

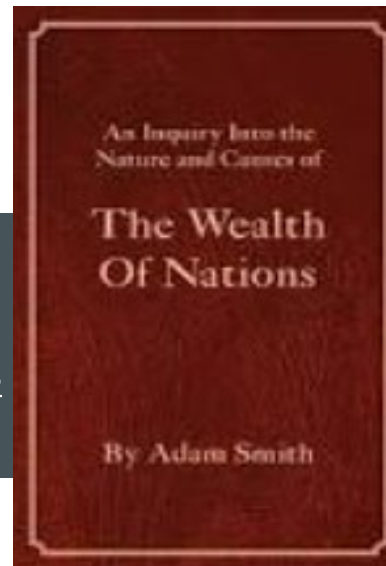
THE HEALTH

THIS DOCUMENT (Part I) IS AVAILABLE FROM THE MIT LIBRARY ■ <https://dspace.mit.edu/handle/1721.1/145774>

OF NATIONS

Part I

<https://dspace.mit.edu/handle/1721.1/145774>



Part II

<https://dspace.mit.edu/handle/1721.1/152921>

The Health of Nations

Shoumen Palit Austin Datta

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ABSTRACT

The requirement for food, agnostic of the economic climate and constraints of individuals, makes plant-based nutrition an overwhelming platform for delivery of preventive and prescriptive therapeutics. The delivery of medicinal value through food and nutrition, for example, prevention of xerophthalmia (blindness) in children using tools of plant biotechnology, is documented through robust scientific research. There is little doubt that the reach of therapeutics can also include vaccines, for the rest of the world which cannot afford the fruits of brilliant but expensive outcomes, for example, mRNA vaccines. This talk lifts the veil over seminal research performed at least a quarter century ago (in the 20th century) which demonstrated the immense potential for global immunization from infectious diseases (for example, Ebola virus) using plant based oral vaccines in food (as well as sublingual and transdermal modes of delivery). Changes in leadership, creative implementation strategies and innovative capacity building are necessary to bring basic health related low-cost solutions to ~7 billion people (~80% of the global population) who are not a part of the affluent world (~1 billion). This talk will also highlight the urgent need for even a modicum of healthcare equity for the down-trodden, forgotten and misbegotten. There is nothing new in this talk but a gentle reminder for the entrepreneurs of social innovation to re-evaluate grand and profound old results, in the context of the post-pandemic world. Is “food” the final frontier in research in plant molecular biology and plant biotechnology research and development?

The ideas in this presentation are not due to the author but based on extrapolations from published research which was not conducted by the author in any capacity, at all. Opinions in this talk may not represent the views of the institutions with which the author is affiliated at present, was affiliated in the past or may be affiliated in the future.

This material was presented on 10-10-2022 to the Global Health Science Sub-Committee members of the EU Political Action Committee (EUPAC) at a private meeting in Gif-sur-Yvette, France (organized by the "Science Valley" institutions). The author was invited to speak by a NGO and was the only speaker without a political affiliation.



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REMEDY & RESPONSE: FROM PARADOX TO PARADIGMS ?

<https://dspace.mit.edu/handle/1721.1/145774>

SHOUMEN PALIT AUSTIN DATTA

<https://ilp.mit.edu/node/23302>

Breaking Through isn't just the story of an extraordinary woman. It's an indictment of closed-minded thinking and a testament to one woman's commitment to laboring intensely in anonymity—knowing she might never be recognized in a culture that is driven by prestige, power, and privilege—because she believed that her work would save lives.



<https://www.nobelprize.org/prizes/medicine/2023/summary/>

The Nobel Prize in Physiology Medicine 2023



Ill. Niklas Elmehed © Nobel Prize Outreach
Katalin Karikó
Prize share: 1/2



Ill. Niklas Elmehed © Nobel Prize Outreach
Drew Weissman
Prize share: 1/2

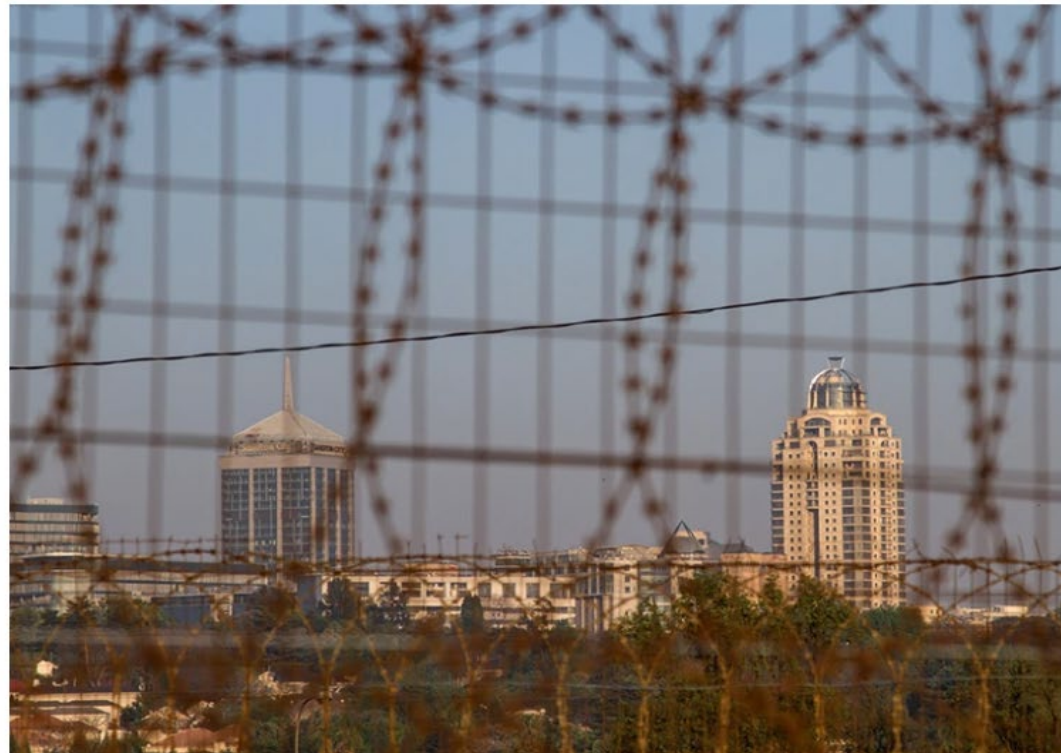
@kkariko @zfrancia

EDITORIAL | 11 July 2023

The best medicine for improving global health? Reduce inequality

The COVID pandemic knocked back progress towards improving public health. Without addressing the underlying social and economic causes of ill health, it could completely stall.

<https://www.nature.com/articles/d41586-023-02251-y.pdf>



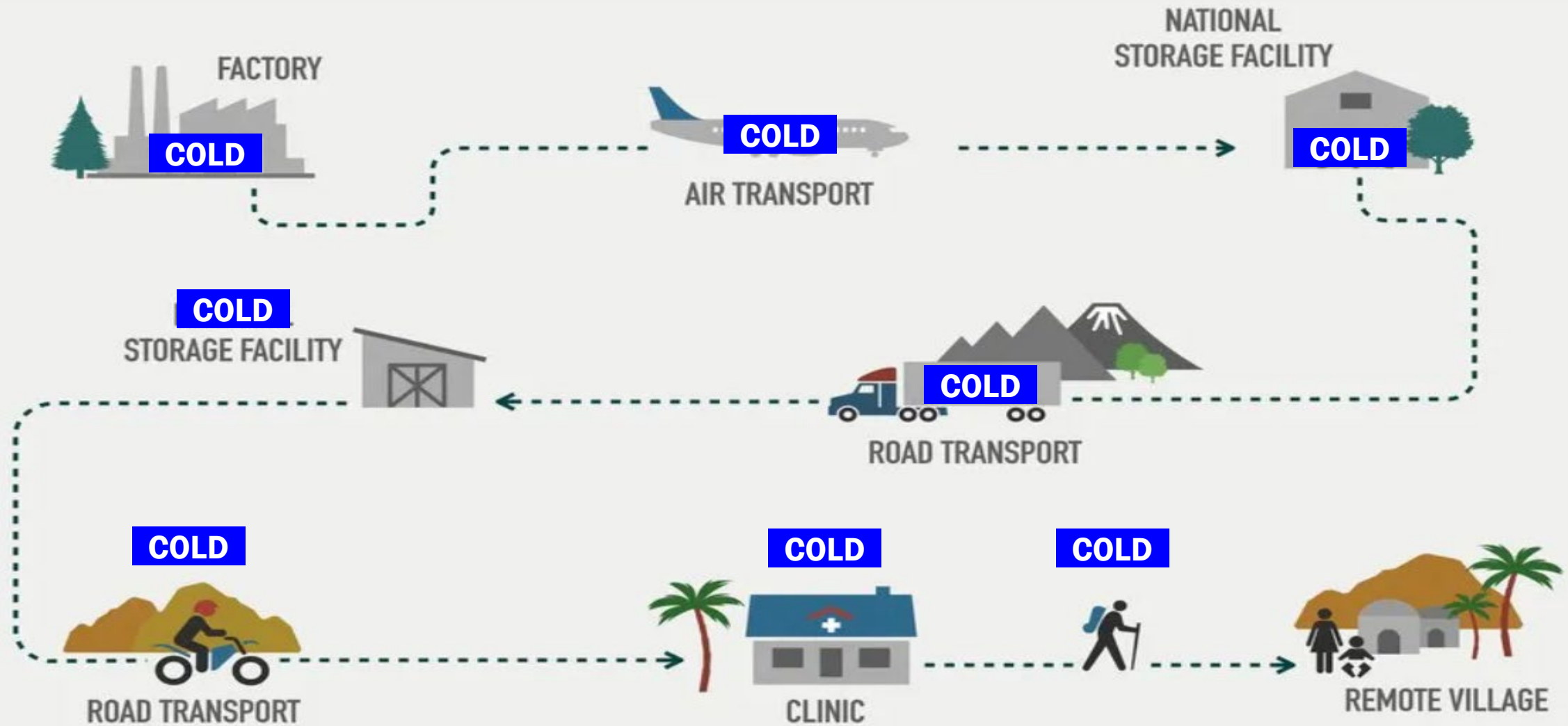
A barbed wire separates Alexandra, a suburb of Johannesburg, South Africa, from its wealthy neighbour, Sandton. Credit: Dean Hutton/Bloomberg/Getty



**THE ENEMY OF
HEALTHCARE ?**

The Greatest Enemy of Preventive Healthcare

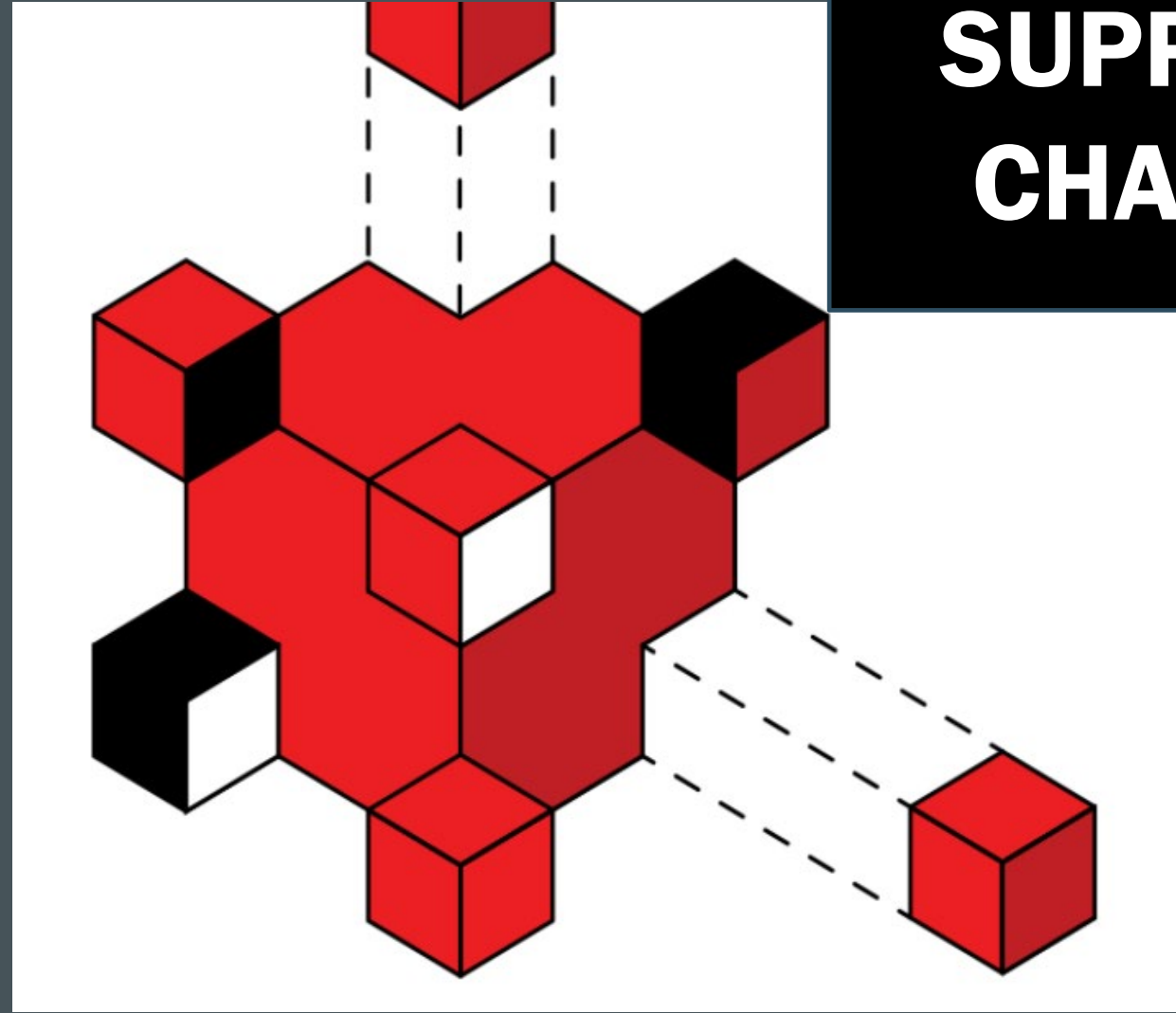
COLD CHAIN - SUPPLY CHAIN MANAGEMENT



THIS PROPOSAL

FOR PREVENTIVE
HEALTHCARE AND
VACCINATION WILL
SHOW HOW TO
DEMOLISH THE
COLD CHAIN OF
SUPPLY CHAIN
MANAGEMENT

**ELIMINATE
THE COLD
SUPPLY
CHAIN**



Plant-based Oral Vaccines for Global Health: *Is it the light at the end of the tunnel?*

Unless prevented by vaccination, global economic loss from future pandemics may exceed \$250 trillion. The jaw-dropping estimate is based on economic disaster data due to CoVID-19¹ and the long list of microbes/viruses with pandemic potential² which may erupt. Human mortality³ due to CoVID-19 may be triple or quadruple the number of reported deaths (~15 million lives⁴). Governments invested ~\$50 billion⁵ to produce vaccines against SARS-CoV-2 (~13 billion doses, mostly for affluent⁶ nations). For >80% of the global population, vaccines will be out of reach at \$130 per dose⁷ due to malicious corporate⁸ greed. To prevent healthcare mediated global economic meltdown due to natural causes (microbes), the concept of vaccines must be extended biologically and geographically to include less affluent nations (*The Health of Nations*⁹) home to ~7 billion people (of ~8 billion global population). Preventive vaccination is key to reducing infectious disease transmission.

OBJECTIVE

EXECUTIVE SUMMARY

We propose an alternative vaccine form for preventive healthcare, based on credible scientific results (published evidence presented in **The Health of Nations**). The central thesis of this proposal begins with the confirmation¹⁰ that Hepatitis B virus surface antigen (HBsAg) mRNA and protein were detected in plant (transgenic tobacco leaf). HBsAg from tobacco leaves elicited HBsAg-specific antibodies in mice¹¹ as proof of immunogenicity. **Human study**¹² with transgenic lettuce plant, expressing hepatitis B virus surface antigen, developed specific serum-IgG response to plant produced HBsAg. **Human study**¹³ with potato-expressed E. coli labile toxin B subunit (LT-B) resulted in toxin neutralizing serum IgG antibodies (10/11) as late as day 59 (ingestion of raw potato expressing LT-B on day 0, 7, 21). **Human study**¹⁴ with potato-expressed capsid protein of Norwalk virus (enteric pathogen) reported 95% of subjects (19/20) showing increases in antibody-secreting cells (IgA).

Taken together, transgenic plants expressing recombinant vaccine immunogens offer an attractive and potentially inexpensive alternative to industrial vaccine production, purification, packaging, storage, distribution and the “last mile” administration by injection (requires trained medical personnel). Plants and edible produce can be grown locally, anywhere. Sublingual¹⁵ consumption of leaf paste or raw produce may be less palatable but does not require any specialized training. Eliminating downstream supply chain of vaccines and “last mile” delivery problems will facilitate access and availability of healthcare products (plants) for self-vaccination, worldwide. Developing immunity is the first step in prevention of infection.

EXECUTIVE SUMMARY - THE HEALTH OF NATIONS

1-Page Extended Summary “POV” may be downloaded from the MIT Library <https://dspace.mit.edu/handle/1721.1/145774>



Are you too busy designing the next gen mRNA vaccine, small molecules or nanobodies for the next pandemic?

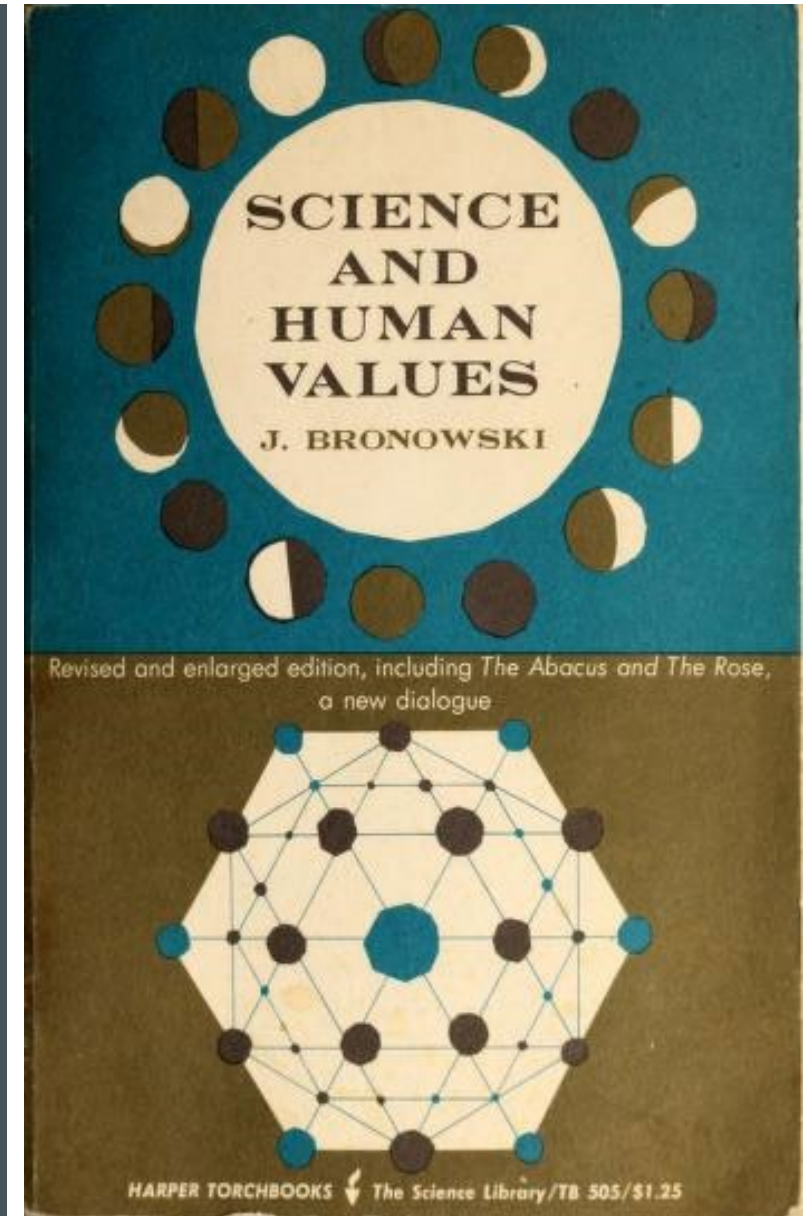
Then you won't have the time to peruse this power-point doc.

Too bad, you wouldn't know what's here, proven and can be delivered, now, to prevent the 22nd century pandemic(s).

OK then ...

IN PRAISE OF IMPERFECTION

- It took almost ~50 years, but the grand convergence of basic science research made it possible to produce and implement the mRNA vaccine for CoVID-19 in order to immunize humans against SARS-CoV-2[n]. It is a brilliant beacon of research excellence and translating science to be of service to society, when it was most needed, during the pandemic of the 21st century, which went viral.



Those who do not learn from history are doomed to repeat it.

ESTHER MAKKAZI SCIENCE OCT 18, 2022 7:00 AM

Ebola Is Back—and Vaccines Don't Work Against It

Public health officials are racing to contain an outbreak in Uganda. It's an urgent warning to the rest of the world.

