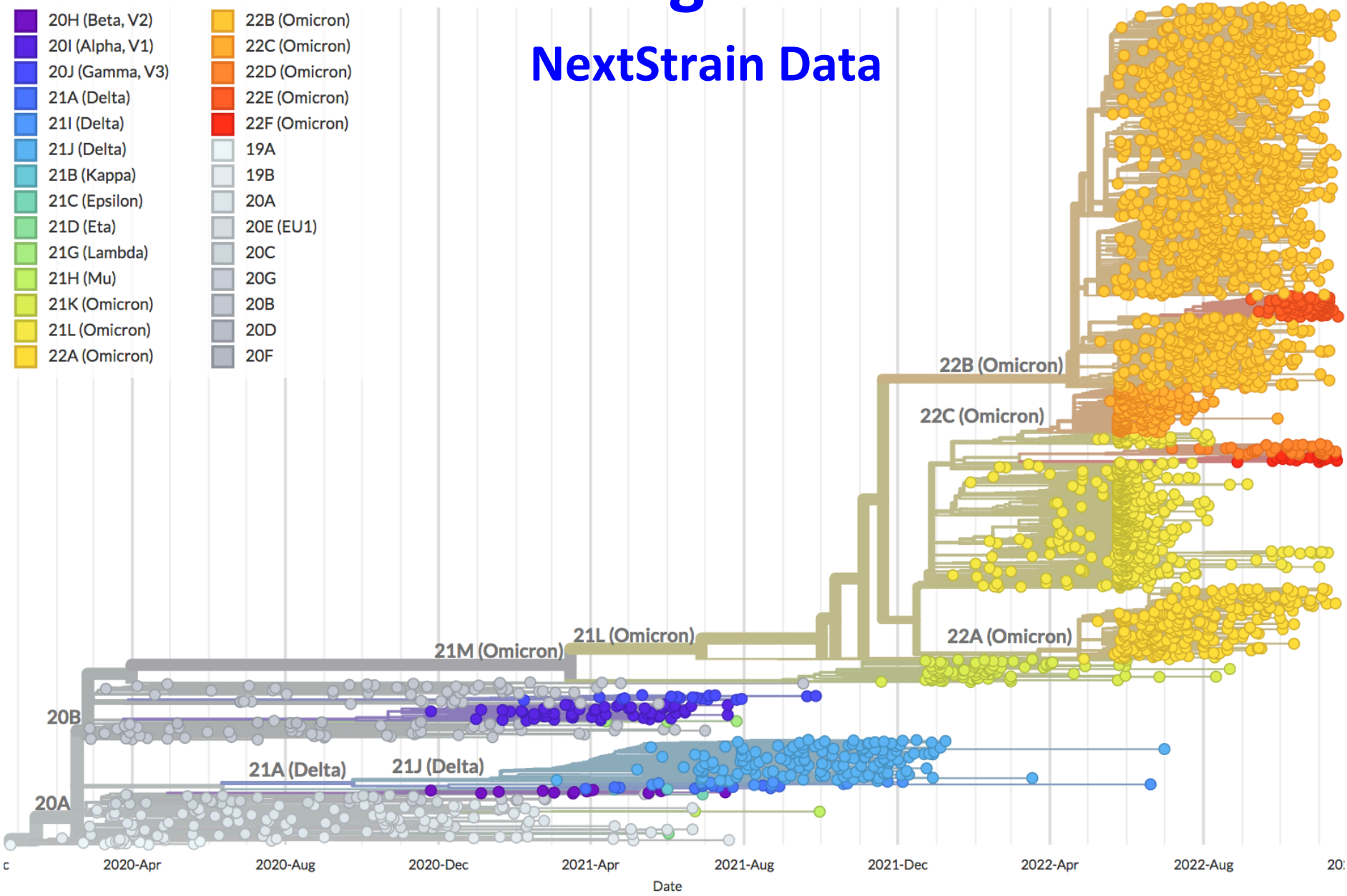
NextStrain Data

ZOOM TO SELECTED RESET LAYOUT

Phylogeny

Clade ^

- 20H (Beta, V2)
- 20I (Alpha, V1)
- 20J (Gamma, V3)
- 21A (Delta)
- 21I (Delta)
- 21J (Delta)
- 21B (Kappa)
- 21C (Epsilon)
- 21D (Eta)
- 21G (Lambda)
- 21H (Mu)
- 21K (Omicron)
- 21L (Omicron)
- 22A (Omicron)
- 22B (Omicron)
- 22C (Omicron)
- 22D (Omicron)
- 22E (Omicron)
- 22F (Omicron)
- 19A
- 19B
- 20A
- 20E (EU1)
- 20C
- 20G
- 20B
- 20D
- 20F



CDC Data for Cases/Deaths

(Nov 9, 2022)

Omicron Waves

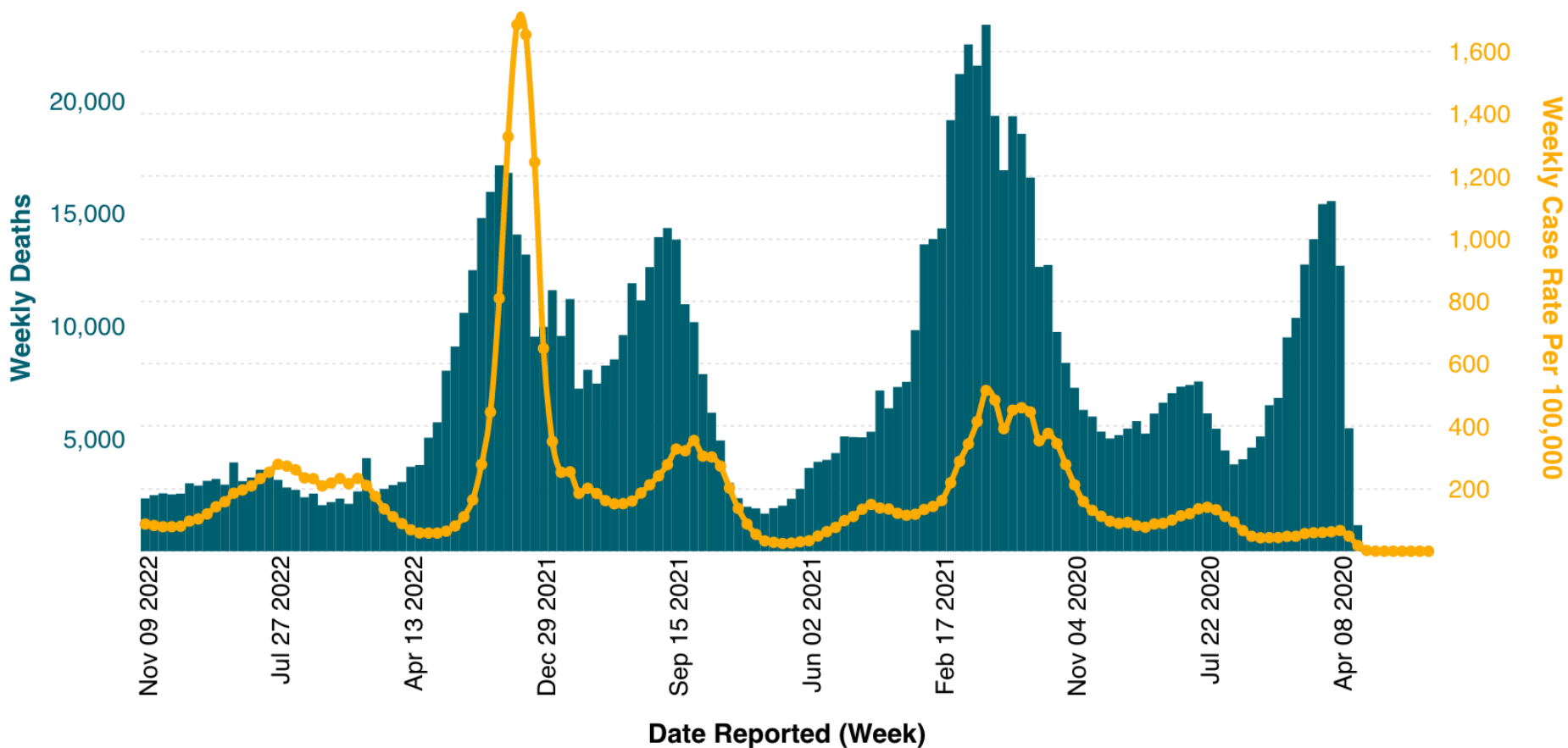
Delta

D

C

B

A



Get a Booster?