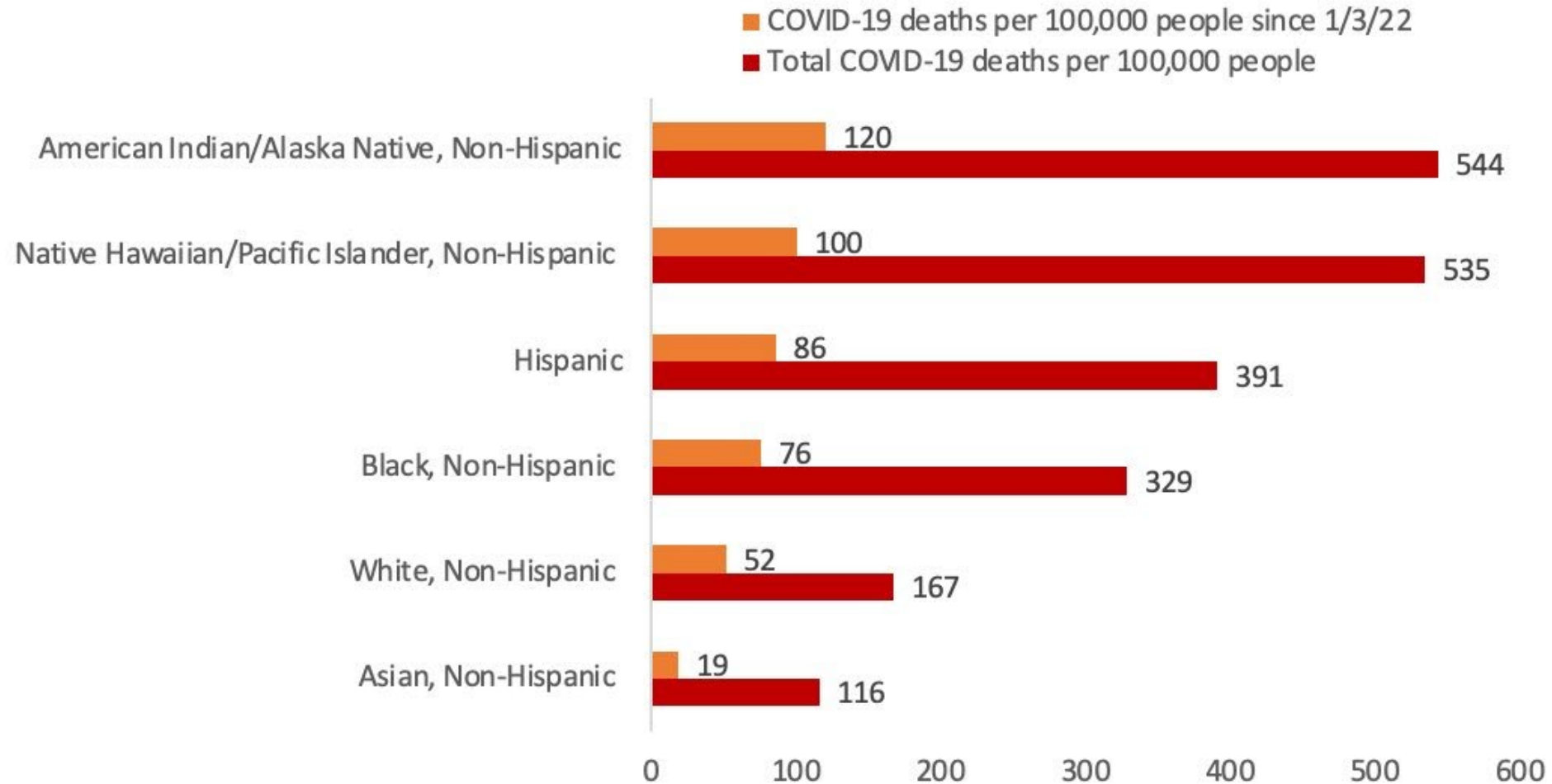


September 15, 2022. A 24-year-old man, suffering from high fever and convulsions, was admitted to Mubende Regional Referral Hospital, Uganda. He was bleeding from his eyes, blood-stained vomit and diarrhea. The man died on September 19, 2022. The next day, tests confirmed the infection by Ebola. By October 16, 2022, the Ministry of Health had reported 60 confirmed cases of Ebola (11 new cases in the previous 2 weeks). In total, 24 deaths have been confirmed, including 4 among health workers, along with 24 recoveries.

www.wired.com/story/uganda-ebola-outbreak-vaccine

Those who cannot remember the past are condemned to repeat it. [George Santayana]

COVID-19 deaths per 100,000 population aged 50 to 64, by race and ethnicity, total and since 1/3/2022



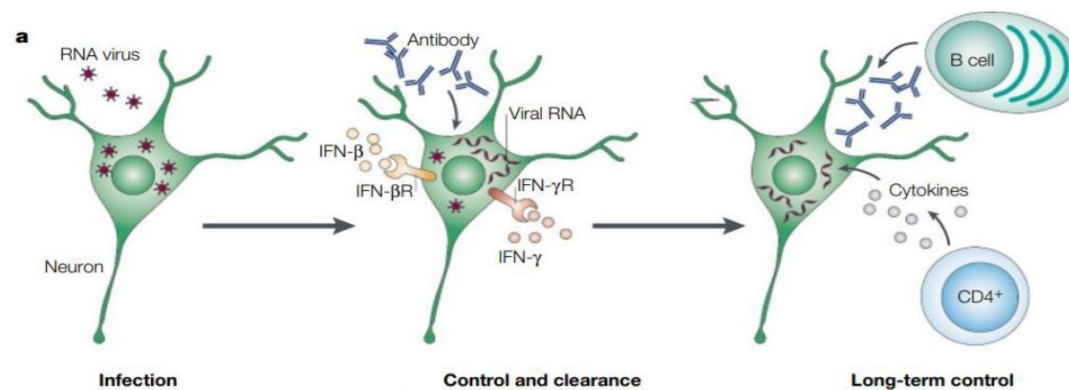
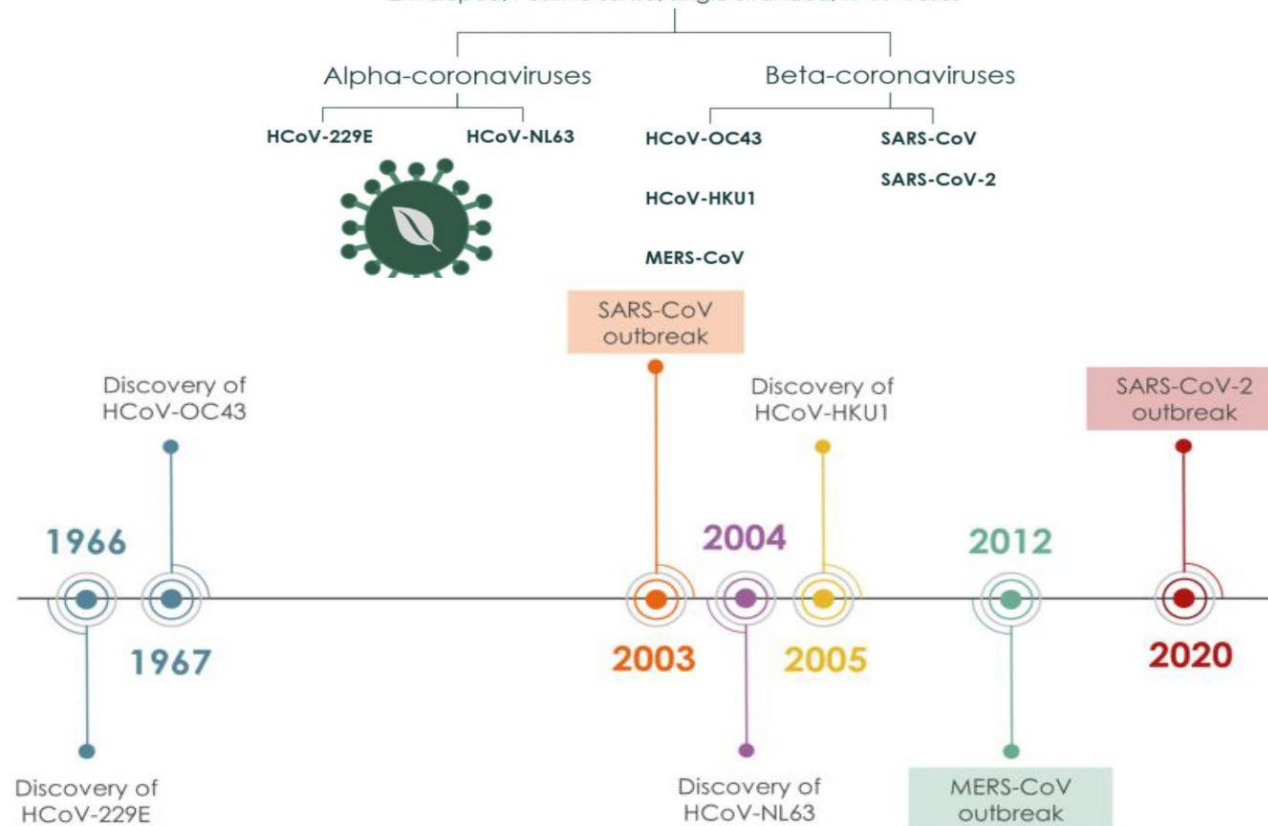
It is so crucial to grasp why chronic long-term morbidity is far worse for society than mortality (death).

21st century viral outbreaks were caused by pathogenic coronaviruses: SARS-CoV-1 (2003), MERS-CoV (2012) and SARS-CoV-2 (2019). Over 3,000 strains of coronavirus have been discovered, but only 7 have crossed the species barrier and spilled over to humans from a zoonotic source. In addition to 3 pathogenic strains, four (OC43, NL63, 229E, HKU1) are endemic in human populations (cause mild respiratory symptoms, contributing to 15-30% of cases of common cold). But, all 7 strains of human coronaviruses are capable of infecting the human brain, presenting an immense risk of chronic long-term morbidity (brain is constantly infected and colonized with numerous microorganisms, some of which can induce substantial pathogenesis). This complex interaction was neglected in the past and one critical reason why vaccination/immunization is crucial against viral/bacterial infections (not only for those with pandemic potential). The transsynaptic spread of SARS-CoV-2 and other human coronaviruses throughout the olfactory path would explain the fast presentation of symptoms such as anosmia (loss of sense of smell). Multiple molecular mechanisms are likely to be involved for brain infection and induced behavioral alterations by microorganisms (e.g., SARS-CoV-2). It will take decades to understand the extent of damage due to neuroinvasive potential of microbes. Long-term outcomes may be grave and grim. Hence, preventive measures (vaccination, immunization) are quintessential to reduce risk of morbidity rather than relying on future discoveries for better treatment (e.g. patients with acute and chronic COVID-19 sequelae).

Human coronaviruses

7 strains known

Enveloped, Positive-sense, single-stranded, RNA viruses



Zika, dengue transmission expected to rise with climate change

by Luís Patriani on 9 August 2023 | Translated by Maya Johnson

<https://news.mongabay.com/2023/08/zika-dengue-transmission-expected-to-rise-with-climate-change/>

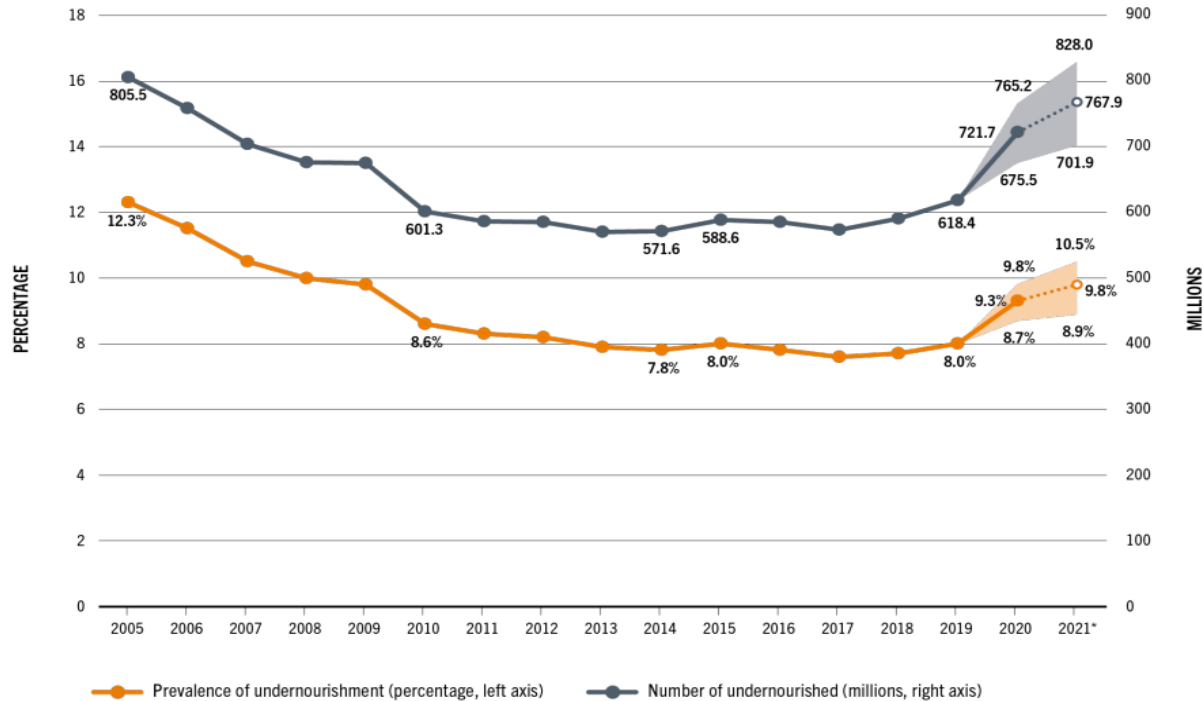


- *A new study foresees a 20% increase in cases of viruses like dengue, Zika and chikungunya over the next 30 years due to climate change.*
- *Higher temperatures are already causing the diseases carried by the *Aedes aegypti* mosquito to spread in cooler regions like southern Brazil and southern Europe.*
- *Deforestation also favors the spread of these illnesses because biodiversity-rich forests with more predators tend to inhibit mosquito populations.*

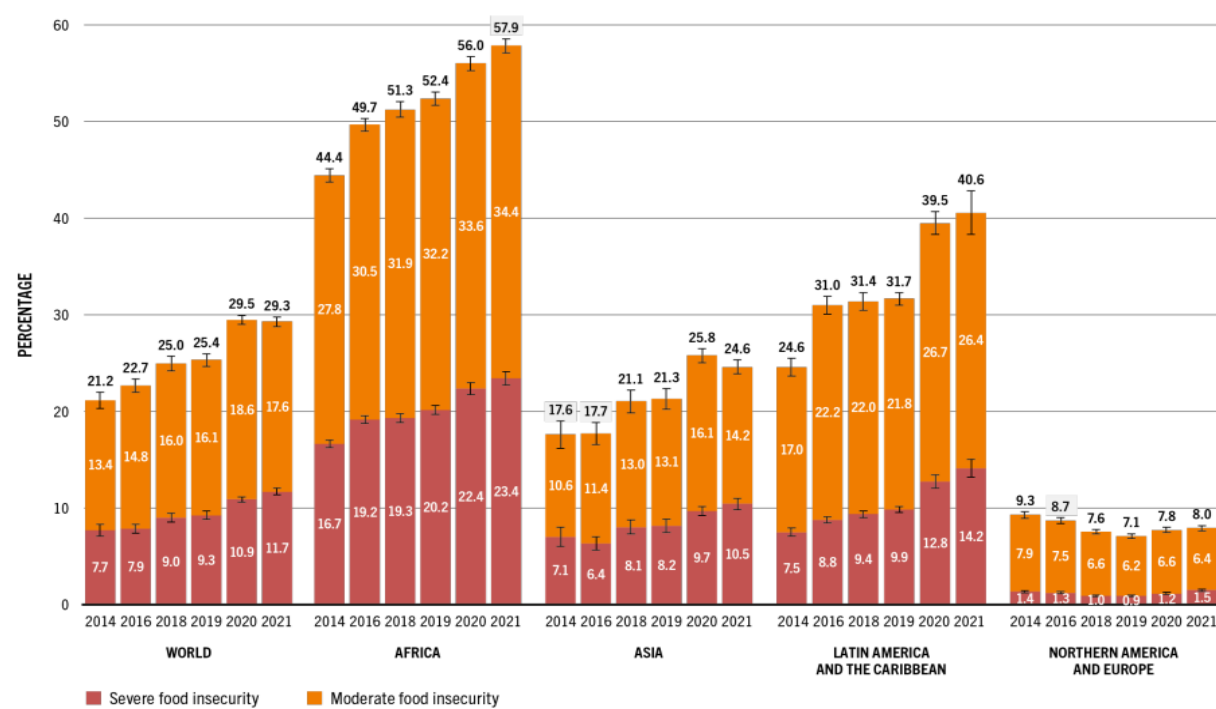
Van Wyk H, Eisenberg JNS, Brouwer AF. Long-term projections of the impacts of warming temperatures on Zika and dengue risk in four Brazilian cities using a temperature-dependent basic reproduction number. PLoS Negl Trop Diseases. 2023 April 27; 17(4):e0010839. doi: 10.1371/journal.pntd.0010839
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10138270/pdf/pntd.0010839.pdf>

The number of deaths in Brazil due to dengue hit a record high in 2022, with 1,016 — the first time in history the number had surpassed four digits.

~1 Billion people in the world: Facing Hunger, 2021



~2 Billion people in the world: Food Insecurity, 2021



FAO, IFAD, UNICEF, WFP and WHO. 2022. *The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable.* Rome, FAO.

<https://doi.org/10.4060/cc0639en>

<https://www.fao.org/3/cc0879en/cc0879en.pdf>

<https://www.fao.org/3/cc0639en/cc0639en.pdf>

THE HEALTH OF NATIONS

An Inquiry into the
Nature and Causes of
The Wealth
Of Nations
By Adam Smith

The requirement for food, agnostic of the economic climate of individuals, makes nutrition an overwhelming platform of choice for delivery of preventive and prescriptive therapeutics. Willful ignorance peddled by a few disenfranchised groups continue their march of unreason by sowing socio-economic morbidity. It has plagued the delivery of medicinal value through food and nutrition, for example, prevention of xerophthalmia in children. The unbounded global transmissibility of prions, viruses and bacteria has exposed the chasm between the affluent nations and resource constrained communities in terms of access to healthcare and public health practices. There is little doubt that the reach of therapeutics (vaccines) are stringently controlled by corporate greed and gluttony, under the protection of legal frameworks. The latter makes a mockery of health as a human right and perpetrates the myth of irremediable injustices. Are they irremediable? Radical changes in research leadership and strategy are necessary to bring health related remedies and solutions to >80% of the global population (~8 billion) who are not a part of the affluent world (~1 billion). Is “food” the final frontier in scientific research in our plight to usher even a modicum of healthcare equity for the down-trodden, forgotten and misbegotten? This talk will not present any new ideas but revisit grand and profound old results, with renewed analyses through my old eyes.

IN PREPARATION

Can we trigger immune response in humans to foreign antigens by sublingual administration of raw leaf “paste” from plants expressing foreign proteins?

ABSTRACT

FDA approval of a form of glucocerebrosidase purified from and produced in plants (carrot cells) unleashed the potential for plant-derived therapeutic molecules to accelerate access to healthcare for resource constrained communities. The pandemic has increased the demand for delivery of antigens to vulnerable populations in remote corners of the world who cannot afford vaccines marketed by US corporations. Global public health challenge from viruses with pandemic potential (e.g., Ebola) requires the convergence of virologists, molecular biologists and plant geneticists to construct vectors expressing viral antigens detectable in leaves and stems of fast-growing transgenic plants (e.g., *Arabidopsis thaliana*). The ubiquitous availability of these plants (each expressing one or more viral antigens or epitopes) and eliminating the need for purification of the viral protein product from the plant, are key catalysts. A low-cost crude leaf “paste” made by using a mortar and pestle, may be used directly under the tongue to allow the viral antigens to enter the bloodstream through the bed of capillaries under the mucosal membranes (sublingual). This review discusses this hypothetical proposal and analyzes why the optimism may not be irrational.

HYPOTHESIS

SELF-VACCINATION USING SUBLINGUAL RAW LEAF PASTE

Raw leaf “paste” from transgenic plants, harboring recombinant foreign antigens (for example, Ebola Virus “Spike” protein – EBOV), can deliver foreign antigen(s) to the bloodstream of humans through sublingual administration. The presence of foreign antigen in the human bloodstream will trigger a healthy immune system to mount humoral (antibodies) and cellular (T-Lymphocytes) response. Thus, plants (raw leaf paste) can be a very low-cost vehicle for self-vaccination which can immunize billions of people in less affluent nations (>80% of the global population). This hypothesis is only about **DELIVERY** of the *optimized antigen* through a low-cost and ubiquitous vehicle (plant, food).

BASIC SCIENCE

Vaccines are a generic term. Delivery of one or more foreign antigen(s) is a more appropriate term. CoVID-19 vaccine was not a conventional attenuated virus vaccine. CoVID-19 vaccine delivered a “blueprint” (mRNA) for a target antigen (Spike protein of SARS-CoV-2). If a healthy human can receive (vaccinated, immunized) the foreign antigen prior to exposure to infectious particles (prions, virus, bacteria, fungi, parasites) then a healthy immune system can naturally defend the body by mounting immune responses (antibodies, T-lymphocytes). Delivering the foreign antigen is key.

Streatfield SJ, Karczewski J, Yusibov V. Introduction. Vaccine. 2017 October 4;35(41):5435-5436. doi: 10.1016/j.vaccine.2017.08.032. Epub on 2017 August 18. PMID: 28826749; PMCID: PMC7130944. www.ncbi.nlm.nih.gov/pmc/articles/PMC7130944/pdf/main.pdf

HELPS TO UNDERSTAND THE NATURE & TYPES OF VACCINES

Vaccine Types <https://www.hhs.gov/immunization/basics/types/index.html>

https://www.pfizer.com/news/articles/understanding_six_types_of_vaccine_technologies

Humoral Immunity (Antibodies) <https://www.ncbi.nlm.nih.gov/books/NBK10752/>

Cellular Immunity (T-Lymphocytes) <https://www.ncbi.nlm.nih.gov/books/NBK10762/>

THE PROPOSAL

WHY THIS SUGGESTION? WHO MAY BENEFIT? HOW?

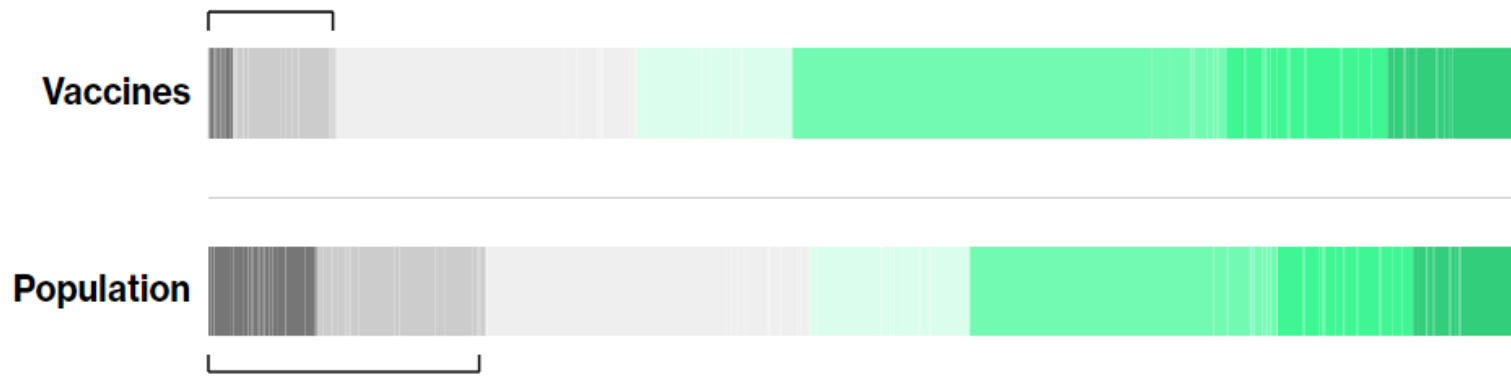
THIS IS NOT A NEW OR NOVEL SUGGESTION. THIS TALK IS MERELY HIGHLIGHTING RESEARCH RESULTS SPANNING 30 YEARS.

In the first two years after a pandemic was declared, a dozen new vaccines were developed and more than 10 billion doses were administered. The rollout was unprecedented in its speed and scope, but distribution has been lopsided. Countries with the highest incomes have been vaccinated 10 times faster than those with the lowest.

Delivering billions of additional doses to some of the world's least-equipped nations remains one of the biggest challenges for global health.

Uneven Access to Vaccines

Least wealthy       Most wealthy

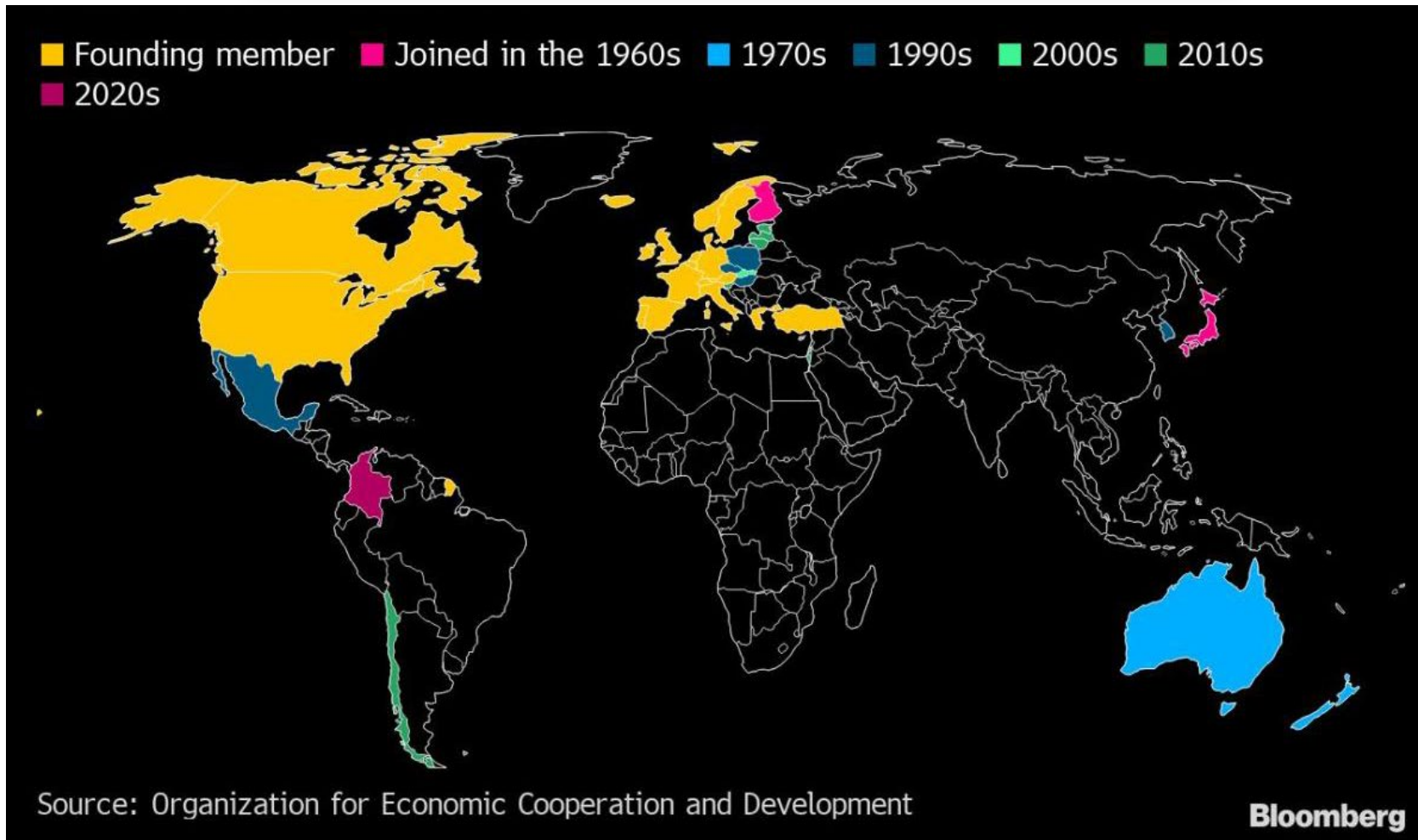


raison d'être

Note: Countries and regions are ordered by GDP per capita (PPP).

<https://www.bloomberg.com/graphics/covid-vaccine-tracker-global-distribution/>

THE WEALTH OF NATIONS



This suggestion may not benefit the founding members of the “Club”

CHANGE

WHY IS THIS IMPORTANT ? WHO MAY BENEFIT? **HOW?**

IMAGINE, INVENT, INNOVATE TO CHANGE THESE THREE PROCESSES

- ANTIGEN-VACCINE MANUFACTURING
- MATERIAL STORAGE, DISTRIBUTION, LOGISTICS
- ACT OF VACCINATION (IMPLEMENTATION OF IMMUNIZATION)

IS DEMOCRATIZATION OF THE PROCESS THE ANSWER ?

ANTIGEN-VACCINE MANUFACTURING CORPORATIONS

SINGLE MOST IMPORTANT RATE LIMITING FACTOR (BOTTLE NECK). PROCESS OWNED BY CORPORATIONS CONTROLLING ACCESS.

Company	Location	Plant	Bioproduct
Kentucky BioProcessing LLC (KBP)	Owensboro, KY, USA	Tobacco, potato	Norovirus VP1 Ebola virus antibody (ZMapp)
Sigma-Aldrich Fine Chemicals	St. Louis, MO, USA	Maize	Trypsin
Medicago Inc.	Quebec, Canada	<i>Nicotiana benthamiana</i>	Influenza HA-VLP
Protalix	Carmiel, Israel	Carrot cells, tobacco cells	Alphataliglycerase
Caliber Biotherapeutics LLC	Byran, TX, USA	Tobacco	Influenza HA
Fraunhofer CMB USA	Newark, DE, USA	<i>Nicotiana benthamiana</i>	Influenza HA
Fraunhofer IME	Aachen, Germany	Tobacco	Antibody (for HIV)
National Institute of Advanced Industrial Science and Technology	Hokkaido, Japan	Strawberry	Canine interferon alpha
Institute of Medical Science, The University of Tokyo	Tokyo, Japan	Rice	Cholera toxin B subunit

May 1, 2012 - US Food & Drug Administration (FDA) approves first plant cell-expressed ELELYSO™ (taliglucerase alfa*), an enzyme replacement therapy for adults with type 1 Gaucher disease. ELELYSO is derived from Protalix's proprietary manufacturing system, using genetically engineered carrot cells as bio-reactors to produce a form of human lysosomal enzyme, glucocerebrosidase.

www.nature.com/articles/nbt0612-472

www.drugs.com/history/elelyso.html

10+ years ago

* Shaaltiel Y, Bartfeld D, Hashmueli S, Baum G, Brill-Almon E, Galili G, Dym O, Boldin-Adamsky SA, Silman I, Sussman JL, Futerman AH, Aviezer D. (2007) Production of glucocerebrosidase with terminal mannose glycans for enzyme replacement therapy of Gaucher's disease using a plant cell system. *Plant Biotechnol J*. 2007 September; 5(5):579-590. doi: 10.1111/j.1467-7652.2007.00263.x. Epub 2007 May 24. PMID: 17524049.

<https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1467-7652.2007.00263.x>

Daniell H, Singh ND, Mason H, Streatfield SJ. (2009) Plant-made vaccine antigens and biopharmaceuticals. *Trends Plant Sci*. 2009 December; 14(12):669-679. doi: 10.1016/j.tplants.2009.09.009. Epub 2009 October 14. PMID: 19836291; PMCID: PMC2787751.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2787751/pdf/main.pdf>

Kwon KC, Verma D, Singh ND, Herzog R, Daniell H. (2013) Oral delivery of human biopharmaceuticals, autoantigens and vaccine antigens bioencapsulated in plant cells. *Adv Drug Deliv Rev*. 2013 June 15; 65(6):782-799. doi: 10.1016/j.addr.2012.10.005. Epub 2012 October 23.

PMID: 23099275; PMCID: PMC3582797. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3582797/pdf/nihms417004.pdf>

Shaaltiel Y, Gingis-Velitski S, Tzaban S, Fiks N, Tekoah Y, Aviezer D. (2015) Plant-based oral delivery of β -glucocerebrosidase as an enzyme replacement therapy for Gaucher's disease. *Plant Biotechnol J*. 2015 October; 13(8):1033-40. doi: 10.1111/pbi.12366. Epub 2015 April 1.

PMID: 25828481. <https://onlinelibrary.wiley.com/doi/epdf/10.1111/pbi.12366>

PLANTS, NATURALLY

NATURAL BIO-MIMETIC MANUFACTURING PROCESS

PLANTS **CARROTS AS PROPRIETARY BIOREACTORS**

NOT NEW. CLINICAL TRIALS ARE IN PROGRESS WITH PLANT-BASED COVID-19 VACCINE. BUT THERE IS AN IMMENSE CONTROL FACTOR - PRODUCTION IS FOLLOWED BY PURIFICATION OF SARS-COV-2 VLP (VIRUS LIKE PARTICLES) FOR USE AS AN ANTIGEN.

REFERENCE [HTTPS://WWW.NATURE.COM/ARTICLES/S41591-021-01370-1](https://www.nature.com/articles/S41591-021-01370-1)

CLINICAL TRIAL [HTTPS://CLINICALTRIALS.GOV/CT2/SHOW/NCT03739112](https://clinicaltrials.gov/ct2/show/NCT03739112)

REVIEW [HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC8473425/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8473425/)

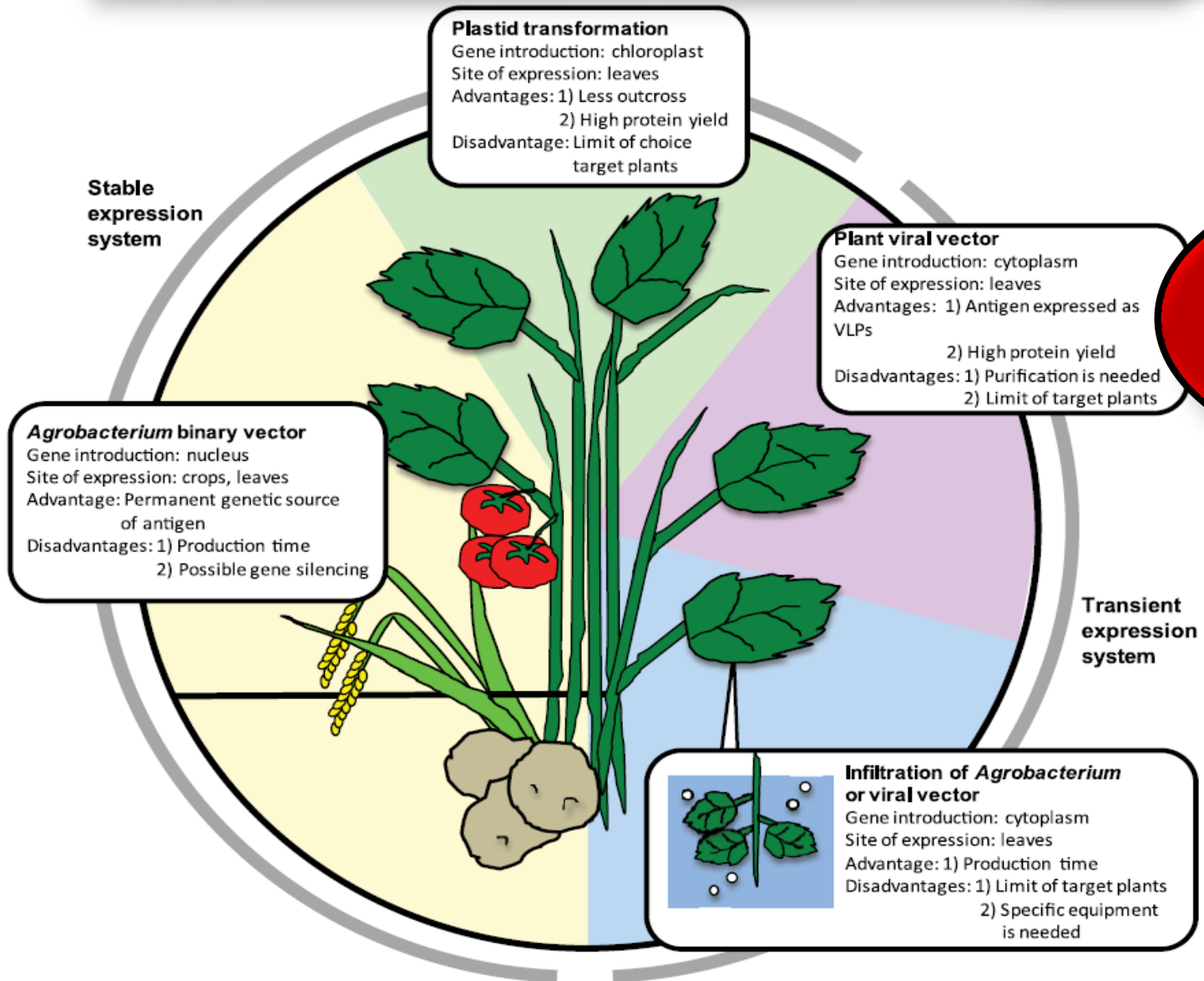
CORPORATE PURIFICATION OF PLANT BASED VLP ROBS THE BIO-MIMICRY OF THE MANUFACTURING PROCESS (PLANTS). AGAIN RE-INTRODUCES INSURMOUNTABLE BARRIERS (ACCESS), INCREASES COST (FOCUS ON SHAREHOLDER PREMIUM NOT HUMAN VALUE) AND CONTROL OF PRODUCT DEVELOPMENT RE-CREATES THE NIGHTMARE OF LOGISTICS BEFORE IT REACHES HUMANS.

SHOULD WE PRAISE IMPURITIES WITH IMPUNITY ?

THE RADICAL PART IN THIS HYPOTHETICAL SUGGESTION

CAN WE ELIMINATE THE
PURIFICATION STEP ???

IN PRAISE OF IMPERFECTION



DO NOT PURIFY

WE HAVE BEEN PRAISING IMPURITIES WITH IMPUNITY



<https://www.youtube.com/watch?v=ebTrfbaAOFE>

https://www.youtube.com/watch?v=aOpTFCVN_0k

https://www.youtube.com/watch?v=RdRNxXf_WXw

Indians still use neem stem as a tooth-brush cum tooth paste, for astringent tooth cleaning. It is an old practice in India (and Asia, Africa) since time immemorial. People pluck and use neem stems as traditional tooth-brushes for tooth cleaning. The fact that the “brush” is a natural plant product helps to bypass corporate greed.

IS PURIFICATION A “WESTERN” CONCEPT ?

THE RADICAL PART IN THIS SUGGESTION IS A COMMON PRACTICE

DO THESE WORDS HOLD THE KEY? RAW? SUBLINGUAL?

THIS SUGGESTION - PLEASE CONSIDER LEAF “PASTE”

ANTIGEN PRODUCED IN A PLANT (IN LEAF)

*SUBLINGUAL DELIVERY (RAW LEAF PASTE)

- * 2007 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2234198/pdf/zpq1644.pdf>
- * 2010 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2950356/pdf/0536-10.pdf>
- * 2011 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3206068/pdf/pone.0026973.pdf>
- * 2018 <https://doi.org/10.1016/j.vaccine.2018.07.073>

ARE WE PROPOSING TO DO WHAT HAS BEEN DONE BEFORE?

EDIBLE RAW PLANT PRODUCTS/EXTRACTS ARE QUITE COMMON IN LESS AFFLUENT NATIONS. 80% OF WORLD

AYURVEDIC MEDICINE RELIES ON PLANTS AND PLANT PRODUCTS WHICH ARE LOCAL, GROWS WITHOUT MUCH ATTENTION, AND USED BY BILLIONS OF PEOPLE FOR THOUSANDS OF YEARS IN INDIA. USE OF MEDICINAL PLANTS IS COMMON IN CHINA.



YES

CAN WE PRODUCE VIRAL ANTIGENS IN PLANTS?

YES.

PUBLISHED 30 YEARS AGO (1992).

ROGER THAT

CAN WE PRODUCE VIRAL ANTIGENS IN FOOD?

YES.

PUBLISHED 25+ YEARS AGO (1996).

AFFIRMATIVE

CAN VIRAL ANTIGENS IN FOOD INDUCE IMMUNITY ??

YES.

HIGH TITERS OF ANTIBODIES IN MICE.

PUBLISHED 25 YEARS AGO (SINCE 1996).

STILL WAITING FOR GODOT ?

WHAT ARE WE WAITING FOR ??

LEADERSHIP IN SCIENTIFIC RESEARCH ??

SCIENCE FOR THE SERVICE OF SOCIETY.

INFECT THE WORLD WITH MAGNANIMITY.

DRUM ROLL

HERE ARE THE EVIDENCE

■ SOMATOSTATIN IN BACTERIA

SCIENCE ● December 1977

198 (4321):1056-1063

doi: [10.1126/science.412251](https://doi.org/10.1126/science.412251).

■ INSULIN IN BACTERIA ● June 1978

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC392859/pdf/pnas00020-0197.pdf>

■ INSULIN IN BACTERIA ● October 1978

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC382885/pdf/pnas00001-0114.pdf>



Proc. Natl. Acad. Sci. USA
Vol. 75, No. 8, pp. 3727-3731, August 1978
Biochemistry

A bacterial clone synthesizing proinsulin

(rat preproinsulin/cDNA cloning/solid-phase radioimmunoassay/DNA sequence/fused proteins)

LYDIA VILLA-KOMAROFF*, ARGIRIS EFSTRATIADIS*, STEPHANIE BROOME*, PETER LOMEDICO*, RICHARD TIZARD*, STEPHEN P. NABER†, WILLIAM L. CHICK†, AND WALTER GILBERT*

* Biological Laboratories, Harvard University, Cambridge, Massachusetts 02138; and † Elliot P. Joslin Research Laboratory, Harvard Medical School, and the Peter Bent Brigham Hospital, Boston, Massachusetts 02215

Contributed by Walter Gilbert, June 9, 1978

Expression in *Escherichia coli* of a Chemically Synthesized Gene for the Hormone Somatostatin

Abstract. A gene for somatostatin, a mammalian peptide (14 amino acid residues) hormone, was synthesized by chemical methods. This gene was fused to the *Escherichia coli* β -galactosidase gene on the plasmid pBR322. Transformation of *E. coli* with the chimeric plasmid DNA led to the synthesis of a polypeptide including the sequence of amino acids corresponding to somatostatin. In vitro, active somatostatin was specifically cleaved from the large chimeric protein by treatment with cyanogen bromide. This represents the first synthesis of a functional polypeptide product from a gene of chemically synthesized origin.

Proc. Natl. Acad. Sci. USA
Vol. 76, No. 1, pp. 106-110, January 1979
Biochemistry

Expression in *Escherichia coli* of chemically synthesized genes for human insulin

(plasmid construction/lac operon/fused proteins/radioimmunoassay/peptide purification)

DAVID V. GOEDEL*†, DENNIS C. KLEID*, FRANCISCO BOLIVAR*, HERBERT L. HEYNEKER*, DANIEL G. YANSURA*, ROBERTO CREA*‡, TADAAKI HIROSE‡, ADAM KRASZEWSKI‡, KEIICHI ITAKURA‡, AND ARTHUR D. RIGGS†‡

*Division of Molecular Biology, Genentech, Inc., 460 Point San Bruno Boulevard, South San Francisco, California 94080; and †Division of Biology, City of Hope National Medical Center, Duarte, California 91010

Communicated by Ernest Beutler, October 3, 1978

>40 years ago

40 years ago at UCSF... a catalyst...
Bill Rutter's HepB antigen in yeast...

Synthesis and assembly of hepatitis B virus surface antigen particles in yeast

Pablo Valenzuela^{*†}, Angelica Medina^{*} & William J. Rutter^{*}

^{*} Department of Biochemistry and Biophysics, University of California, San Francisco, California 94143, and [†] Chiron Corporation, 4560 Horton, Emeryville, California 94608, USA

Gustav Ammerer & Benjamin D. Hall

Department of Genetics, SK-50, University of Washington, Seattle, Washington 98195, USA

The surface antigen of hepatitis B virus (HBsAg) has been synthesized in the yeast Saccharomyces cerevisiae by using an expression vector that employs the 5'-flanking region of yeast alcohol dehydrogenase I as a promoter to transcribe surface antigen coding sequences. The protein synthesized in yeast is assembled into particles having properties similar to the 22-nm particles secreted by human cells.

Valenzuela P, Medina A, Rutter WJ, Ammerer G, Hall BD. (1982)
Synthesis and assembly of hepatitis B virus surface antigen particles in yeast. Nature. 1982 July 22;298(5872):347-350.
doi: 10.1038/298347a0. PMID: 7045698.

Bill Rutter <https://oac.cdlib.org/view?docId=kt7q2nb2hm&query=&brand=oac4>

Nature. 1989 Nov 2;342(6245):76-8. doi: [10.1038/342076a0](https://doi.org/10.1038/342076a0).

Production of antibodies in transgenic plants

A Hiatt ¹, R Cafferkey, K Bowdish

Affiliations

Affiliation

¹ Department of Molecular Biology, Research Institute of Scripps Clinic, La Jolla, California 92037.

PMID: 2509938 DOI: [10.1038/342076a0](https://doi.org/10.1038/342076a0)

Production of antibodies in transgenic plants

Andrew Hiatt, Robert Cafferkey & Katherine Bowdish

Department of Molecular Biology, The Research Institute of Scripps Clinic,
10666 North Torrey Pines Road, La Jolla, California 92037, USA

WHERE IS THE EVIDENCE ?

[HTTPS://WWW.NATURE.COM/ARTICLES/342076A0.PDF](https://www.nature.com/articles/342076a0.pdf)

33 years ago

Publication Number

WO/1990/002484

Publication Date

22.03.1990

International Application No.

PCT/US1989/003799

International Filing Date

05.09.1989

Chapter 2 Demand Filed

21.03.1990

IPC

A61K 39/00 2006.1

C07K 14/245 2006.1

C07K 14/315 2006.1

C12N 9/10 2006.1

C12N 9/24 2006.1

C12N 15/82 2006.1

CPC

A01H 5/00

A61K 39/00

C07K 14/245

C07K 14/315

C07K 2319/00

C12N 15/8258

[View more classifications](#)**Applicants**

WASHINGTON UNIVERSITY [US]/[US]
1 Brookings Drive St. Louis, MO 63130, US

Inventors

CURTISS, Roy, III
CARDINEAU, Guy, A.

Title**[EN]** ORAL IMMUNIZATION BY TRANSGENIC PLANTS**[FR]** IMMUNISATION PAR VOIE ORALE A L'AIDE DE PLANTES TRANSGENIQUES**Abstract**

[EN] The invention is directed to transgenic plants expressing colonization and/or virulence antigens specified by genes from pathogenic microorganisms. It is also directed to the use of such transgenic plants for oral immunization of humans and other animals to elicit a secretory immune response which inhibits colonization of or invasion by such pathogenic microorganisms through a mucosal surface of humans or other animals.

[FR] L'invention concerne des plantes transgéniques exprimant des antigènes de colonisation et/ou de virulence spécifiés par des gènes provenant de microorganismes pathogènes. Elle concerne également l'utilisation de telles plantes transgéniques pour l'immunisation par voie orale de l'homme et de l'animal, afin de provoquer une réponse immunitaire sécrétoire inhibant la colonisation ou l'invasion par lesdits microorganismes pathogènes, à travers une surface muqueuse humaine ou animale.

Related patent documents

[EP0433372](#) [AU1989043172](#) [CA1339307](#) [JP1992501801](#) [AT218797](#) [ZA1989/06803](#) [KR1019900701152](#) [US5654184](#)
[US5679880](#) [US5686079](#) [JP2000166411](#)

<https://patentscope.wipo.int/search/en/detail.jsf?docId=WO1990002484>

↑ 33 years ago
3 years ago ↓

Ma F, Zhang E, Li Q, Xu Q, Ou J, Yin H, Li K, Wang L, Zhao X, Niu X, Li X, Zhang S, Wang Y, Deng R, Zhou E, Zhang G. (2020) *A Plant-Produced Recombinant Fusion Protein-Based Newcastle Disease Subunit Vaccine and Rapid Differential Diagnosis Platform*. *Vaccines* (Basel). 2020 March 9; 8(1):122. doi: 10.3390/vaccines8010122. www.ncbi.nlm.nih.gov/pmc/articles/PMC7157242/pdf/vaccines-08-00122.pdf

WHERE IS THE
EVIDENCE ?

Proc. Natl. Acad. Sci. USA
Vol. 89, pp. 11745–11749, December 1992
Immunology

Expression of hepatitis B surface antigen in transgenic plants

(oral vaccine/foreign genes/plants)

HUGH S. MASON*†, DOMINIC MAN-KIT LAM*‡, AND CHARLES J. ARNTZEN†§

*AgriStar Inc., 100 Hawthorn, Conroe, TX 77301; †Institute of Biosciences and Technology, Center for Plant Biotechnology, Texas A&M University, Houston, TX 77030-3303; and ‡LifeTech Industries, Ltd., 100 Hawthorn, Conroe, TX 77301

Contributed by Charles J. Arntzen, September 16, 1992

WHERE IS THE EVIDENCE ?

[HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC50633/PDF/PNAS01098-0106.PDF](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC50633/pdf/PNAS01098-0106.pdf)

30 years ago

Proc. Natl. Acad. Sci. USA
Vol. 92, pp. 3358–3361, April 1995
Immunology

Immunogenicity of transgenic plant-derived hepatitis B surface antigen

(plant-derived antigens/antibody production/T-cell proliferation)

Y. THANAVALA*, Y.-F. YANG*, P. LYONS†, H. S. MASON†, AND C. ARNTZEN†

*Department of Molecular Immunology, Roswell Park Cancer Institute, Elm and Carlton Streets, Buffalo, NY 14263; and †Alkek Institute of Biosciences and Technology, Texas A&M University, 2121 Holcombe Boulevard, Houston, TX 77030-3303

Contributed by C. Arntzen, January 6, 1995

WHERE IS THE EVIDENCE ?

[HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC42165/PDF/PNAS01492-0291.PDF](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC42165/pdf/PNAS01492-0291.pdf)

27 years ago

Production of hepatitis B surface antigen in transgenic plants for oral immunization

Liz J. Richter¹, Yasmin Thanavala², Charles J. Arntzen¹, and Hugh S. Mason^{1*}

¹Boyce Thompson Institute for Plant Research, Inc., Tower Rd., Ithaca, NY 14853-1801. ²Department of Immunology, Roswell Park Cancer Institute, Elm and Carlton Streets, Buffalo, NY 14263. *Corresponding author (HSM7@cornell.edu).

Received 24 January 2000; accepted 27 June 2000

WHERE IS THE EVIDENCE ?