Get the 'best booster available' 3 months after recovering from COVID-19

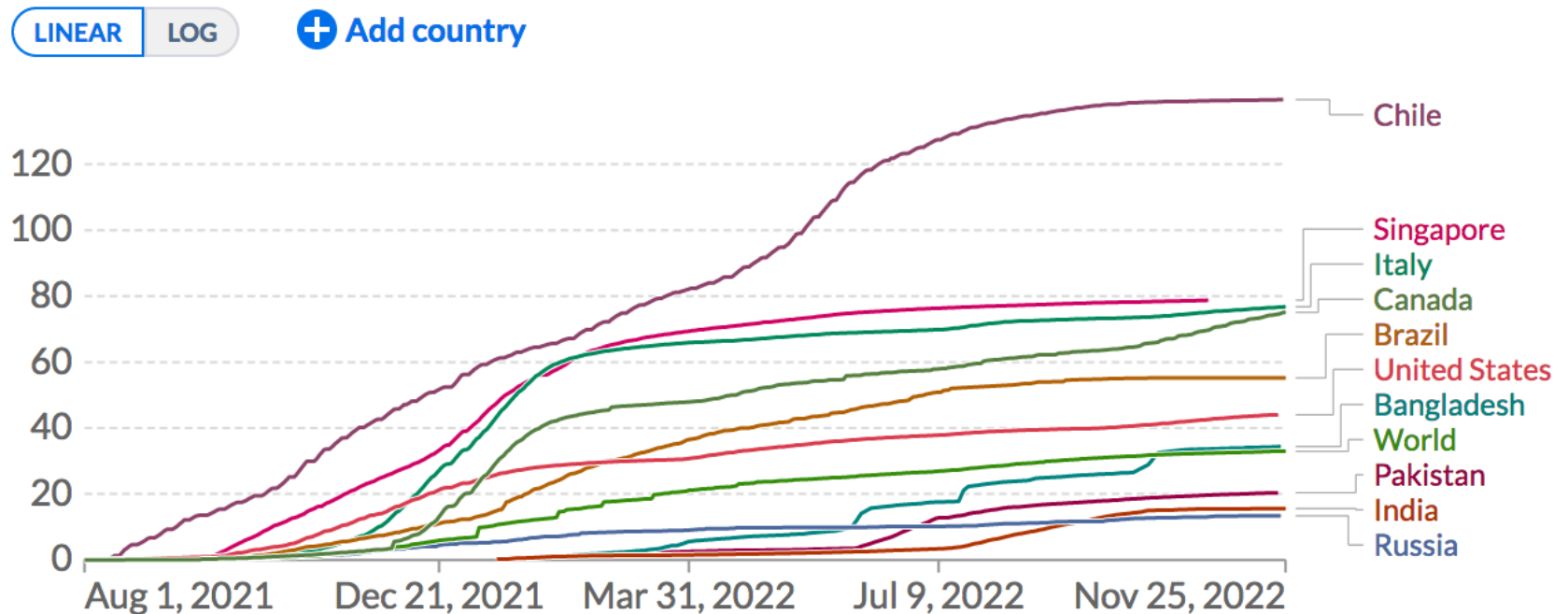
- CDC → get up-dated bivalent booster if >2 months since last dose
- Canada → all people ≥ 12 years should get a booster and bivalent preferred
- ECDC/EMA → people at risk should have 2nd booster this autumn

Boosters Administered?

COVID-19 vaccine boosters administered per 100 people

Total number of vaccine booster doses administered, divided by the total population of the country. Booster doses are doses administered beyond those prescribed by the original vaccination protocol.

Our World
in Data



Source: Official data collated by Our World in Data - Last updated 26 November 2022
OurWorldInData.org/coronavirus • CC BY