HBSAG POTATO [HTTPS://WWW.NATURE.COM/ARTICLES/NBT1100_1167.PDF](https://www.nature.com/articles/NBT1100_1167.pdf)

22 years ago

Human Immune Responses to a Novel Norwalk Virus Vaccine Delivered in Transgenic Potatoes

Carol O. Tacket,¹ Hugh S. Mason,³
Genevieve Losonsky,¹ Mary K. Estes,²
Myron M. Levine,¹ and Charles J. Arntzen³

¹Center for Vaccine Development, University of Maryland School of Medicine, Baltimore; ²Baylor College of Medicine, Division of Molecular Virology, Houston, Texas; ³Boyce Thompson Institute for Plant Research, Ithaca, New York

A new approach for delivering vaccine antigens is the use of inexpensive, plentiful, plant-based oral vaccines. Norwalk virus capsid protein (NVCP), assembled into virus-like particles, was used as a test antigen, to determine whether immune responses could be generated in volunteers who ingested transgenic potatoes. Twenty-four healthy adult volunteers received 2 or 3 doses of transgenic potato ($n = 20$) or 3 doses of wild-type potato ($n = 4$). Each dose consisted of 150 g of raw, peeled, diced potato that contained 215–751 μg of NVCP. Nineteen (95%) of 20 volunteers who ingested transgenic potatoes developed significant increases in the numbers of specific IgA antibody-secreting cells. Four (20%) of 20 volunteers developed specific serum IgG, and 6 (30%) of 20 volunteers developed specific stool IgA. Overall, 19 of 20 volunteers developed an immune response of some kind, although the level of serum antibody increases was modest.

WHERE IS THE EVIDENCE ?

NORO VLP IN POTATO [HTTPS://ACADEMIC.OUP.COM/JID/ARTICLE/182/1/302/884350](https://academic.oup.com/jid/article/182/1/302/884350)

22 years ago

Oral Immunogenicity of Human Papillomavirus-Like Particles Expressed in Potato

Heribert Warzecha,^{1†} Hugh S. Mason,^{1‡} Christopher Lane,² Anders Tryggvesson,¹ Edward Rybicki,³
Anna-Lise Williamson,³ John D. Clements,⁴ and Robert C. Rose^{2*}

Boyce Thompson Institute for Plant Research, Ithaca, New York 14850¹; Department of Medicine, University of Rochester School of Medicine and Dentistry, Rochester, New York 14642²; Department of Medical Microbiology, University of Cape Town, Cape Town, South Africa³; and Department of Microbiology and Immunology, Tulane University Health Sciences Center, New Orleans, Louisiana 70118⁴

Received 10 January 2003/Accepted 13 May 2003

Human papillomavirus-like particles (HPV VLPs) have shown considerable promise as a parenteral vaccine for the prevention of cervical cancer and its precursor lesions. Parenteral vaccines are expensive to produce and deliver, however, and therefore are not optimal for use in resource-poor settings, where most cervical HPV disease occurs. Transgenic plants expressing recombinant vaccine immunogens offer an attractive and potentially inexpensive alternative to vaccination by injection. For example, edible plants can be grown locally and can be distributed easily without special training or equipment.

WHERE IS THE EVIDENCE ?

[HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC167207/PDF/0052.PDF](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC167207/pdf/0052.pdf)

~ 20 years ago

“water, water everywhere, nor any drop to drink”

Su H, Yakovlev IA, van Eerde A, Su J, Clarke JL. (2021) Plant-Produced Vaccines: Future Applications in Aquaculture. *Front Plant Sci.* 2021 August 12;12:718775. doi: 10.3389/fpls.2021.718775. PMID: 34456958; PMCID: PMC8397579.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8397579/pdf/fpls-12-718775.pdf>

EMBARRASSMENT OF RICHES (EVIDENCE)

POVERTY OF IMPLEMENTATION

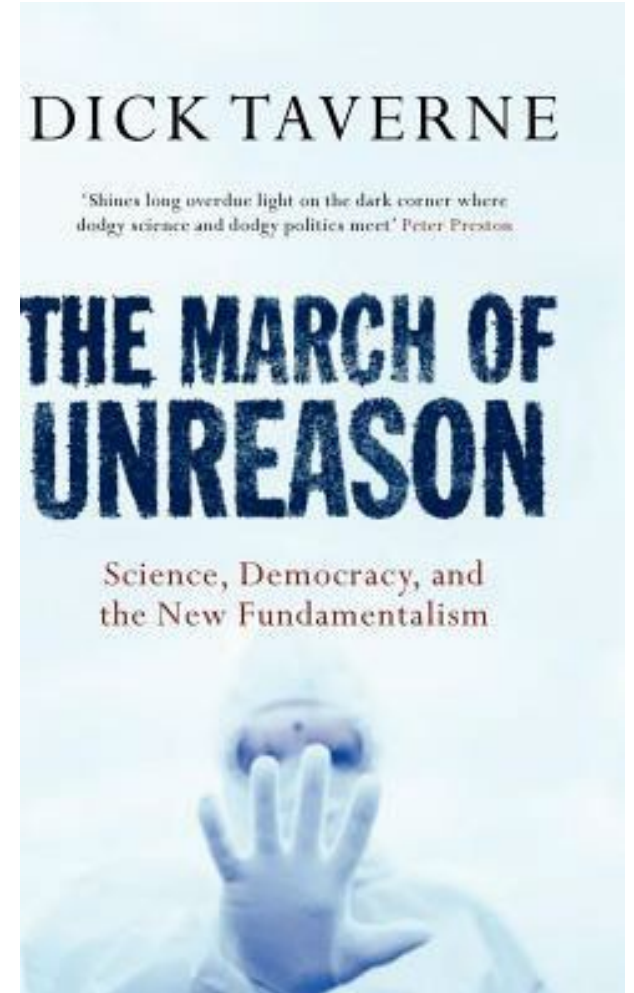
DON'T ASK "WHY?"... ASK "WHY NOT?" ■ THE TRIUMPH OF REASON

PURIFICATION

&

PHOBIA

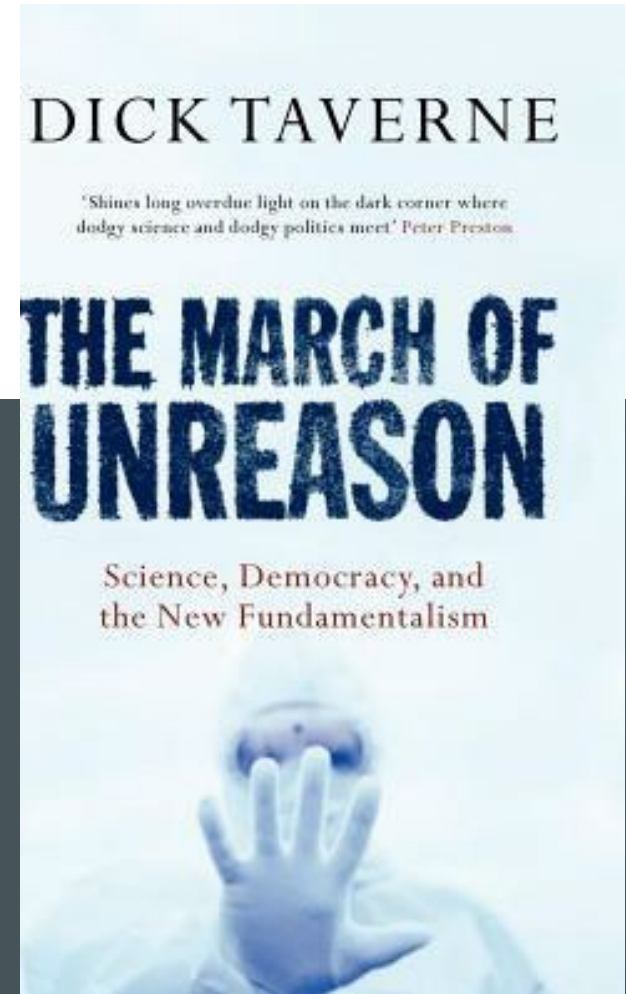
<https://ccc.bc.edu/content/ccc/blog-home/2011/07/blog-2011-07-don-t-ask-why---ask-why-not-.html>



<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC558032/pdf/bmj33001214.pdf>

IRRATIONAL EXUBERANCE OR EGREGIOUS ERRORS ?

**PHOBIA ABOUT TRANSGENIC
PLANTS IS KILLING PEOPLE,
STARVING NATIONS AND FUELS
ANARCHY BECAUSE OF WILLFUL
IGNORANCE OF A FEW, ABOUT
SCIENCE. PLANTS/FOOD CAN STOP
SPREAD OF INFECTIOUS DISEASE.**



Vitamin A deficiency (VAD) has killed millions of children in less-developed countries for at least the last three decades—roughly 2 million annually in the early 1990s alone (1–4). Although the number is

<https://www.pnas.org/doi/epdf/10.1073/pnas.2120901118>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8713968/pdf/pnas.202120901.pdf>

declining, it was estimated to be 266,200 (4) at the start of the millennium.

The consumption of the genetically modified rice variety known as Golden Rice (GR) offers a potent and



Wu F, Wessler J, Zilberman D, Russell RM, Chen C, Dubock AC. (2021) *Opinion: Allow Golden Rice to save lives*. Proc Natl Acad Sci USA. 2021 Dec 21; 118(51): e2120901118. doi: 10.1073/pnas.2120901118.

Widespread consumption of the genetically modified rice variety known as Golden Rice offers a potent and cost-effective strategy to combat vitamin A deficiency. Image credit: International Rice Research Institute; photo licensed under [CC BY 2.0](https://creativecommons.org/licenses/by/2.0/).

Vaccines are for dinner

David W. Pascual*

Department of Veterinary Molecular Biology, Montana State University, Bozeman, MT 59717-3610

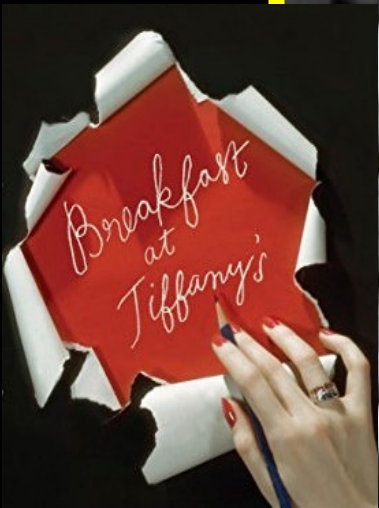
Transgenic plants have been sought not only as bioreactors but also as potential scaffolds for oral vaccines.

Table 1. Edible transgenic plant vaccines

Vaccine	Edible plant	Ref.
Norwalk virus particle	Potato	3
	Tomato	4
Heat-labile enterotoxin B subunit	Potato	5
	Maize	6
	Soybean	20
Cholera toxin B subunit	Rice	14
	Potato	21
Enterotoxigenic <i>Escherichia coli</i> fimbrial subunit	Soybean	11
Japanese cedar pollen peptide	Rice	19

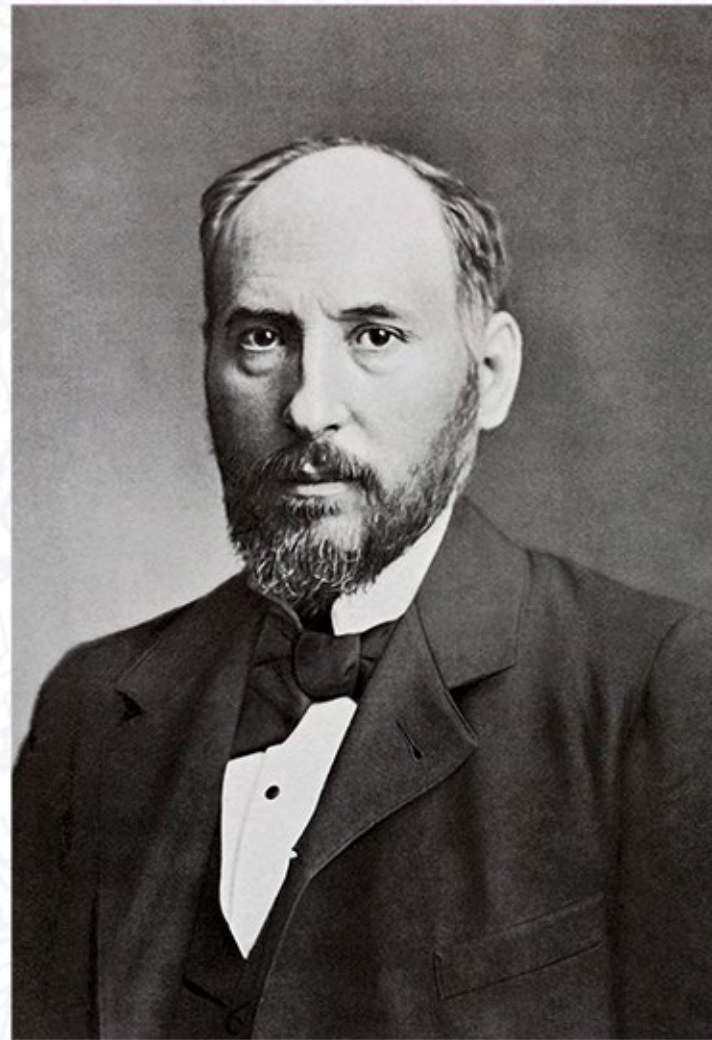


Breakfast at Vaxine's



SANTIAGO RAMÓN Y CAJAL (IN 1899)

“Every disease has two causes. The first is pathophysiological; the second, political.”



CLARK UNIVERSITY, 1899. RESTORATION BY GARRONDO.

Also known as the Father of Neuroscience, Cajal discovered that neurons function as individual, separate cells. Cajal shared the 1906 Nobel Prize for Medicine or Physiology with Camillo Golgi for their work on the nervous system.

Moss, William J. (2022) “The Seeds of Ignorance - Consequences of a Booming Betel-Nut Economy.” *New England Journal of Medicine*, September 2022, p. NEJMp2203571. <https://doi.org/10.1056/NEJMp2203571>. <https://www.nejm.org/doi/pdf/10.1056/NEJMp2203571?articleTools=true>

RE-SEARCH WHAT WAS ONCE RESEARCHED AND FOUND

RESEARCH SUGGESTION

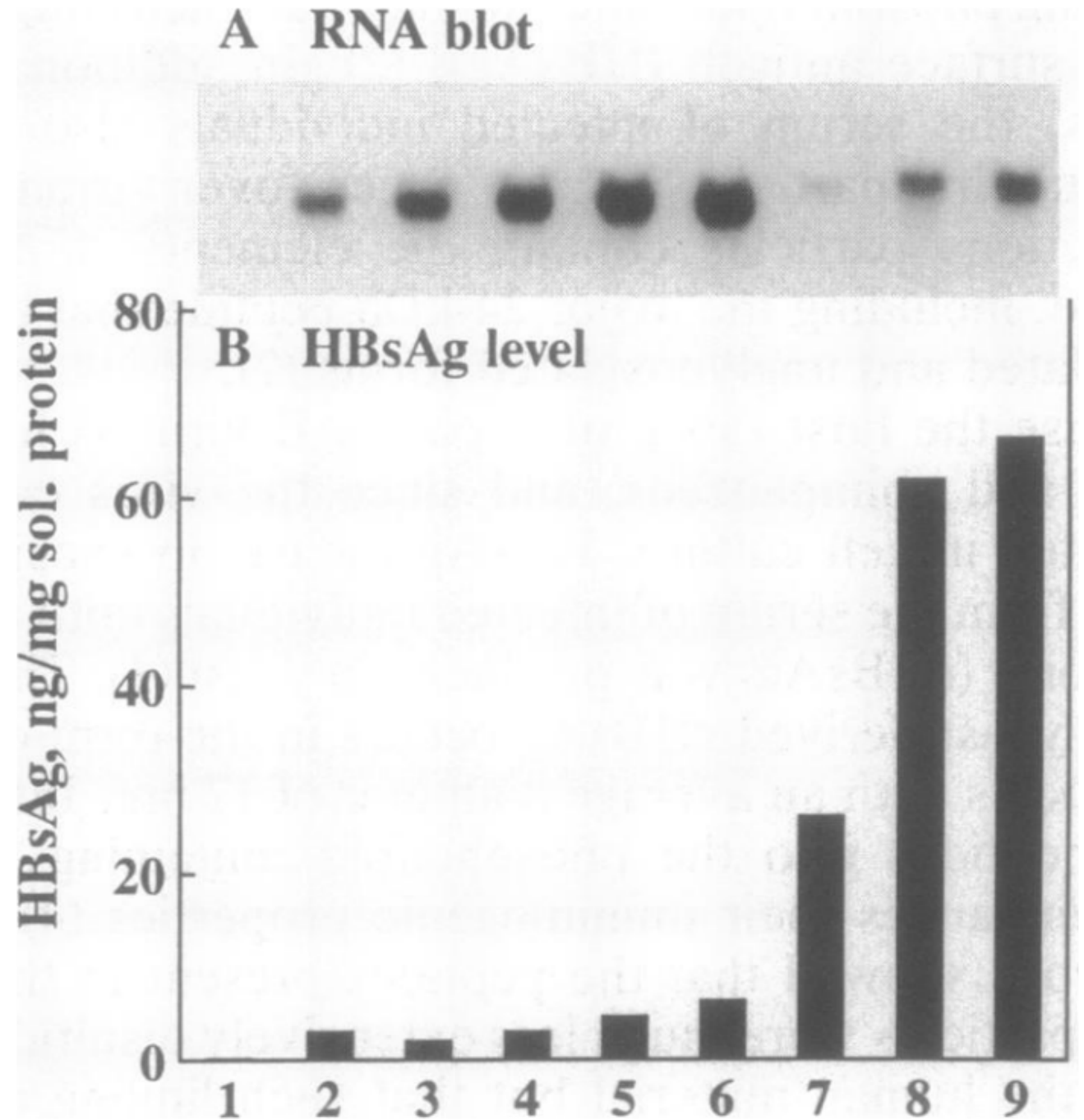
SIMPLIFY WHAT WE KNOW FROM CHARLES ARNTZEN

THE MEANING

UNDERSTAND THE SIGNIFICANCE - EXPERIMENTAL RESULT IN FIG 2

FROM CHARLES ARNTZEN, 1992

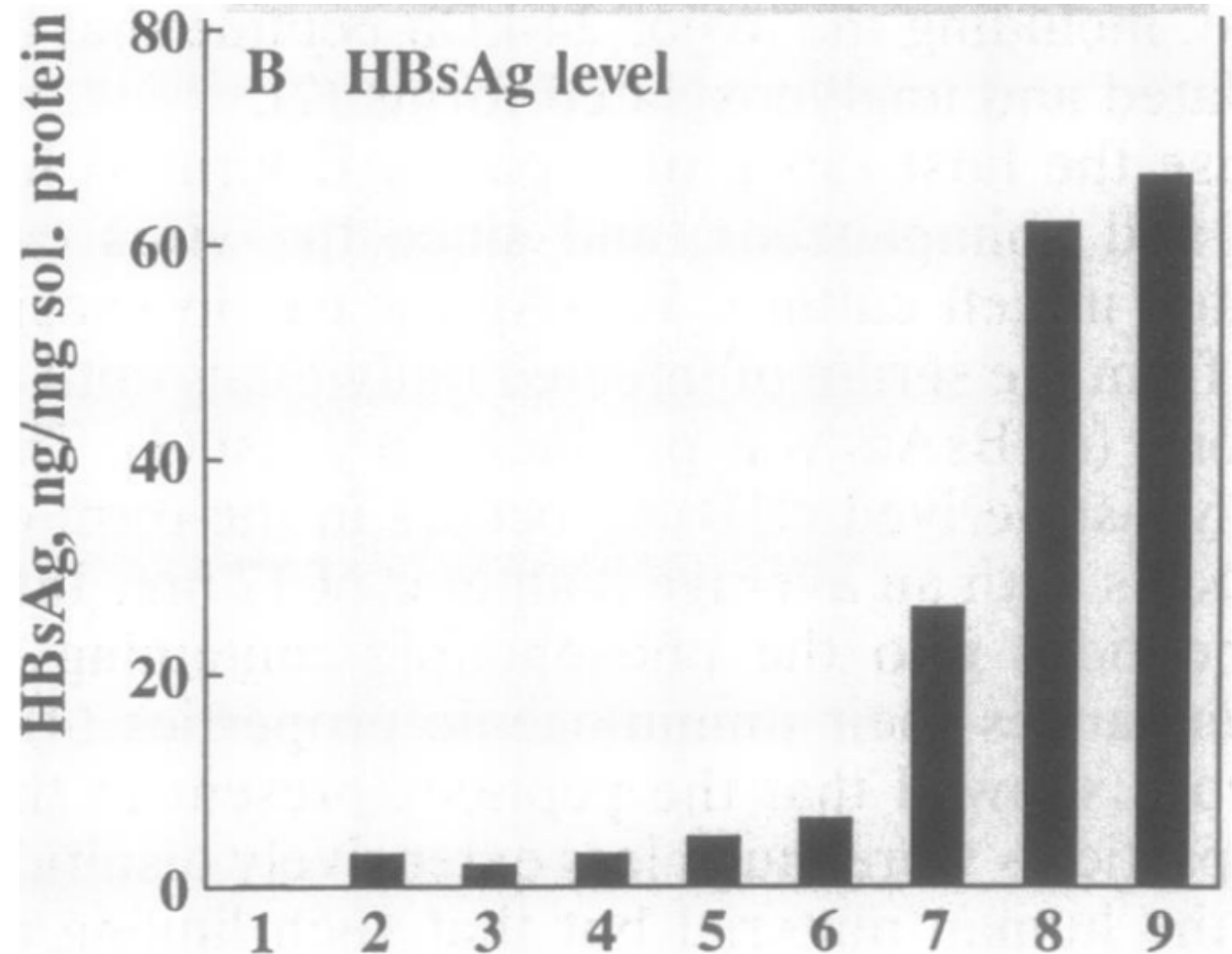
FIG. 2. HBsAg mRNA and protein levels in transgenic tobacco plants. (A) Total RNA from wild-type untransformed or independent transgenic tobacco lines carrying either the pHB101 or the pHB102 construct was hybridized with a probe specific for the HBsAg coding region. (B) Protein extracts from the same leaves were tested for HBsAg with the Auszyme monoclonal kit (Abbott), and HBsAg levels were quantified using a standard curve of human serum derived HBsAg. Numbers: 1, wild-type control plant; 2-6, independent transformants harboring the construct in pHB101; 7-9, independent transformants harboring pHB102 (dual enhancer).



THIS EXPERIMENTAL RESULT MAY UNLOCK POTENTIAL FOR GLOBAL VACCINATION AT LOW COST, FOR 80% OF THE WORLD'S POPULATION

(Charles Arntzen et al, 1992) Data from Fig 2

Hepatitis B antigen was detected in the leaves of the plant (as it should, see 2-9). This or other plant can be grown almost anywhere in the world, the leaves can be mashed up in a mortar and pestle to make a paste (contains the antigen). This paste (may not be tasty) may be placed under the tongue (sublingual route by which substances diffuse directly into the blood through tissues under the tongue). The “expectation” is that the antigen (protein molecules) will diffuse out of the paste and enter the blood of the person. Antigen then triggers the immune system. Hence, the person is vaccinated (hypothetical).



KEEP IT SIMPLE ■ PLANT MUSH UNDER TONGUE DAILY, (HOME) TEST (SENSOR) TO DETECT ANTIBODY IN BLOOD. VOILA! VACCINATED!

RESEARCH STUDY – REPEAT ARNTZEN’S 1992 SEMINAL WORK WITH EBOLA VIRUS SURFACE GLYCOPROTEIN EBOV (BINDS HUMAN TIM-1)

To get started follow the Arntzen Way (1992)

- Use EBOV or TIM-1 binding epitopes of EBOV?
- Can we detect EBOV protein in sap, stem, leaves?
- Is the sap, stem, leaf *mush* safe from side effects?
- Assay human blood sample for EBOV on day 0
- Sublingual administration of “mush” 2-3 times/day
- Assay blood for EBOV and EBOV-ab every few days
- Titer of EBOV-ab is KPI (key performance indicator).

KEEP IT SIMPLE ■ PLANT MUSH UNDER TONGUE DAILY, (HOME) TEST (SENSOR) TO DETECT ANTIBODY IN BLOOD. VOILA! VACCINATED!

RESEARCH STUDY – REPEAT ARNTZEN’S 1992 SEMINAL WORK WITH EBOLA VIRUS SURFACE GLYCOPROTEIN EBOV (BINDS HUMAN TIM-1)

Tobacco - The Arntzen Way

- Use EBOV or TIM-1 binding epitopes of EBOV?
- Can we detect EBOV protein in sap, stem, leaves?
- Is the sap, stem, leaf *mush* safe from side effects?
- Assay human blood sample for EBOV on day 0
- Sublingual administration of “mush” 2-3 times/day
- Assay blood for EBOV and EBOV-ab every few days
- Titer of EBOV-ab is KPI (key performance indicator).

Also: Arabidopsis, Rose, Tulip, Potato, Orange

- Arabidopsis can be transfected by dipping leaves
- Use Arntzen’s CaMV vectors, *A. tumefaciens*, etc.
- Can we find a way to create EBOV in Rose, Tulip?
- Rose/Tulip vectors: Rose Rosette Virus, Potyviruses
- Expectation: EBOV in rose / tulip (petals are edible)
- Food: Arntzen’s potato, lettuce, carrot, citrus*
- KPI (outcome) high EBOV-ab titer detected in blood

Ebola (and Marburg Virus) Receptor Human TIM-1 <https://www.pnas.org/doi/pdf/10.1073/pnas.1019030108>

*CITRUS <https://patentimages.storage.googleapis.com/2a/ad/8a/0eb4420eea4fc7/US20130125254A1.pdf>

Play it again, Sam

REPEAT THIS PROTOCOL WITH ANY (VIRAL*) ANTIGEN

THIS IS A “PLATFORM” APPROACH TO VACCINATION.

**IMMUNIZATION WITHOUT CORPORATE CONTROL AND
MEDICAL STAFF MAY IMPROVE “WELLNESS” ACCESS**

*

Graham BS, Sullivan NJ. Emerging viral diseases from a vaccinology perspective: preparing for the next pandemic.

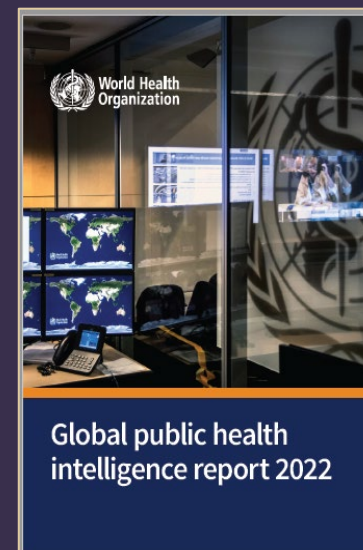
Nat Immunol. 2018 Jan; 19(1):20-28 www.ncbi.nlm.nih.gov/pmc/articles/PMC7097586/pdf/41590_2017_Article_7.pdf

WHO WILL CONSTRUCT VECTOR WITH ANTIGEN, TRANSFECT, CREATE THE CONDITIONS FOR GROWING THE PLANT?

NEED A SCIENTIFIC TEAM, OPEN COMMUNICATIONS, CENTRAL REPOSITORY FOR DISTRIBUTING MATERIALS, ANTIBODY TESTING AND ASSOCIATED MATERIALS/SENSORS, DATA SYSTEMS, DATA TRANSMISSION USING MOBILE PHONE APPS.

TABLE 6 Event Information Site bulletins published, by disease, condition or hazard, 2018–2022

No.	Disease/Condition/Hazard	Annually					Five-year period 2018–2022
		2018	2019	2020	2021	2022	
1	Acute gastrointestinal syndrome	—	—	—	1	—	1
2	Acute haemorrhagic fever syndrome	—	3	—	2	—	5
3	Acute hepatitis E	3	—	1	4	—	8
4	Acute hepatitis of unknown aetiology	—	—	—	—	1	1
5	Antibiotic-resistant bacterial infection	—	2	—	—	—	2
6	Arenaviral haemorrhagic fever	—	—	1	—	—	1
7	Argentine haemorrhagic fever	—	—	1	—	—	1
8	Chikungunya virus disease	2	1	1	—	—	4
9	Cholera	8	3	1	4	13	29
10	COVID-19/SARS-CoV-2	—	—	90	—	—	90
11	Crimean–Congo haemorrhagic fever	—	—	—	—	1	1
12	Dengue fever	3	10	3	2	7	25
13	Diphtheria	1	—	—	—	—	1
14	Dracunculiasis	—	—	1	—	—	1
15	Ebola virus disease	7	1	4	5	4	21



Ebola Virus

MARBURG, EBOLA, HANTA, LASSA, JUNIN, NORO

PLANT-BASED TECHNOLOGIES TO ENABLE RAPID RESPONSE TO EBOLA OUTBREAK

Jerzy Karczewski, Fraunhofer CMB, Newark, Delaware, USA

Vidadi Yusibov, Fraunhofer CMB, Newark, Delaware, USA

June 12-17, 2016

PRIORITIZE DEADLY VIRUSES FOR VACCINE TARGETS

[HTTPS://DC.ENGCONFINTL.ORG/VACCINE_VI/44/](https://dc.engconfintl.org/vaccine_vi/44/)

[HTTPS://DC.ENGCONFINTL.ORG/CGI/VIEWCONTENT.CGI?FILENAME=0&ARTICLE=1043&CONTEXT=VACCINE_VI&TYPE=ADDITIONAL](https://dc.engconfintl.org/cgi/viewcontent.cgi?filename=0&article=1043&context=vaccine_vi&type=additional)

Hefferon, Kathleen Laura (2012) Plant virus expression vectors set the stage as production platforms for biopharmaceutical proteins. *Virology*. 2012 November 10; 433(1):1-6. doi: 10.1016/j.virol.2012.06.012. PMID: 22979981.

<https://www.sciencedirect.com/science/article/pii/S0042682212003145?via%3Dihub>

Loh HS, Green BJ, Yusibov V. (2017) Using transgenic plants and modified plant viruses for the development of treatments for human diseases. *Curr Opin Virol*. 2017 October; 26:81-89. doi: 10.1016/j.coviro.2017.07.019. Epub 2017 August 8. PMID: 28800551; PMCID: PMC7102806. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7102806/pdf/main.pdf>

IS MEASURABLE SUCCESS STILL JUST AN IMAGINARY MIRAGE ?

Ponndorf D, Meshcheriakova Y, Thuenemann EC, Dobon Alonso A, Overman R, Holton N, Dowall S, Kennedy E, Stocks M, Lomonossoff GP, Peyret H. (2021) Plant-made dengue virus-like particles produced by co-expression of structural and non-structural proteins induce a humoral immune response in mice. *Plant Biotechnol J*. 2021 April; 19(4):745-756. doi: 10.1111/pbi.13501. Epub 2020 Nov 22. PMID: 33099859; PMCID: PMC8051607.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8051607/pdf/PBI-19-745.pdf>

USDA approves the first plant-based vaccine

In what could be a milestone for veterinary as well as human vaccine research, the US Department of Agriculture (USDA) on January 31, 2006, announced it had issued the first market license ever issued to a veterinary vaccine produced in plant cells. The vaccine, made by Dow AgroSciences of Indianapolis, Indiana, a wholly owned subsidiary of the Dow Chemical Company, has proven safe and effective in protecting chickens from illness caused by the Newcastle disease virus, according to the USDA's Center for Veterinary Biologics. The subunit vaccine was produced using modified tobacco plant cells in an indoor, biocontained production system, eliminating environmental or consumer concerns about pharmaceuticals produced in food crops or open fields. Although Dow may decide not to sell the now-approved chicken vaccine because of market concerns, the company called the license a "regulatory milestone," allowing it to develop a range of other veterinary vaccines. Using the same production system for human vaccines is "a real possibility," the company said. Charles Arntzen, a biotech researcher at Arizona State University in Phoenix, who has been pushing plant-based vaccines for many years, welcomes the approval. "It shows that large companies are investing product-development resources in plant-derived pharmaceuticals, [and] that the [USDA] is receptive to the new strategy," Arntzen says. *PV*

www.nature.com/articles/nbt0306-233

USDA approves the first plant-based vaccine

January 2006 · *Nature Biotechnology* 24(3):233-234

DOI:[10.1038/nbt0306-233](https://doi.org/10.1038/nbt0306-233)

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BOTTOM LINE – CAN WE FAST FORWARD TO ARABIDOPSIS ?

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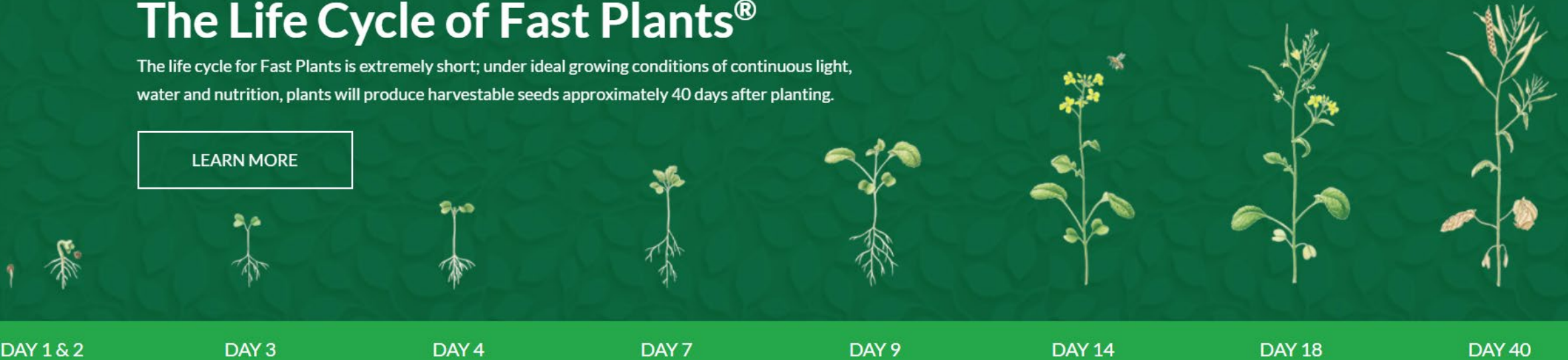
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WHY FAST FORWARD TO ARABIDOPSIS ?

Arabidopsis thaliana, small dicotyledonous species, is a member of the Brassicaceae family. *Arabidopsis* requires light, air, water and few minerals to complete its fast life cycle (seeds in ~ 40 days). It produces numerous self progeny, requires limited space, and is easily grown in a greenhouse or indoor growth. <https://www.nsf.gov/pubs/2002/bio0202/model.htm>

PLATFORM ARABIDOPSIS ?

References 1-18 included in the following 4 pages

Arabidopsis has a rich scientific history¹ and its genetics² continues to be an active³ field of plant research with potential for applications in medicine⁴ as well as improving our understanding of basic science⁵, food and nutrition. Hence, the Arabidopsis system is a suitably informed platform to explore the expression of recombinant proteins⁶ in vegetables⁷ and cereals⁸ by creatively⁹ re-constructing or modifying available¹⁰ viral¹¹ vectors (RNA¹² or DNA¹³ based) which are safe¹⁴ for the environment. Success¹⁵ of Arabidopsis as a platform¹⁶ and the potential for paradigm shift¹⁷ may translate into tangible results¹⁸ of immense human value.

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WORK IN PROGRESS ??

Plant-based human vaccines in clinical trials.

Pathogen or disease	Antigen	Plant	Expression system	Administration route	Clinical trial	Reference
Enterotoxigenic <i>E. coli</i>	LTB	Potato	Transgenic	Oral	Phase I	Tacket et al. [1998]
Enterotoxigenic <i>E. coli</i>	LTB	Maize	Transgenic	Oral	Phase I	Tacket et al. [2004]
Norovirus	Capsid protein	Potato	Transgenic	Oral	Phase I	Tacket et al. [2000]
Hepatitis B virus	Viral major surface protein	Lettuce	Transgenic	Oral	Phase I	Kapusta et al. [1999]
Hepatitis B virus	Viral major surface protein	Potato	Transgenic	Oral	Phase I	Thanavala et al. [2005]
Rabies virus	Glycoprotein and nucleoprotein (fusion)	Spinach	Viral vector (transient)	Oral	Phase I	Yusibov et al. [2002]
Influenza virus (H5N1)	HA	<i>Nicotiana benthamiana</i>	Launch vector (transient)	Intramuscular	Phase I	Chichester et al. [2012]
Influenza virus (H1N1; 2009 pandemic)	HA	<i>Nicotiana benthamiana</i>	Launch vector (transient)	Intramuscular	Phase I	Cummings et al. [2014]
Influenza virus (H5N1)	HA (H5; VLP)	<i>Nicotiana benthamiana</i>	Agrobacterial binary vector (transient)	Intramuscular	Phase I Phase II	D'Aoust et al. [2008] Landry et al. [2010]
Influenza virus (H7N9)	HA (H7; VLP)	<i>Nicotiana benthamiana</i>	Agrobacterial binary vector (transient)	Intramuscular	Phase I	Medicago Inc. (http://www.medicago.com)
Influenza virus	HA (VLP) (seasonal; quadrivalent)	<i>Nicotiana benthamiana</i>	Agrobacterial binary vector (transient)	Intramuscular	Phase I	Medicago Inc. (http://www.medicago.com)
Cholera	CTB	Rice	Transgenic	Oral	Phase I	Nochi et al. [2009] Yuki et al. [2013]

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<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4550766/pdf/AV2015-936940.pdf> (Pit Sze Liew and Mohd Hair-Bejo ▪ Email mdhair@upm.edu.my)

Cereals for cattle? Can wheat pastures provide immune protection from farm animal diseases?



<https://www.nal.usda.gov/animal-health-and-welfare/farm-animal-diseases>

<http://agtoday.wpengine.com/wp-content/uploads/2016/12/Jourdans-photo.jpg>

<https://agrifetoday.tamu.edu/2016/12/07/winter-wheat-management-critical-spring-production/>

https://www.hpj.com/crops/the-best-ways-to-utilize-wheat-pasture-for-cattle/article_07bf9f28-ee88-11e9-aa66-9b267ae8f7b4.html

Table 3. Plant-based vaccines for veterinary use.

Host	Pathogen	Antigen	Plant	Administration route	Treated animal	Reference
Chicken	Newcastle disease	Hemagglutinin-neuraminidase	Tobacco suspension cells	Subcutaneous	Chicken	Vermij <i>et al.</i> [2006]
Chicken	Newcastle disease	F protein	Maize	Oral	Chicken	Approved by USDA Guerrero-Andrade <i>et al.</i> [2006]
Chicken	Newcastle disease	F protein	Rice	Oral	Mice	Yang <i>et al.</i> [2007]
Chicken	IBV	S1 glycoprotein	Potato	Oral	Chicken	Zhou <i>et al.</i> [2004]
Chicken	IBDV	VP2	Rice	Oral	Chicken	Wu <i>et al.</i> [2007]
Pig	ETEC	Fimbriae (F4)	Tobacco (chloroplast)	N/D	Pig (in vitro assay in intestines)	Kolotilin <i>et al.</i> [2012]
Pig	ETEC	Fimbriae (F4)	Alfalfa	Oral	Piglet	Joensuu <i>et al.</i> [2006]
Pig	ETEC	Cholera toxin B subunit	Rice	Oral	Pig	Takeyama <i>et al.</i> [2015]
Pig	ETEC	Fimbriae (F4)	Barley	Subcutaneous	Mice	Joensuu <i>et al.</i> [2006]
Pig	Foot and mouth disease virus	VP1	<i>Nicotiana bentamiana</i>	Intramuscular	Pig	Yang <i>et al.</i> [2007]
Pig	TGEV	S protein	Tobacco	Intramuscular	Pig	Tuboly <i>et al.</i> [2000]
Cattle	Bovine Herpesvirus	gD protein	Tobacco	Intramuscular and subcutaneous	Cattle	Pérez Filgueira <i>et al.</i> [2003]
Cattle	Bovine Viral Diarrhea Virus	E2 protein	Alfalfa	Intramuscular	Cattle	Peréz Aguirreburualde <i>et al.</i> [2013]
Cattle	Rinderpest virus	Hemagglutinin	Peanut	Oral	Cattle	Khandelwal <i>et al.</i> [2003]

Guerrero-Andrade O, Loza-Rubio E, Olivera-Flores T, Fehérvári-Bone T, Gómez-Lim MA. (2006) Expression of the Newcastle disease virus fusion protein in transgenic maize and immunological studies. *Transgenic Res.* 2006 August; 15(4):455-463. PMID: 16906446. doi: 10.1007/s11248-006-0017-0. <https://link.springer.com/content/pdf/10.1007/s11248-006-0017-0.pdf>

Transplant paradoxes with paradigms ?



Tacket CO. (2009) Plant-based oral vaccines: results of human trials. *Curr Top Microbiol Immunol.* 2009; 332:103-17. doi: 10.1007/978-3-540-70868-1_6.

IS THIS THE HEART OF THE PROBLEM?

Finally, we need to define the procedures for manufacturing and processing of plant-based pharmaceuticals. The challenge is to facilitate the procedures without compromising quality, which is a prerequisite for manufacturing plant-based human and animal vaccines.

IS THIS SCIENCE IN THE SERVICE OF SOCIETY ?

ARABIDOPSIS ANTIGEN DELIVERY PLATFORM ?

LOGICAL STEPS FOR AN EBOLA ANTIGEN ?

THE MINIMUM PROOF OF CONCEPT IS ...

- Re-construct available viral vector(s) with EBOV
- Transfect Arabidopsis with EBOV-containing vector
- Assay for EBOV protein (antigen) in stem/leaf
- Test sublingual stem/leaf “paste” in humans
- Detect EBOV antigens / antibodies in blood

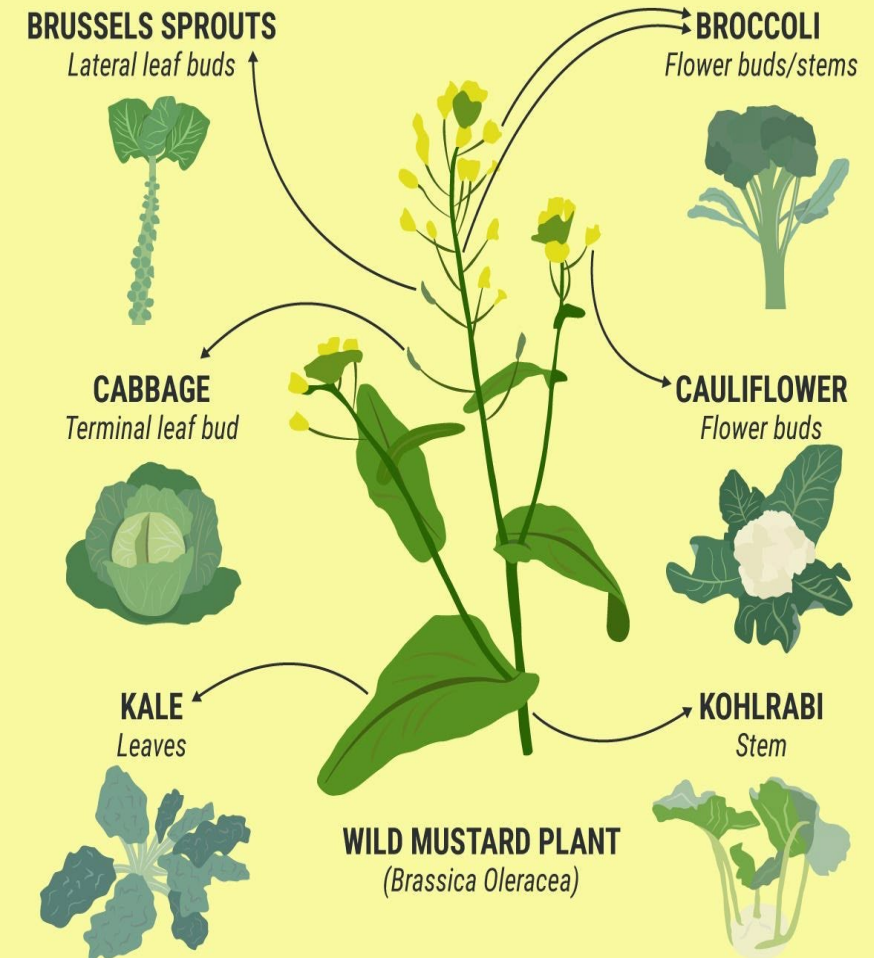


Arabidopsis thaliana, the thale cress, mouse-ear cress or arabidopsis, is a small flowering plant native to Eurasia and Africa. A. thaliana is considered a weed; it is found along the shoulders of roads and in disturbed land.

Transplant paradoxes with paradigms ?
With just one plant.

6 vegetables that are the same plant

Over hundreds of years farmers have been breeding one plant – called *Brassica Oleracea* – into dozens of different varieties. These six vegetables you can find in the grocery store are actually all the same plant.



PROBLEMS, ISSUES, QUESTIONS AND THE CONTEXT OF REMEDIABLE INJUSTICES VS TOLERABLE DISCOMFORTS NECESSARY FOR GLOBAL ACCESS TO IMMUNIZATION

- BIO-AVAILABILITY of antigens [1] through the sublingual route: will the plant “paste” release sub-cellular proteins? [2] if antigens enter the bloodstream, will it suffice (critical mass, threshold) to trigger a robust immune response?
- Why it may work: Crushing garlic in a mortar and pestle releases alliinase which converts alliin into allicin, the sulfur-containing molecule which provides garlic its signature odour (cannot be detected if the cells fail to rupture/break).
- Why it may work: Salivary amylase in saliva can reach amyloplasts (sub-cellular organelles) to hydrolyze starch in potato. Hence, proteins (antigens) should be available (a theoretical expectation) for sublingual extraction.
- Pre-treatment of “paste” with non-denaturing agents and/or non-proteolytic enzymes to partially loosen/break the cellulose scaffolds and/or cell walls, provides opportunity for proteins from sub-cellular compartments to escape.
- Uncooked plant “paste” (from tobacco leaves, potato/carrot slices, orange juice) may contain other proteins or small molecules (alkaloids) which may structurally or functionally interfere with the antigen expected to be delivered. What if other proteins in the “paste” also trigger immune responses? The Pandora’s Box of “paste” related potential contraindications justifies purification of antigen prior to administration to humans but increases control and cost.
- VLPs are not suggested (but should be) partly because the dimensions (~100nm) may be a magnitude larger than antigens (proteins). Small molecules have a higher probability of diffusing through the mucous membranes and absorbed into the bed of capillaries under the tongue. Sublingual route is commercially (www.biologus.ch) viable.

TRANSFORM PARADOXES TO PARADIGMS (TP-TOP)

DISCLAIMER AND HYPOTHETICAL RESERVATIONS

The cautious suggestion in this document to explore plants as a source of foreign antigen for self-vaccination and immunization of humans (and animals) is **NOT A PANACEA** solution for all ills and illnesses. It may be a low-cost tool in our “tool-box” of mitigation strategies for future public health catastrophes, epidemics and pandemics. The concept of TP-TOP (pronounced “*tipee-top*”) may face scientific limitations which may render the overtly simple idea impractical, inefficient and untenable as a vehicle for low-cost implementation of immunization. The reliance on virologists, molecular biologists and plant geneticists to create recombinant vectors and the transgenic plants may lead to economic and IP challenges. Organisms evolve through mutations which causes antigenic drift (affects virulence?). The latter may introduce insurmountable biological barriers due to unknown unknowns. The current SARS-CoV-2 pandemic highlights the importance of *a priori* molecular engineering in RSV which unleashed the critical need to insert two Prolines (2P by Jason McClellan) to prepare the prefusion stabilized SARS-CoV-2 Spike glycoprotein which was used as the antigen template for the mRNA (by Katalin Kariko) vaccine. The molecular biology and protein chemistry of the antigen is quintessential for efficacy of any hypothetical immune response. This hypothesis is about **DELIVERY** of the *optimized antigen* through a low-cost ubiquitous vehicle (plant).

**YOU ARE WELCOME
TO DEMOLISH THIS
BIT TOO OPTIMISTIC
HYPOTHESIS WITH
A SLEDGE HAMMER.**



Research is four things: brains with which to think, eyes with which to see, machines with which to measure and, fourth, money.