CHART

MAP

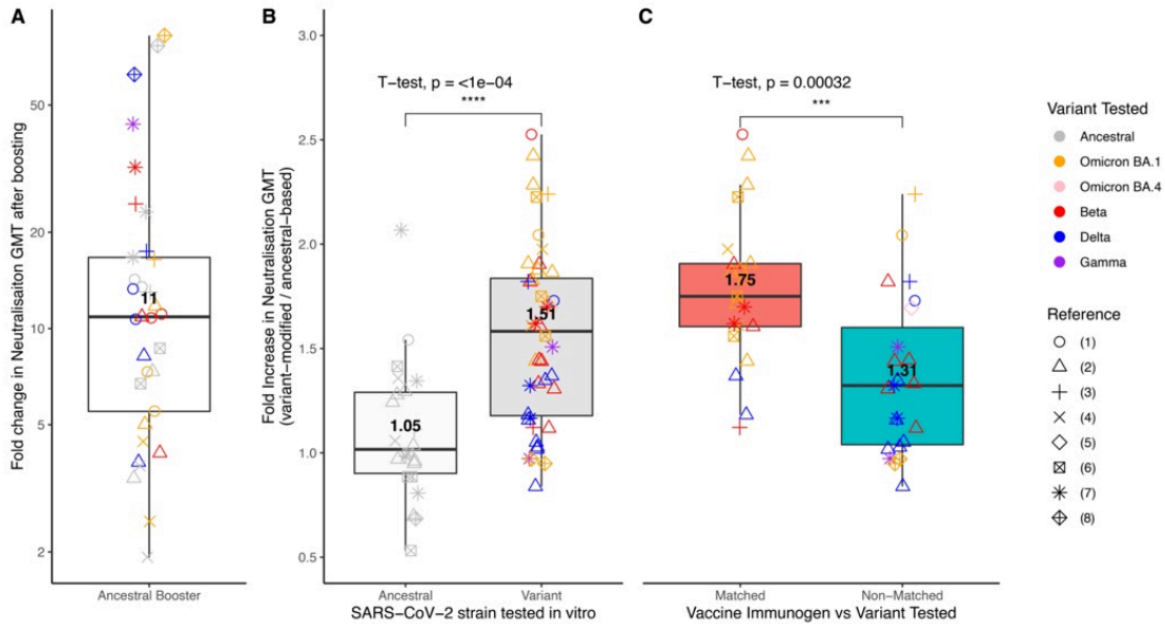
TABLE

SOURCES

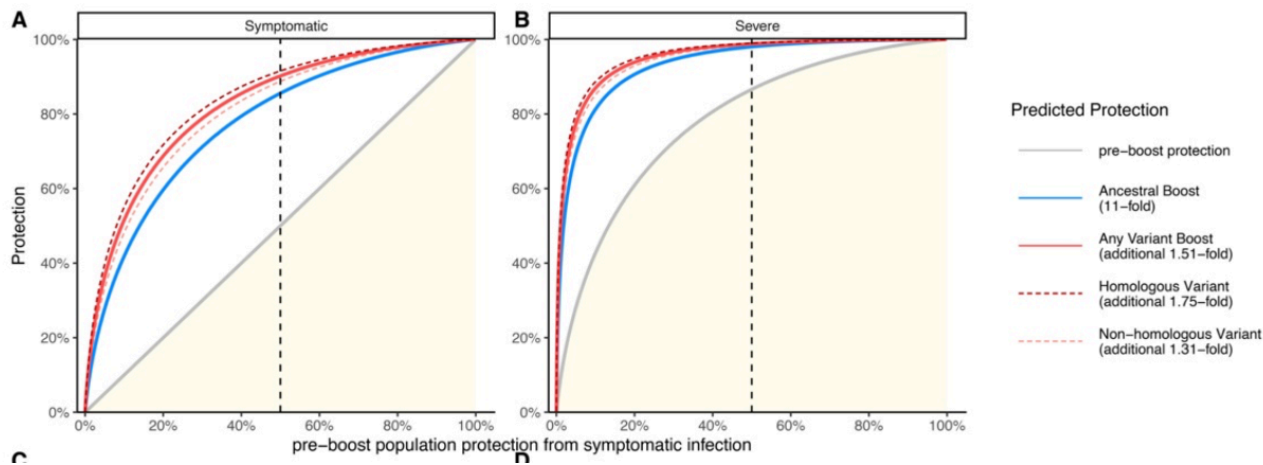
DOWNLOAD



Advantage of a Variant Booster?