— *Albert Szent-Gyorgyi* —

1. Money from grant or philanthropic contribution to lead without IP
2. Recombinant vector lab (molecular biology) and a plant bio lab
3. Few enthusiastic molecular biology students & plant bio students
4. Create EBOV vector, transfect, harvest a raw leaves for “paste”
5. Administer RAW LEAF “paste” to sublingual volunteer (S. Datta)
6. Check volunteer’s blood (ELISA) for EBOV antigen and antibodies

OPULENCE OF OPTIMISM

We may not abandon the hope that conventional and more recent vaccine technologies can be streamlined and localized so that every country can possess the capability to produce safe and effective formulations. Perhaps recombinant protein production can be franchised to the point where different agencies/countries can execute the recipes. The same is likely true of mRNA vaccines and it may not be just wishful thinking that this technology may be off-the-shelf in a few decades (few years?). More research is necessary to better understand what makes a good RNA sequence (or protein sequence) for a vaccine. We need to know with precision and accuracy the range of factors that can lead to unwanted effects. Some vaccines may become a part of our daily lives (routine, safe) while others may be used when there is an urgency. Some examples of the ability of individual non-OECD nations to develop superior public health and vaccine infrastructures have been evident during the pandemic (e.g., Cuba). Sharing technologies and information about pathogens is key. The latter (pathogen information, particularly emerging pathogens) is possible with internet/sequencing/cooperation. There will always be some conflicts over intellectual property (Moderna has been particularly aggressive with lawsuits against both BioNTech/Pfizer and the US Government). Are these events transient theatrics by heavy handed venture capitalists or more ominous than meets the eye? The diffusion of technology (which in reality is fairly common in the biomedical world) must be supported.

English translation

Lippenbekenntnis

lip service

<https://www.nature.com/articles/d41586-023-02251-y.pdf>

The best medicine for improving global health? Reduce inequality

But then the pandemic hit, taking millions of lives, leaving millions of people living with disability and disrupting health-care systems worldwide. There were indirect, as well as direct, effects. With world leaders focusing on the pandemic, [global spending on tuberculosis services](#) dropped by 10%, from US\$6 billion in 2019 to \$5.4 billion in 2021; over the same period, deaths from tuberculosis rose from 1.4 million to about 1.6 million. [Malaria-associated deaths rose by 12%](#), from 558,000 in 2019 to 627,000 in 2020. Childhood vaccination rates against diphtheria, tetanus and pertussis fell between 2019 and 2021.



STILL OPTIMISTIC? TOO LATE, FOR TOO FEW, AT A COST TOO HIGH

Wu RL, Idris AH, Berkowitz NM, Happe M, Gaudinski MR, Buettner C, Strom L, Awan SF, Holman LA, Mendoza F, Gordon IJ, Hu Z, Campos Chagas A, Wang LT, Da Silva Pereira L, Francica JR, Kisalu NK, Flynn BJ, Shi W, Kong WP, O'Connell S, Plummer SH, Beck A, McDermott A, Narpala SR, Serebryanny L, Castro M, Silva R, Imam M, Pittman I, Hickman SP, McDougal AJ, Lukoskie AE, Murphy JR, Gall JG, Carlton K, Morgan P, Seo E, Stein JA, Vazquez S, Telscher S, Capparelli EV, Coates EE, Mascola JR, Ledgerwood JE, Dropulic LK, Seder RA; VRC 614 Study Team. (2022) Low-Dose Subcutaneous or Intravenous Monoclonal Antibody to Prevent Malaria. *New England Journal of Medicine* 2022 August 4; 387(5):397-407. doi: 10.1056/NEJMoa2203067. PMID: 35921449. <https://www.nejm.org/doi/pdf/10.1056/NEJMoa2203067?articleTools=true>

ESTABLISHED IN 1812

AUGUST 4, 2022

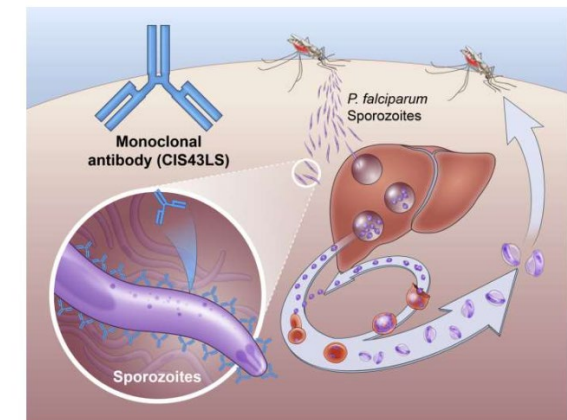
VOL. 387 NO. 5

Low-Dose Subcutaneous or Intravenous Monoclonal Antibody to Prevent Malaria

R.L. Wu, A.H. Idris, N.M. Berkowitz, M. Happe, M.R. Gaudinski, C. Buettner, L. Strom, S.F. Awan, L.S.A. Holman, F. Mendoza, I.J. Gordon, Z. Hu, A. Campos Chagas, L.T. Wang, L. Da Silva Pereira, J.R. Francica, N.K. Kisalu, B.J. Flynn, W. Shi, W.-P. Kong, S. O'Connell, S.H. Plummer, A. Beck, A. McDermott, S.R. Narpala, L. Serebryanny, M. Castro, R. Silva, M. Imam, I. Pittman, S.P. Hickman, A.J. McDougal, A.E. Lukoskie, J.R. Murphy, J.G. Gall, K. Carlton, P. Morgan, E. Seo, J.A. Stein, S. Vazquez, S. Telscher, E.V. Capparelli, E.E. Coates, J.R. Mascola, J.E. Ledgerwood, L.K. Dropulic, and R.A. Seder, for the VRC 614 Study Team*

Monoclonal antibody prevents malaria infection in African adults

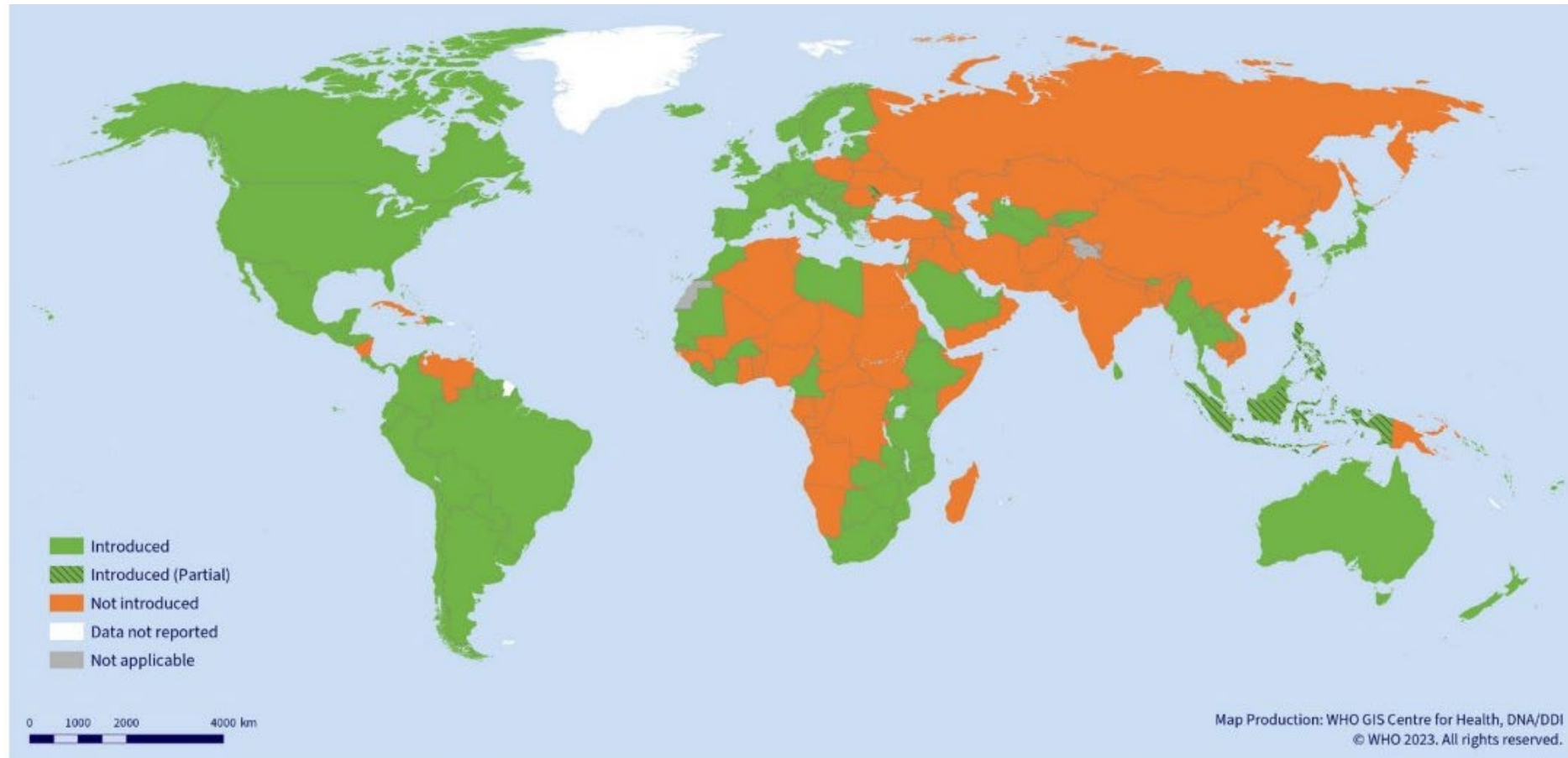
by NIH/National Institute of Allergy and Infectious Diseases



An antibody drug called CIS43LS prevents malaria infection

Gaudinski MR, Berkowitz NM, Idris AH, Coates EE, Holman LA, Mendoza F, Gordon IJ, Plummer SH, Trofymenko O, Hu Z, Campos Chagas A, O'Connell S, Basappa M, Douek N, Narpala SR, Barry CR, Widge AT, Hicks R, Awan SF, Wu RL, Hickman S, Wycuff D, Stein JA, Case C, Evans BP, Carlton K, Gall JG, Vazquez S, Flach B, Chen GL, Francica JR, Flynn BJ, Kisalu NK, Capparelli EV, McDermott A, Mascola JR, Ledgerwood JE, Seder RA; VRC 612 Study Team. (2021) A Monoclonal Antibody for Malaria Prevention. *New England Journal of Medicine*. 2021 August 26; 385(9):803-814. doi: 10.1056/NEJMoa2034031. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8579034/pdf/nihms-1751179.pdf>

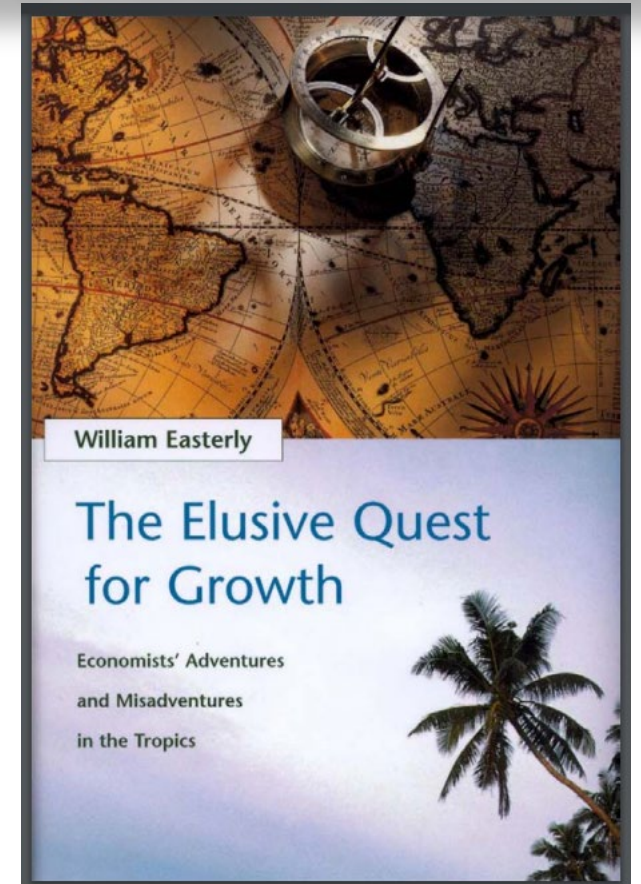
Do we still think corporate controlled vaccination is the global solution?



Source: WHO HPV Vaccine Introduction Clearing House: HPV dashboard. [Immunization, Vaccines and Biologicals \(who.int\)](https://www.who.int/immunization/vaccines/biologics). Accessed 17 July 2023.

IS FINANCIAL INCENTIVE THE KEY TO LIFT MANY BOATS ?

**PLANT BASED SELF-VACCINATION
AND MASS IMMUNIZATION WILL
IMPROVE THE GLOBAL ECONOMY.**



Plant based vaccination as a cottage industry and social business opportunity to improve financial health.

■ Over the period 1996 to 2020, the economic benefits for those using GM technology increased by \$261.3 billion US dollars. In terms of investment, for each extra dollar invested in GM crop seeds (relative to conventional seed cost), farmers gained an average US \$3.76 extra income. In developing countries, the average return was \$5.22 for each extra dollar invested in GM crop and in developed countries the average return was \$3.00.




<https://www.tandfonline.com/doi/pdf/10.1080/21645698.2022.2105626?needAccess=true>

Farm income and production impacts use of genetically modified (GM) crop technology 1996-2020

Graham Brookes 

Pages 171-195 | Received 09 May 2022, Accepted 20 Jul 2022, Published online: 19 Aug 2022

 Download citation

 <https://doi.org/10.1080/21645698.2022.2105626>

 Check for updates



<https://sites.google.com/forteprotein.com/forteprotein/blog?authuser=0>

Viewpoint: After years of misreporting, NY Times embraces safety and efficacy of GMOs — but still stumbles on nuance and key facts

Henry Miller, Kathleen Hefferon | October 13, 2021



Viewpoint: Farm-to-Fork plan suggests Europe wants sustainable farming. So why do EU politicians ignore the ‘green’ benefits of GM crops?

Henry Miller, Kathleen Hefferon | May 24, 2021



23 July 2021, Los Baños, PHILIPPINES – Filipino farmers will become the first in the world to be able to cultivate a variety of rice enriched with nutrients to help reduce childhood malnutrition, after receiving the green light from [regulators](#).

Golden Rice was developed by the [Department of Agriculture-Philippine Rice Research Institute \(DA-PhilRice\)](#) in partnership with the International Rice Research Institute (IRRI) to contain additional levels of beta-carotene, which the body converts into vitamin A.

Around [one in five](#) children from the poorest communities in the Philippines suffer from vitamin A deficiency (VAD), which affects an estimated [190 million children](#) worldwide. The condition is the most common cause of childhood blindness, as well as a contributing factor to a weakened immune system.

“This milestone puts the Philippines at the global forefront in leveraging agriculture research to address the issues of malnutrition and related health impacts in a safe and sustainable way” said Dr. Jean Balié, Director General of IRRI, a CGIAR research centre.

Resipiscence

Kenya approves GMOs after 10-year ban

Joseph Maina | Cornell Alliance for Science | October 14, 2022



In an effort to reduce corn stem-borer infestations, corporate and public researchers partner to develop GMO varieties suitable for Kenya.

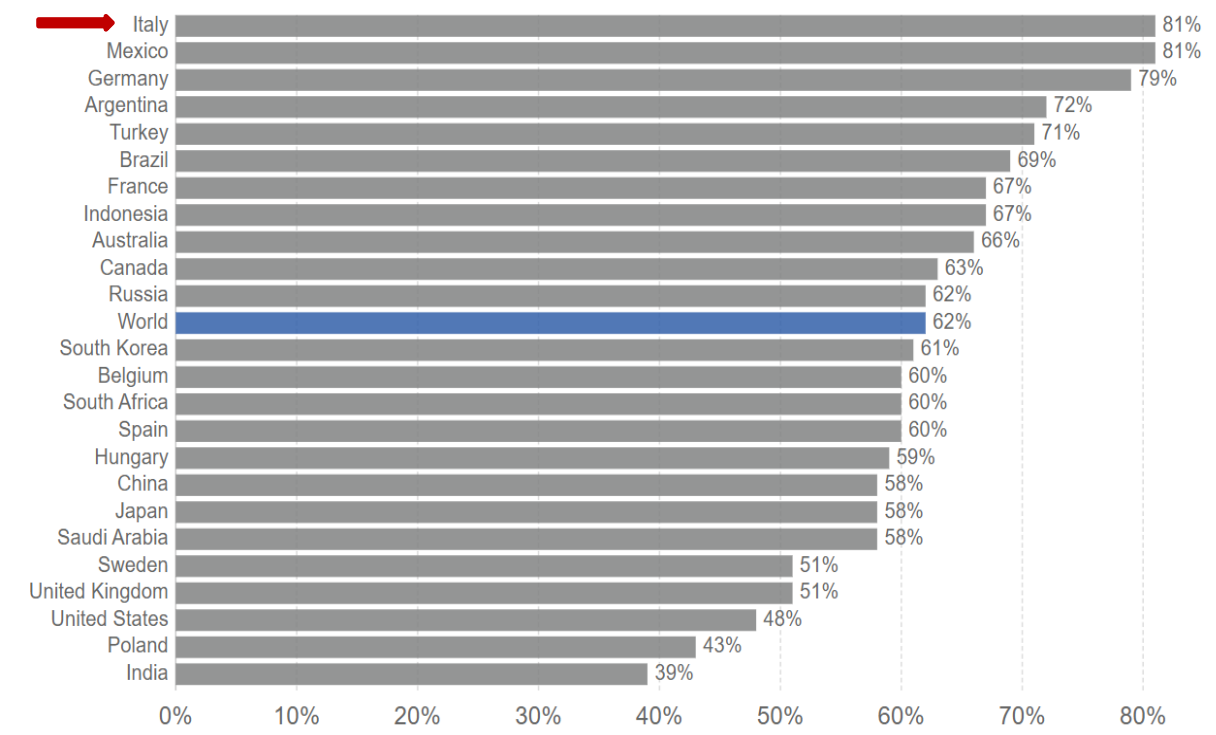
Credit: Dave Hoisington via PLoS

Resipiscence

Resipiscence

Public opposition to nuclear energy production

Share of the public who oppose the nuclear energy as a means of electricity production in 2011, following the Fukushima disaster. This constitutes the sum of respondents who stated they were either "somewhat opposed" or "strongly opposed" to nuclear energy.



ECONOMY • NUCLEAR ENERGY

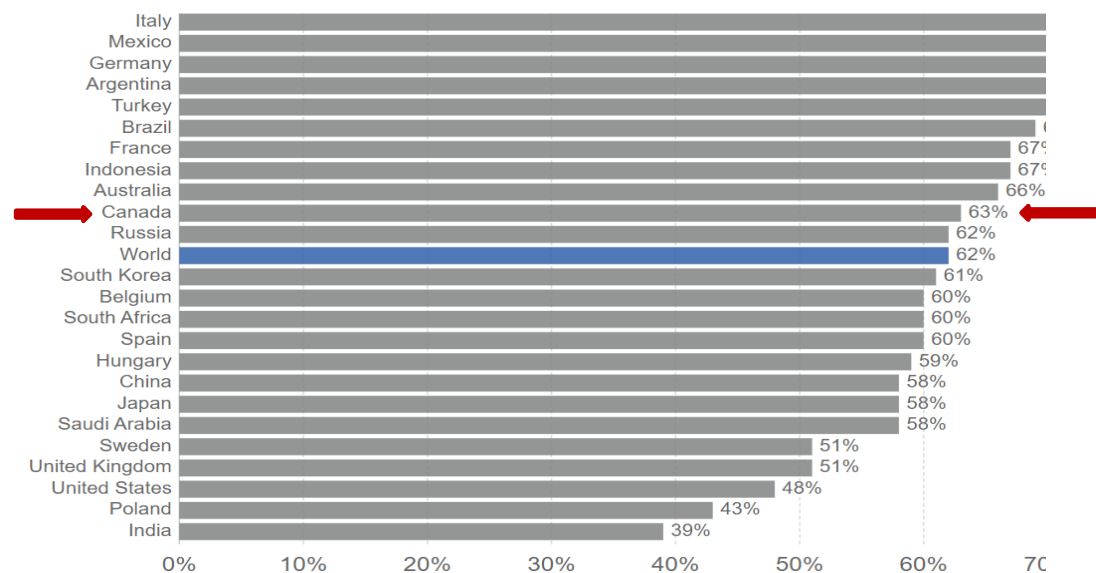
Italy takes another step toward new nuclear plants

A motion requesting the return of nuclear power to Italian territory was approved by the Chamber of Deputies on Tuesday, strengthening Prime Minister Giorgia Meloni's pro-nuclear stance.

By Allan Kaval (Rome (Italy) correspondent) and Adrien Pécout
Published on May 11, 2023, at 11:33 am (Paris), updated on May 11, 2023, at 11:33 am - 2 min - Lire en français

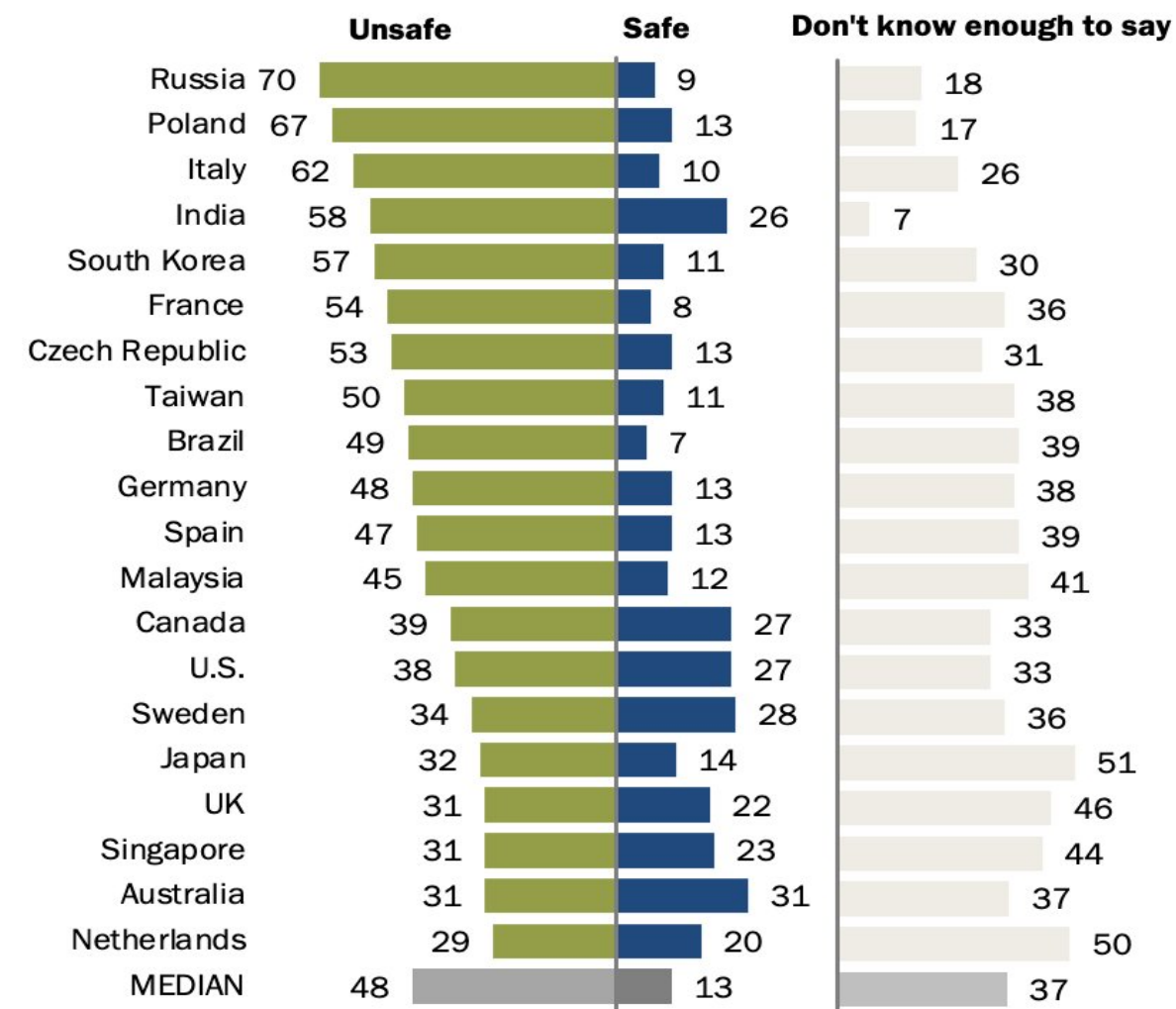
Public opposition to nuclear energy production

Share of the public who oppose the nuclear energy as a means of electricity production in 2011, following the Fukushima disaster. This constitutes the sum of respondents who stated they were either "somewhat opposed" or "strongly opposed" to nuclear energy.



Widespread skepticism about the safety of genetically modified foods

% who say genetically modified foods are generally ___ to eat



Note: Respondents who did not give an answer are not shown.
Source: International Science Survey 2019-2020. Q20.

"Science and Scientists Held in High Esteem Across Global Publics"

PEW RESEARCH CENTER

world nuclear news

Energy & Environment | [New Nuclear](#) | Regulation & Safety | Nuclear Policies | Corporate | Uranium & Fuel |

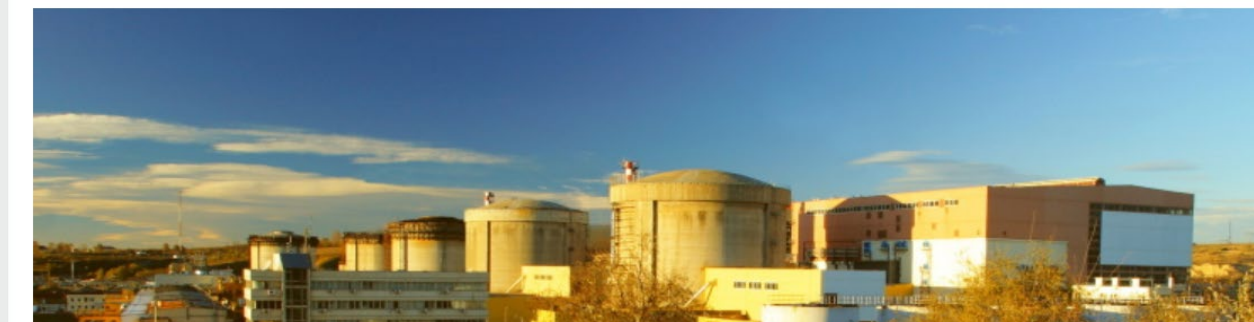
Canada offers CAD3 billion finance for nuclear in Romania

20 September 2023

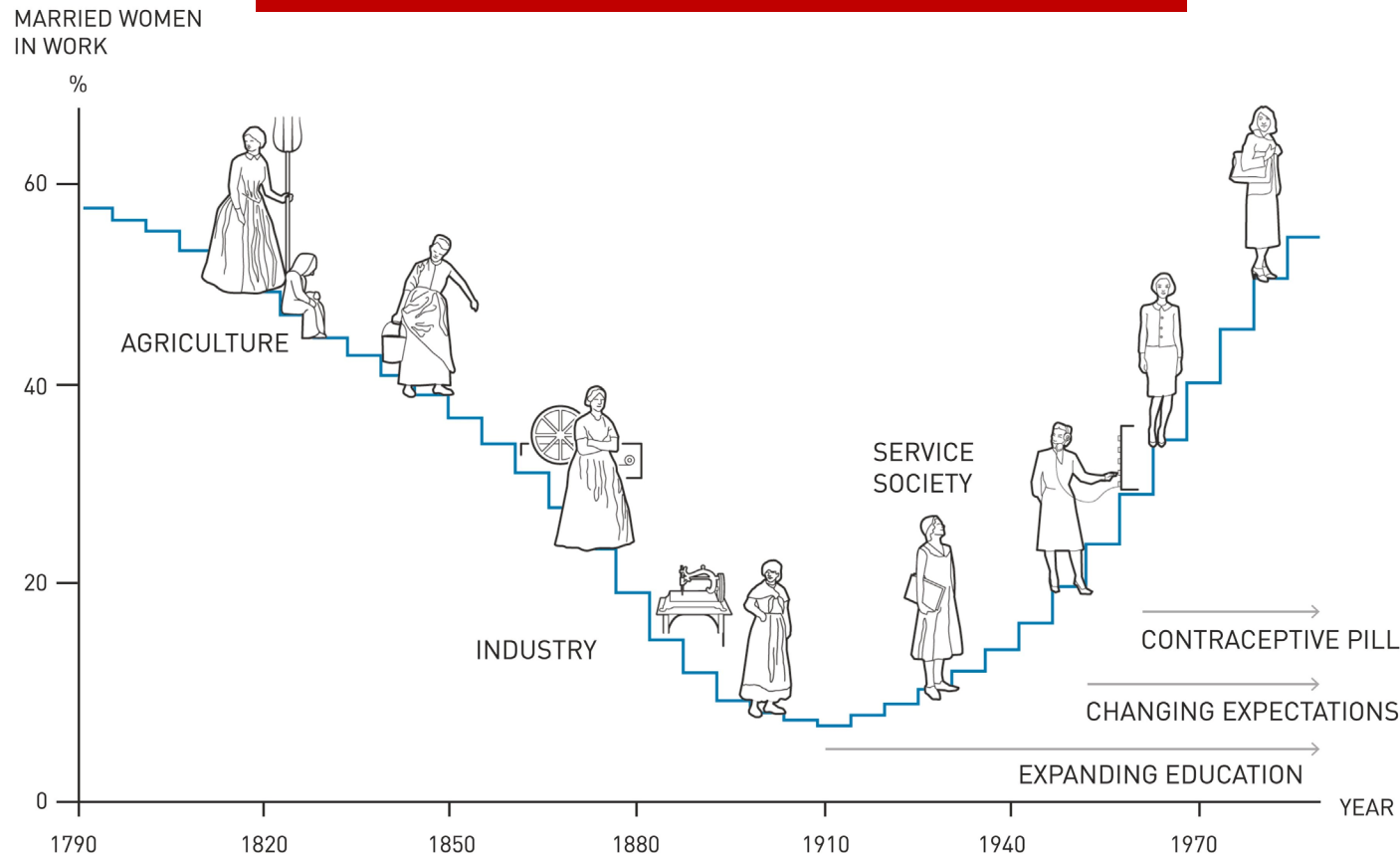
<https://world-nuclear-news.org/Articles/Canada-offers-CAD3-billion-finance-for-new-nuclear>



The Canadian Minister of Energy and Natural Resources Jonathan Wilkinson has announced CAD3 billion (USD2.2 billion) of export financing to Nuclearelectrica to support the building of two CANDU-6 reactors at the Cernavoda nuclear power plant in Romania.



Resipiscence



©Johan Jarnestad/The Royal Swedish Academy of Sciences

Businesses had been banning married women from work since at least the 1880s. Marriage bars were designed not only to reserve employment opportunities for men, but to ensure that unmarried women without families to support were kept in the lowest paying, least prestigious positions.

Claudia Goldin www.nber.org/papers/w2747

India, the “pharmacy of the world”?

Should not the pharma industry set its own house in order?

<http://eassarma.in/>

E A S Sarma

Former Secretary to Government of India

Inaugurating the first Global Innovation Summit of the pharmaceuticals sector in November, 2021, Prime Minister Modi, in his characteristic triumphant style, said, “*the global trust earned by the Indian healthcare sector (in recent times) has led to the nation being called the "pharmacy of the world"* (https://www.business-standard.com/article/current-affairs/india-is-now-being-called-pharmacy-of-the-world-says-pm-modi-121111801288_1.html).

It is true that the Indian pharmaceutical sector meets 50% of the global demand for various vaccines, 40% of generic demand in the US and 25% of all medicine in the UK. The domestic pharmaceutical industry includes a network of 3,000 drug companies and around 10,500 manufacturing units. India therefore occupies an important position in the global pharmaceuticals sector (<https://www.ibef.org/industry/pharmaceutical-india>) The country has a large supporting pool of scientists and engineers, who should primarily take credit for this.

Recent setbacks:

<http://eassarma.in/v1/sites/default/files/public/India-the-Pharmacy-of-the-world.pdf>

*Is there a
pharmacy
where
we can buy
plant-based
oral
vaccines?*



WHY VACCINATION / IMMUNIZATION IS SO CRITICAL

VACCINATION AND IMMUNIZATION NOT ONLY REDUCES THE RISK FROM IMMEDIATE INFECTION AND TRANSMISSIBILITY OF THE INFECTION BUT ALSO REDUCES THE LONG TERM RISK OF OTHER (EVEN MORE SERIOUS) AFFLICTIONS WITH FAR GREATER SCOPE FOR MORBIDITY.

INFECTIOUS AGENTS, ESPECIALLY VIRUSES, INTERACTS WITH THE GENETIC MATERIAL OF CELLS, DIRECTLY OR INDIRECTLY. VIRUSES ARE KNOWN TO INFLICT CELLULAR DAMAGES. THE CUMULATIVE DETRIMENTAL EFFECT OF SUCH DAMAGES ARE UNCERTAIN. IT MAY MANIFEST IN THE FUTURE AS A DYSFUNCTION OR TRIGGER DORMANT CONDITIONS WHICH MAY BE UNTREATABLE AND AFFECT THE QUALITY OF LIFE.

Table 1 | Viral infections linked to neurodegenerative diseases

Disease	Infection
Alzheimer disease	Influenza and pneumonia
	Intestinal infections
	Meningitis
	Viral encephalitis
Amyotrophic lateral sclerosis	Human papilloma virus
Generalized dementia	Influenza and pneumonia
	Viral encephalitis
Multiple sclerosis	Epstein–Barr virus
	Herpes simplex virus
	Varicella zoster virus
Parkinson disease	Hepatitis C virus
	Influenza and pneumonia
Vascular dementia	Influenza and pneumonia
	Varicella zoster virus

Levine KS, Leonard HL, Blauwendraat C, Iwaki H, Johnson N, Bandres-Ciga S, Ferrucci L, Faghri F, Singleton AB, Nalls MA. Virus exposure & neurodegenerative disease risk across national biobanks. *Neuron*. 2023 Apr 5;111(7):1086-1093.e2. doi: 10.1016/j.neuron.2022.12.029. Epub 2023 January 19. PMID: 36669485

Data from national biobanks offer evidence that exposure to common viral pathogens increases the risk of Alzheimer's disease and other diseases (neurodegenerative diseases).

[Discov Med](#). Author manuscript; available in PMC 2022 Oct 27.

PMCID: PMC9608336

Published in final edited form as:

NIHMSID: NIHMS1843545

[Discov Med. 2022 Sep-Oct; 34\(172\): 97–101.](#)

PMID: [36281030](#)

Vaccination Reduces Risk of Alzheimer's Disease, Parkinson's Disease, and Other Neurodegenerative Disorders

[Steven Lehrer](#) and [Peter H Rheinstein](#)

► [Author information](#) ► [Copyright and License information](#) ► [PMC Disclaimer](#)

Implementation of POV will be a win for ethical globalization. A small step to enable the delivery of global public goods to reduce disparity and inequity in healthcare services. An example of collaborative action rather than *lippenbekenntnis*. A tiny domain where the mighty Hermes may not be able to fully exert his influence and may fail to exercise his pecuniary interests. A human triumph?



Asclepius, the god of healing and his three daughters, Meditrina (medicine), Hygieia (hygiene), and Panacea (healing). The staff and single snake of Asclepius should not be confused with the twin snakes and caduceus of Hermes, the deified trickster and god of commerce, who is viewed with disdain.

Plate from Aubin L Millin, *Galerie Mythologique* (1811)

The New England Journal of Medicine

Downloaded from nejm.org by SHOUMEN DATTA on July 15, 2023. For personal use only. No other uses without permission.
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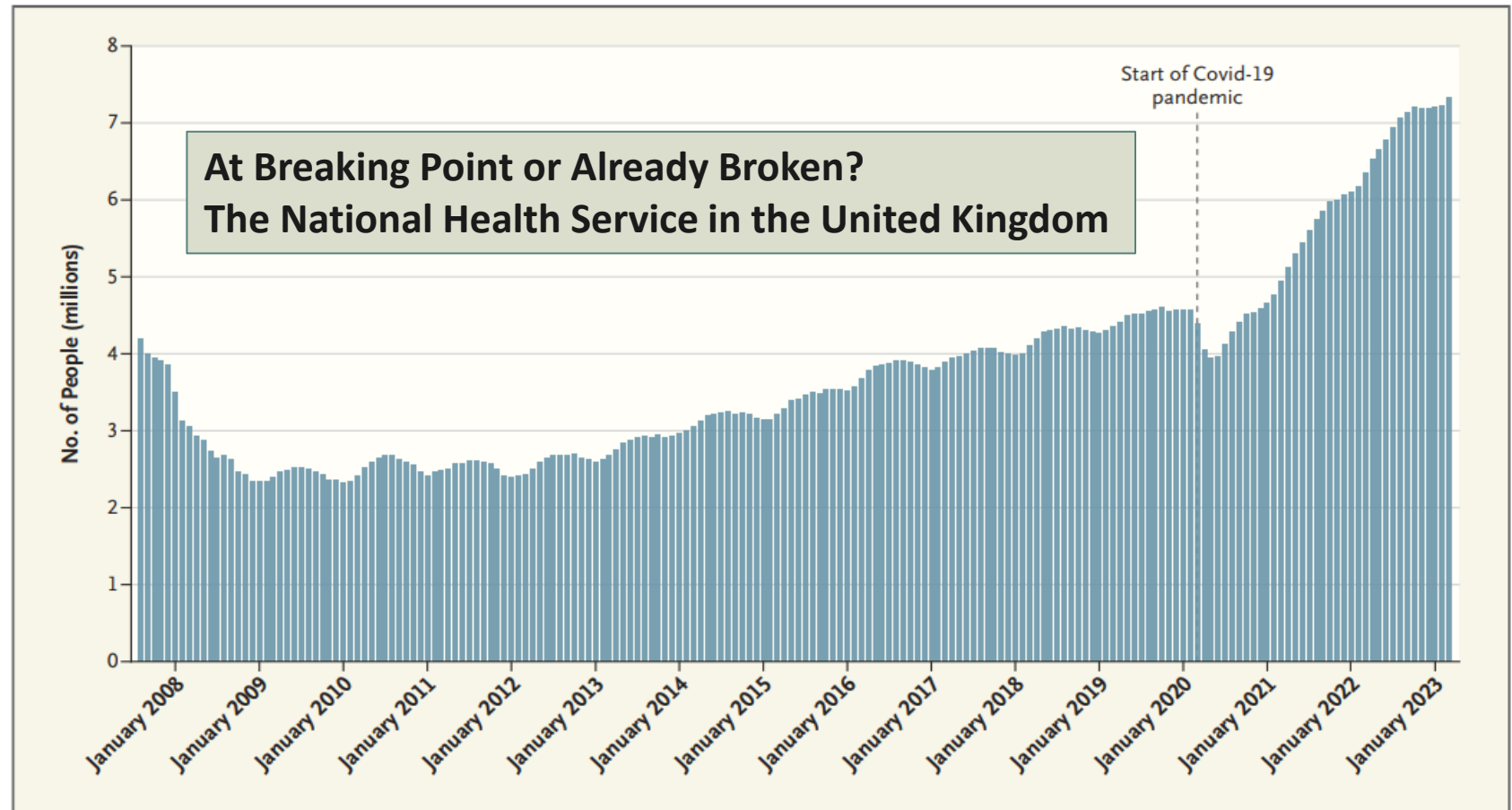
Could
Plant
based
Oral
Vaccines
save
people
in UK?

July 13, 2023

N Engl J Med 2023; 389:100-103

DOI: 10.1056/NEJMp2301257

AT BREAKING POINT OR ALREADY BROKEN?



Number of People on National Health Service Waiting Lists for Consultant-Led Elective Care, August 2007 to March 2023.

Data are from the National Health Service (<https://www.england.nhs.uk/statistics/statistical-work-areas/rtt-waiting-times/rtt-data-2022-23/>).

This is a clarion call for scientific leadership as well as other skills (financial, political, diplomatic). Paralysis due to analysis and “purified to perfection” are platitudes to be retired. Translating the patent-free (or expired) published research to pragmatic working reality requires a few students skilled in molecular biology and plant genetics, a few human volunteers and a host laboratory. Operating funds may be sourced as a consortium with tiny contributions from donors/foundations or crowd funding. The entity can also be a business if investors agree to the convergence of for-profit and not-for-profit *under one roof*. Products and services for affluent nations may be a for-profit operation (signatories¹⁶ at The Convention on the OECD, on 14 December 1960) while the not-for-profit operation will apply to the rest of the world. The scientific credibility of this proposal assures outcome which will be catalytic to build capacity for global vaccinations, if implemented. Sourcing the recombinant antigens (vectors, plasmids) and creating transgenic plants will need help from scientists (geneticists) and other global experts.

For more than a quarter century, the destructive demonization of transgenic plants and ill-informed fanatical resistance to genetically-modified¹⁷ crops has robbed the poor of global public goods, food, nutrition and healthcare. The cruel march of unreason¹⁸ is a debilitating blow to our sense of the future by forcibly destroying¹⁹ the fruits of science which could be of service to society, especially for communities under severe economic constraints. We view malicious, mis-information fueled social cataclysms as a point of inflection. We are optimistic that the tide is beginning to turn²⁰ from bad²¹ to good²² in the court of public opinion, both in Africa²³ and Asia²⁴, the geographies with the greatest need for plant-based oral vaccines.

The ability to prevent infection through low-cost self-vaccination and plant-based oral vaccines for immunization can reduce the horrendous scale of mortality and morbidity due to future infectious diseases and/or chronic diseases. Ethical globalization demands that affluent nations enable the less affluent nations to develop and implement this cottage industry of plant based vaccines, in the economic interest related to immigration, travel, commerce, and growing markets. Our collective inaction to neglect scientific proof and turn a blind eye to sourcing vaccines from transgenic plants is inhuman and unethical.

1-Page Extended Summary “POV” may be downloaded from the MIT Library <https://dspace.mit.edu/handle/1721.1/145774>

TEMPORARY
CONCLUSION

(continued from front flap)

Breaking Through isn't just the story of an extraordinary woman. It's an indictment of closed-minded thinking and a testament to one woman's commitment to laboring intensely in anonymity—knowing she might never be recognized in a culture that is driven by prestige, power, and privilege—because she believed that her work would save lives.



Katalin Karikó, PhD, is a Hungarian American biochemist who specializes in RNA-mediated mechanisms. She is an adjunct professor of neurosurgery at the University of Pennsylvania, and her research was foundational in the development of the Pfizer-BioNTech and Moderna mRNA vaccines.

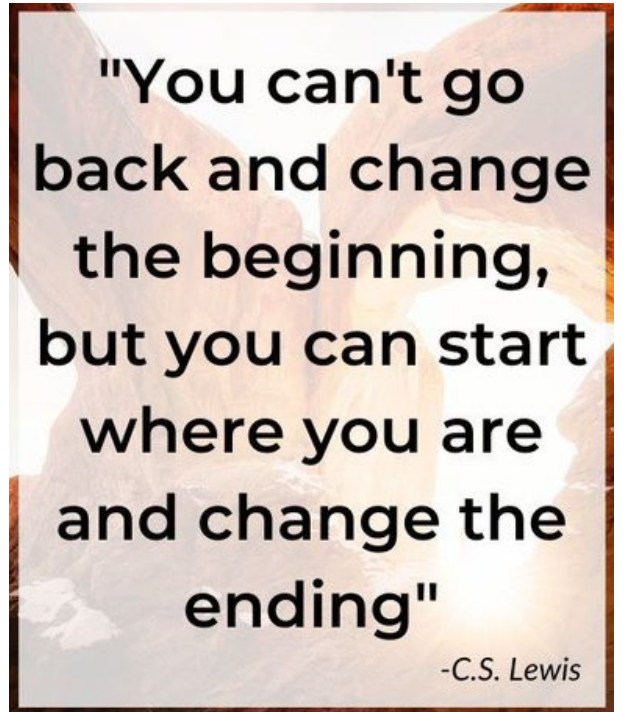
Twitter: @kkariko



Breaking Through

My Life
in Science

Katalin
Karikó



"You can't go
back and change
the beginning,
but you can start
where you are
and change the
ending"

-C.S. Lewis

ACKNOWLEDGEMENTS

Kathleen Hefferon, Cornell University

Andrew Fire, Stanford University

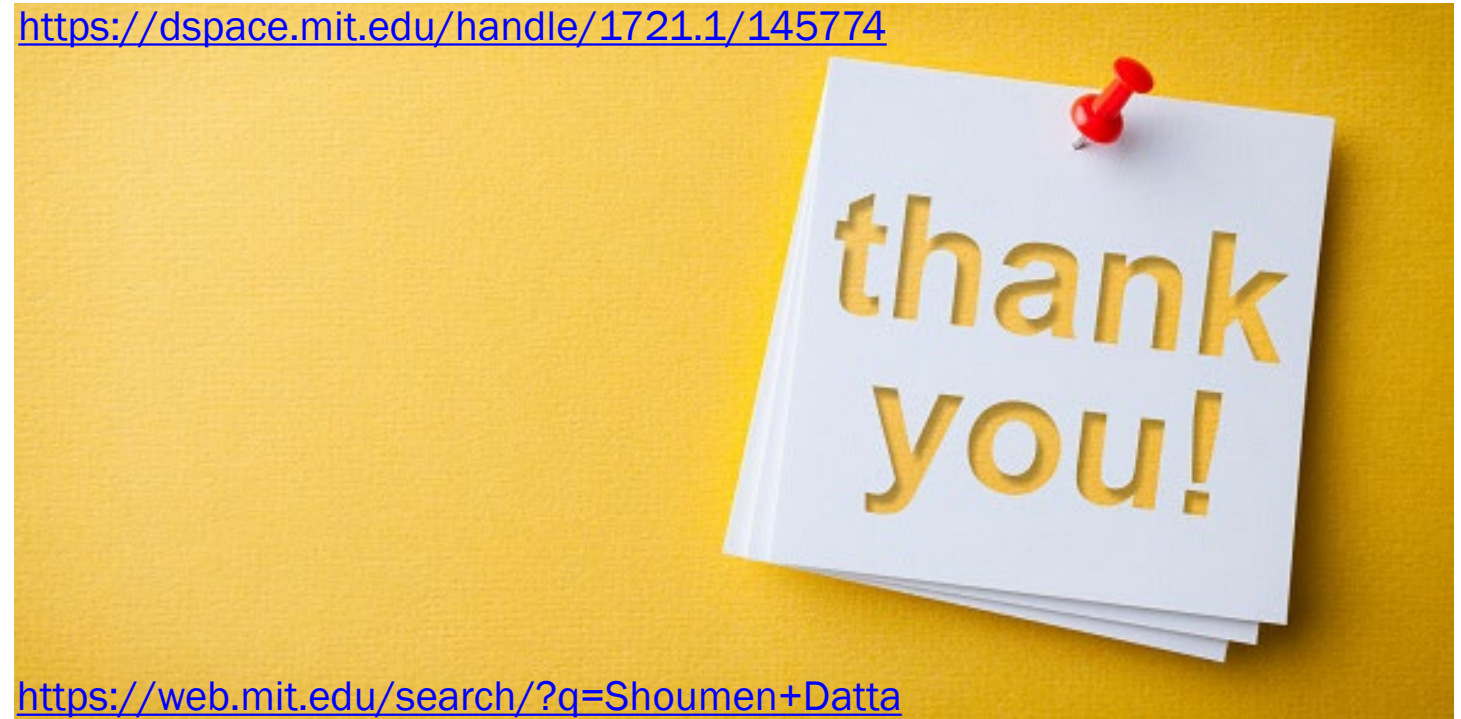
John Carr, Cambridge University

Elliot Meyerowitz, Cal Tech

Sanjay Sarma, MIT

Roy Curtiss III, UF

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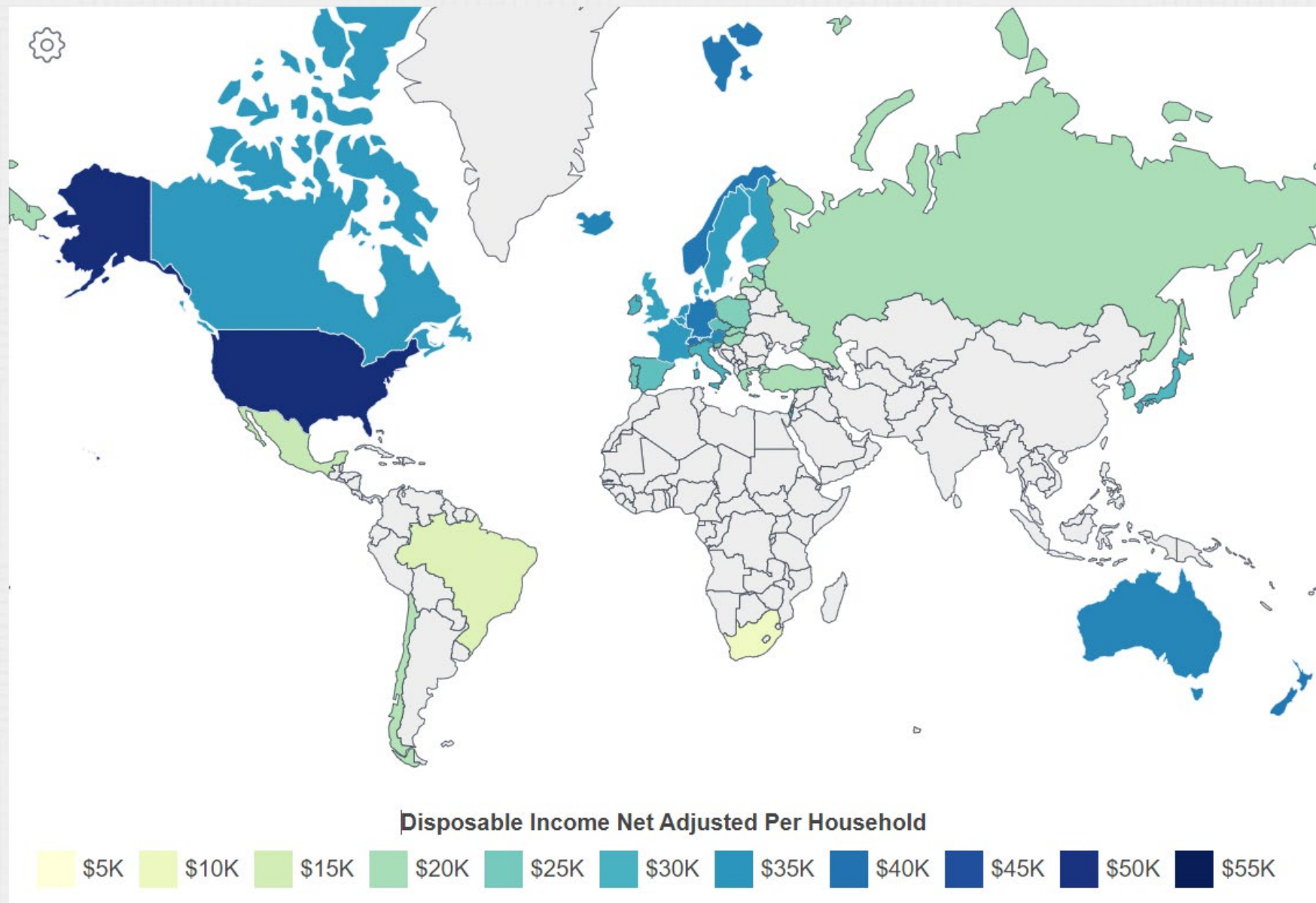
<https://web.mit.edu/search/?q=Shoumen+Datta>