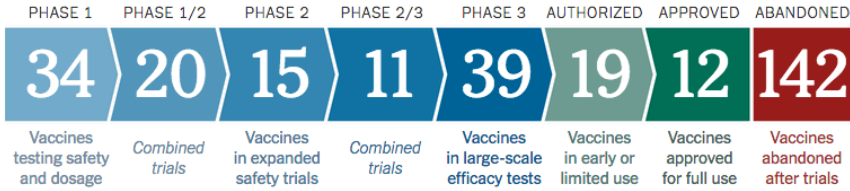
- Fold-increase in NAb with an mRNA boost ~10x pre-boost titre
- Fold-increase in NAb (variant/ancestral) with ancestral- versus variant-based vaccine
- Fold-increase: matched vs. not-matched booster



- X-axis: pre-boost level of protection
- Y axis: post-boost level of protection vs. 'any' or severe disease

Coronavirus Vaccine Tracker

By Carl Zimmer, Jonathan Corum, Sui-Lee Wee and Matthew Kristoffersen Updated April 8, 2022



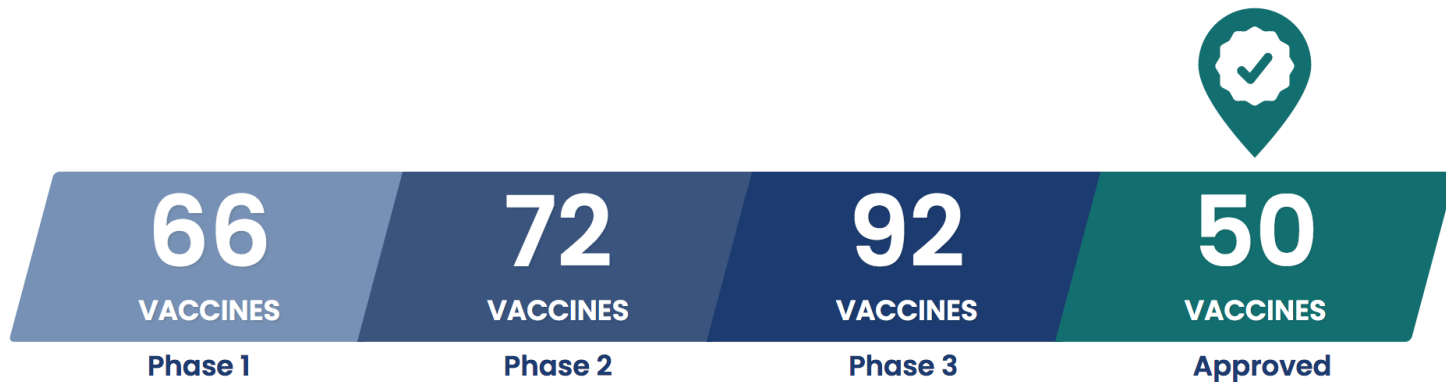
Vaccines typically require years of research and testing before

The Vaccines Themselves

242
Vaccine Candidates

821
Vaccine Trials

80
Countries with Vaccine Trials



12 vaccines no longer progressing

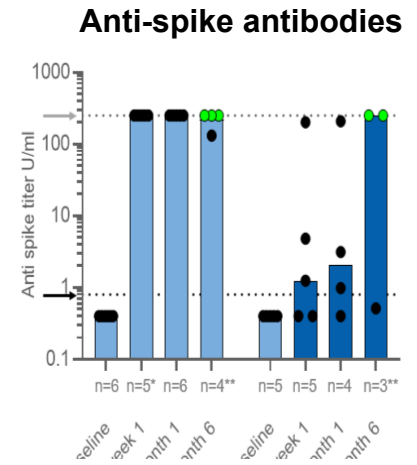
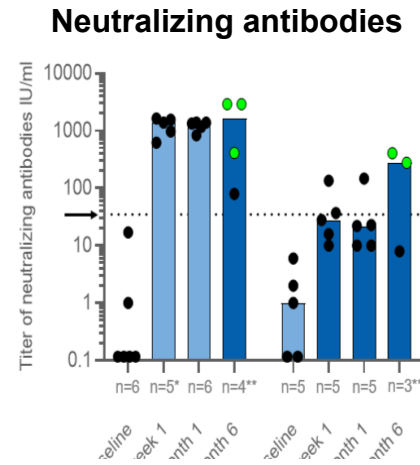
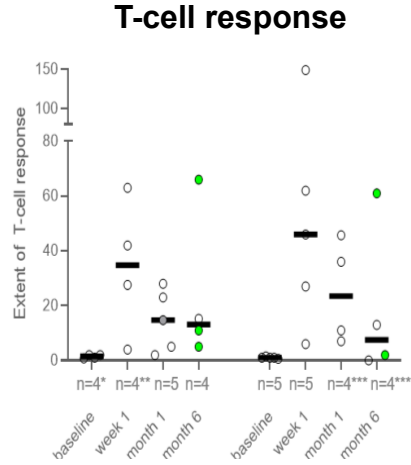
<https://covid19.trackvaccines.org/vaccines/>

Antibody & T Cell Responses in MS Patients Taking Ofatumumab: Primary and Booster Vaccination

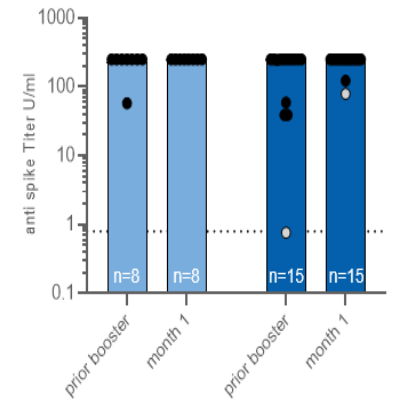
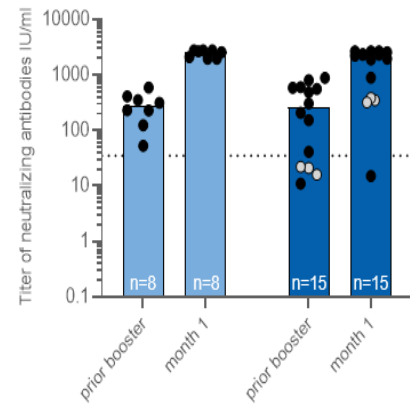
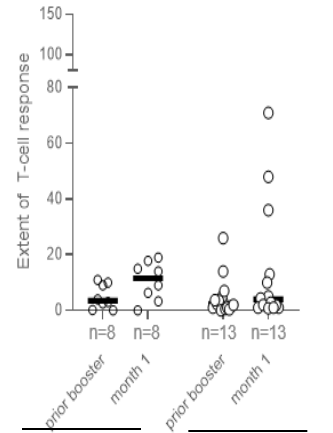
- Boosted before 6mo visit
- COVID-19 infection before 6mo visit

- Before first ofatumumab
- During stable ofatumumab

Primary Series



Booster Vaccination



Cohort 1
Vaccination **before** ofatumumab

Cohort 2
Vaccination **during** ofatumumab

Cohort 1
Vaccination **before** ofatumumab

Cohort 2
Vaccination **during** ofatumumab

Cohort 1
Vaccination **before** ofatumumab

Cohort 2
Vaccination **during** ofatumumab

Travel Vaccines Will NOT Become Less Complicated



Questions or
Comments

Case #1

A 52 year old businesswoman will be travelling to Peru for an 8-day trip. The WHO website indicates that Peru is endemic for yellow fever, malaria, typhoid and many other infections. She will stay at a 5-star hotel in Lima and will eat almost exclusively in the hotel restaurant and in high-quality restaurants in Lima.

What are your principal concerns?

Would you recommend malaria prophylaxis, yellow fever vaccination, typhoid vaccination, etc?

Case #2

A school group is going to India (Delhi, Akra and Jaipur) to volunteer in a girls-only orphanage/school. They will do some minor tourist activities but will spend most of the time with the girls in and around the orphanage in the rural outskirts of Akra. They will be in India for almost 3 months.

What are your principal concerns?

What do you recommend?

Case #3

A geography PhD student is planning to travel to rural Panama to collect data for their thesis that focuses on health risks associated with inner city poverty. They be exposed to urban garbage, raw sewage, local residents (who will almost certainly invite them to share food) and urban animals (ie: dogs, cats, rats, other). They plan to spend 6 months in country. Their parents are/were borderline anti-vaccination and they have no vaccine record.

What are your principal concerns?

What do you recommend?

Case #4

A couple (65 year old man, 63 year old woman) is planning a cruise in the Caribbean. They will first travel to the Dominican republic and stay in a modest beach resort for 1 week before boarding the cruise-ship. The cruise will visit 7 different islands over a 14-day period. Most of their time will be spent on the boat and participating in cruise-organized visits to local sites and restaurants. They are in good health and take no medications.

What are your principal concerns?

What do you recommend?