THIS SECTION IS FOR THOSE WHO MUST MAKE SOME

MONEY

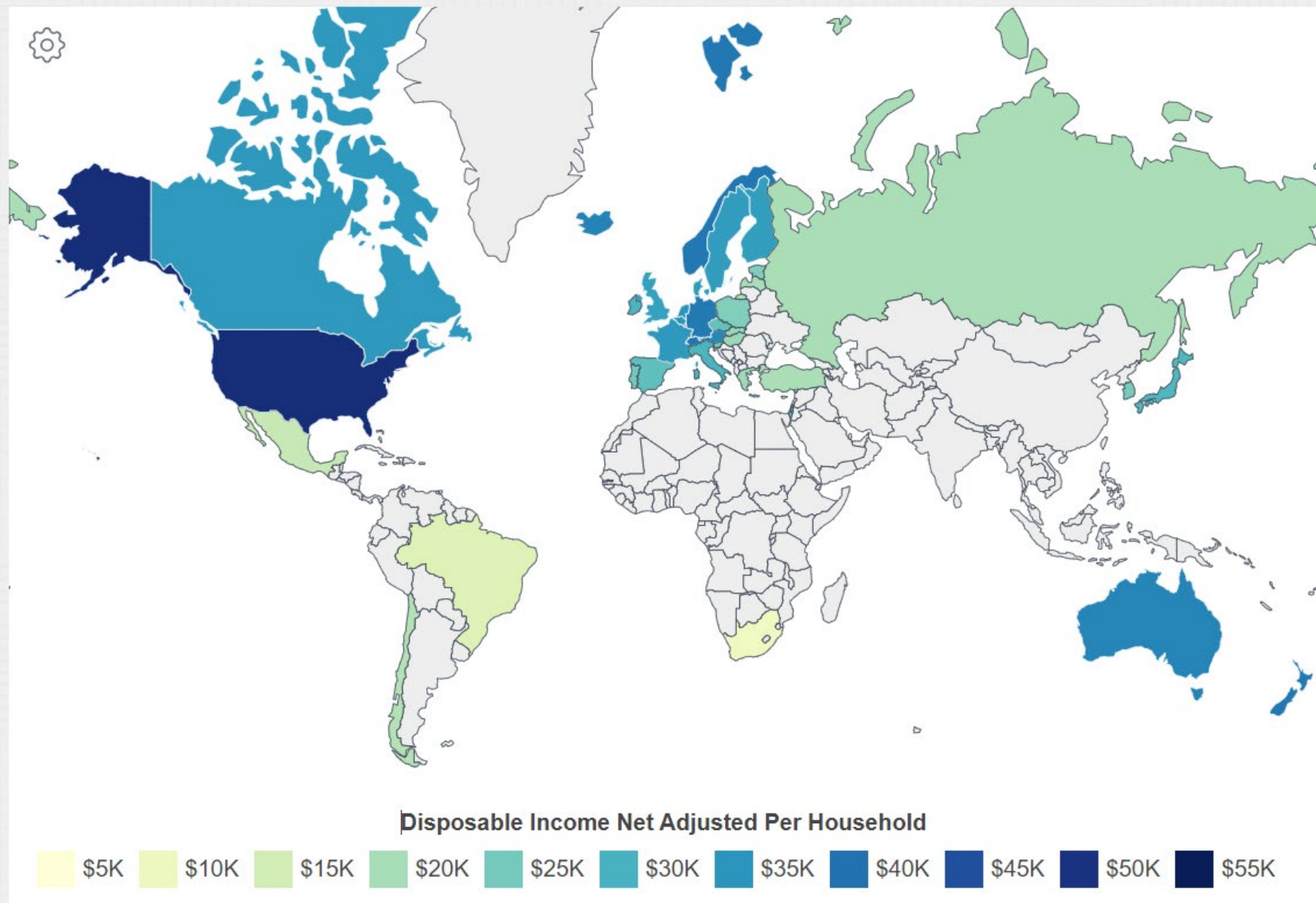
CAN WE PROFIT FROM PLANT VACCINES FOR POOR PEOPLE

YES



>80% of the global population (~7 billion people) DO NOT LIVE IN COUNTRIES WITH DISPOSABLE INCOME

<https://worldpopulationreview.com/country-rankings/disposable-income-by-country>



Can ~ 7 billion poor people spend US\$1 per month for plant based oral vaccination ?

<https://worldpopulationreview.com/country-rankings/disposable-income-by-country>

Can ~7 billion poor people spend US\$1 per month for plant based oral vaccination ?

CAN WE PROFIT FROM PLANT VACCINES FOR POOR PEOPLE

YES

Can ~7 billion poor people spend US\$1 per month for plant based oral vaccination ?

CAN WE PROFIT FROM PLANT VACCINES FOR POOR PEOPLE

**DID WE JUST SUGGEST A SOCIAL
BUSINESS WITH A POTENTIAL REVENUE
OF APPROX \$84 BILLION PER ANNUM ?**

Can ~7 billion poor people spend US\$1 per month for plant based oral vaccination ?

WHAT IF OUR PROFIT FROM PLANT VACCINES IS ONLY ~ 1%

**CAN THIS IDEA DEVELOP INTO A SOCIAL
BUSINESS WITH A POTENTIAL PROFIT OF
APPROX US\$1 BILLION PER ANNUM ?**

PAY A PENNY PER USE (PAPPU) – CENTRAL CONCEPT FOR SOCIAL BUSINESS PROFITABILITY

LET US PROFIT FROM SOCIAL BUSINESS FOR POOR PEOPLE

PAPPU

The idea is to lower the barrier to market entry for products and services by eliminating initial capital cost (for example, you get a free phone if you pay a small charge per call). The concept of PAPPU suggests charging a very small fee (penny?) each time the customer uses the product and/or the service.

PAPPU

Open Access Review

Peer-Review Record

Sensor-as-a-Service: Convergence of Sensor Analytic Point Solutions (SNAPS) and Pay-A-Penny-Per-Use (PAPPU) Paradigm as a Catalyst for Democratization of Healthcare in Underserved Communities

Diagnostics 2020, 10(1), 22; <https://doi.org/10.3390/diagnostics10010022>

by Victoria Morgan ¹ ✉, Lisseth Casso-Hartmann ^{2,3} ✉, David Bahamon-Pinzon ⁴ ✉ , Kelli McCourt ⁴ ✉, Robert G. Hjort ⁵ ✉ , Sahar Bahramzadeh ⁶ ✉, Irene Velez-Torres ^{2,3} ✉ , Eric McLamore ¹ ✉ , Carmen Gomes ⁵ ✉ , Evangelyn C. Alocilja ^{7,8} ✉, Nirajan Bhusal ^{7,9,10} ✉, Sunaina Shrestha ¹⁰ ✉, Nisha Pote ¹⁰ ✉, Ruben Kenny Briceno ^{11,12,13,7} ✉ , Shoumen Palit Austin Datta ^{1,14,15,16} ✉ and Diana C. Vanegas ^{3,4,*} ✉ 

Reviewer 1: Anonymous

Reviewer 2: Anonymous

Diagnostics 2020, 10(1), 22; <https://doi.org/10.3390/diagnostics10010022>

Received: 18 December 2019 / Revised: 29 December 2019 / Accepted: 30 December 2019 / Published: 1 January 2020
(This article belongs to the Special Issue **Biosensors-Based Diagnostics**)

Round 1

Reviewer 1 Report

The manuscript is clearly written, well structured, I recommend this paper for publication in *Diagnostics*.



WHY STOP AT JUST ONE GOOD IDEA ...

<https://dspace.mit.edu/handle/1721.1/145774>

EXTRA ... BUT NOT EXTRANEOUS

**THE NEXT SUGGESTION
IS UNRELATED TO THIS**

HYPOTHESIS

**SUPERVISED MOBILE MOSQUITO “BITE” STATION AS A
DELIVERY MECHANISM FOR ASSISTED VACCINATION ?**

THE CONVENTIONAL WISDOM

Infographic: Just one mosquito species can spread 54 viruses. Here's how genetic modification can help us conquer this disease-spreading, destructive powerhouse

Victoria Wise | Health Match | October 7, 2022



Credit: Matthew Twombly/NPR

FLIP THE PARADIGM? THINK DIFFERENT

FROM

MOSQUITO BITE TRANSMITTING VIRUS

TO

MOSQUITO BITE DELIVERING ANTIGEN

GENETICS

Gene drive mosquitoes can aid malaria elimination by retarding *Plasmodium* sporogonic development

Astrid Hoermann^{1†}, Tibebu Habtewold^{1†}, Prashanth Selvaraj², Giuseppe Del Corsano¹, Paolo Capriotti¹, Maria Grazia Inghilterra¹, Temesgen M. Kebede¹, George K. Christophides^{1*}, Nikolai Windbichler^{1*}

Gene drives hold promise for the genetic control of malaria vectors. The development of vector population modification strategies hinges on the availability of effector mechanisms impeding parasite development in transgenic mosquitoes. We augmented a midgut gene of the malaria mosquito *Anopheles gambiae* to secrete two exogenous antimicrobial peptides, magainin 2 and melittin. This small genetic modification, capable of efficient nonautonomous gene drive, hampers oocyst development in both *Plasmodium falciparum* and *Plasmodium berghei*. It delays the release of infectious sporozoites, while it simultaneously reduces the life span of homozygous female transgenic mosquitoes. Modeling the spread of this modification using a large-scale agent-based model of malaria epidemiology reveals that it can break the cycle of disease transmission across a range of transmission intensities.

<https://www.science.org/doi/epdf/10.1126/sciadv.abo1733>

Insect vectors which transmit microbes to human hosts, are, therefore, Nature's mechanism for cross-kingdom "infection". In a biomimicry approach, it may be possible to apply a "reverse" design. Could we use Nature's mechanism to "infect" people with vectors (mosquitoes) carrying antigens and virus-like particles (VLPs)? If we leave aside ethical, legal and societal issues from *pre-planned* mosquito bite, this natural biomimicry (*insects as immunization delivery platform*) may be the Holy Grail for low-cost immunization delivery for billions of people who cannot afford infrastructure costs associated with the "last mile" delivery which continues to pose insurmountable problems for vaccination programs.

Genetic engineering of viruses which infect *Anopheles*⁷³² and *Aedes*⁷³³ mosquitoes are the targets for development of vectors to shuttle antigens and for creating virus-like particles for specific viruses, for example, Ebola, SARS-CoV-2, and others. Targets for genetic modification may include re-engineering tissue-specific regulation of the small interfering RNA (siRNA) pathway controlled by the double stranded (ds) RNA binding protein Loqs2⁷³⁴ (and its genetic circuit) which appears to be specific to *Aedes aegypti* mosquito. Are there Loqs2 equivalents or similar pathways in other mosquitoes?

Source: Page 86 from Datta, Shoumen et al (2020) *Aptamers for Detection and Diagnostics (ADD): Can mobile systems process optical data from aptamer sensors to identify molecules indicating presence of SARS-CoV-2 virus? Should healthcare explore aptamers as drugs for prevention as well as its use as adjuvants with antibodies and vaccines?*

ChemRxiv Preprint server <https://chemrxiv.org/engage/chemrxiv/article-details/617c108926b9c744380acf48>

PDF in MIT Library <https://dspace.mit.edu/handle/1721.1/128017> (Questions? shoumen@mit.edu / sdatta8@mgh.harvard.edu)

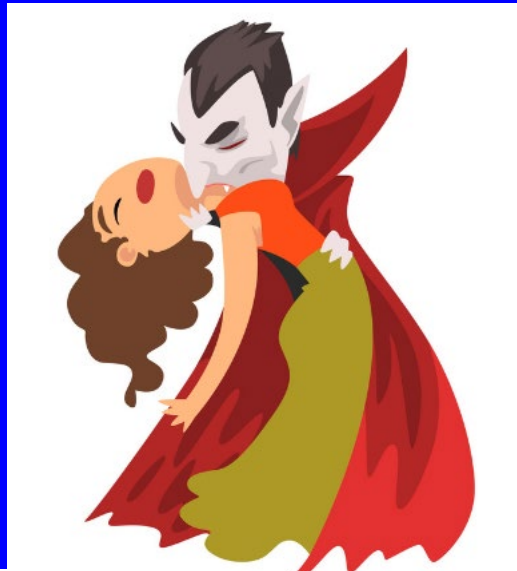
SUPERVISED MOBILE MOSQUITO “BITE” STATIONS

Imagine boxes of genetically engineered mosquitoes (with a portfolio of antigens: Ebola, Polio, SARS, etc.).

Boxes are on a platform which is on a cycle rickshaw (peddled by a human to reach remote geographies).

Individuals go up to the platform and insert their palms in the mosquito boxes (multiple vaccinations possible).

Wait for mosquito to bite. Close trap door. Take out the hand. You have been bitten. You are now vaccinated.



<https://www.sunbrella.com/>



“I rarely think in words at all. A thought comes, and I may try to express it in words afterwards.” (Attributed to Albert Einstein, 1916)

ENGINEERED MOSQUITO - A PROVEN IDEA WHICH WORKS ?

NEWS | 14 April 2023

Massive mosquito factory in Brazil aims to halt dengue

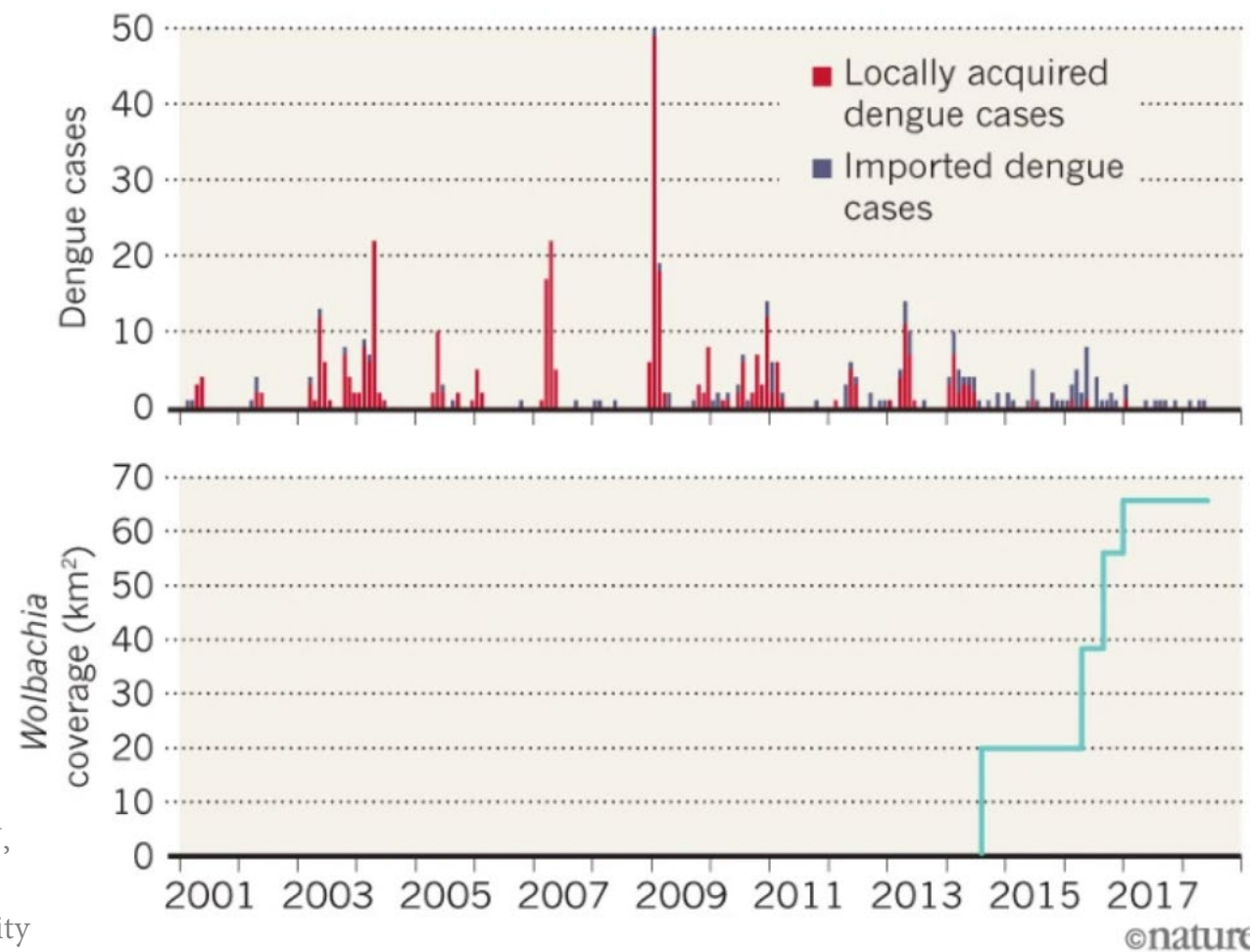
Facility will produce up to five billion bacteria-infected mosquitoes per year.

In a series of releases starting in late 2014, 4 million mosquitoes carrying *Wolbachia* bacteria were deployed across Townsville in Australia. The graph below shows the insects taking root in the central suburb of Belgian Gardens.



“This is not a silver bullet.” ■ DOI: <https://doi.org/10.1038/d41586-023-01266-9>

After the mosquito releases, locally acquired cases of dengue plummeted.



O'Neill SL, Ryan PA, Turley AP, Wilson G, Retzki K, Iturbe-Ormaetxe I, Dong Y, Kenny N, Paton CJ, Ritchie SA, Brown-Kenyon J, Stanford D, Wittmeier N, Jewell NP, Tanamas SK, Anders KL, Simmons CP. (2019) Scaled deployment of *Wolbachia* to protect the community from dengue and other *Aedes* transmitted arboviruses. *Gates Open Res.* 2019 August 13;2:36. doi: 10.12688/gatesopenres.12844.3. PMID: 30596205; PMCID: PMC6305154.

Source: S. L. O'Neill et al. *Gates Open Res.* 2, 36 (2018)

“BITE” – CONTRACTILE INJECTION SYSTEM ?

Programmable protein delivery with a bacterial contractile injection system

<https://doi.org/10.1038/s41586-023-05870-7>

Received: 6 October 2022

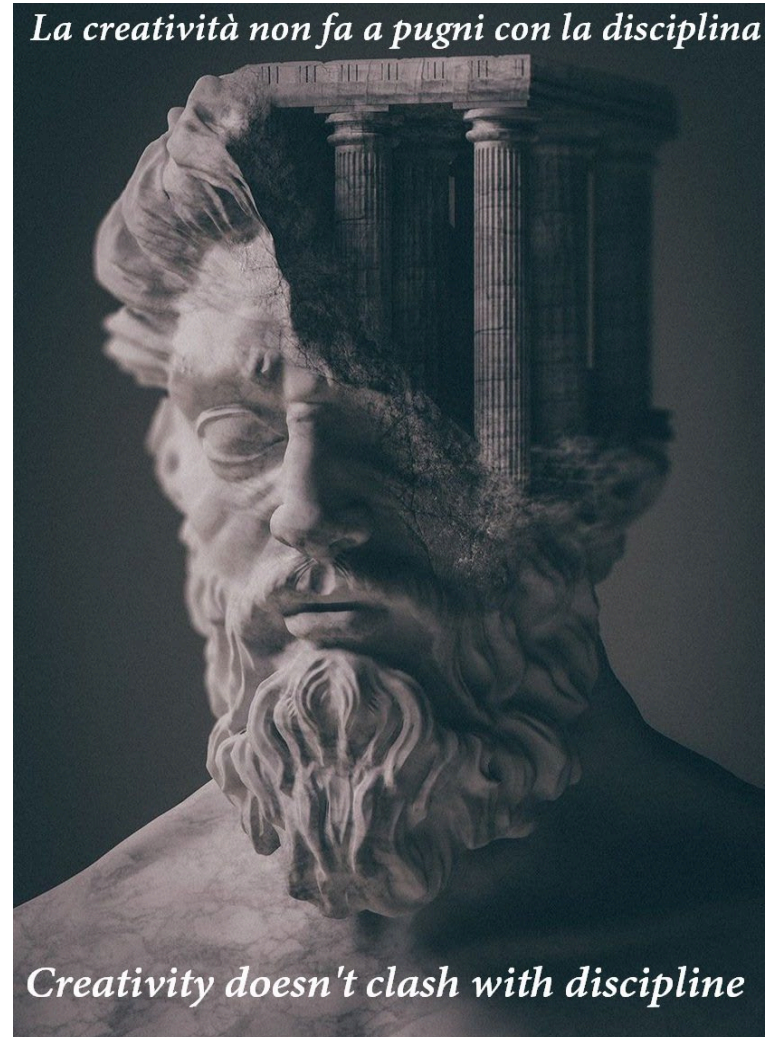
Accepted: 21 February 2023

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Makoto Saito^{1,2,3,4,5}, Rhiannon K. Macrae^{1,2,3,4,5} & Feng Zhang^{1,2,3,4,5}✉

Endosymbiotic bacteria have evolved intricate delivery systems that enable these organisms to interface with host biology. One example, the extracellular contractile injection systems (eCISs), are syringe-like macromolecular complexes that inject protein payloads into eukaryotic cells by driving a spike through the cellular membrane. Photorhabdus virulence cassette (PVC)—an eCIS from the entomopathogenic bacterium *Photorhabdus asymbiotica*—is mediated by specific recognition of a target receptor by a distal binding element of the PVC. PVC can be reprogrammed to target organisms not natively targeted by these systems—including human cells and mice—with efficiencies approaching 100%. PVCs can load diverse protein payloads, including Cas9, base editors and toxins, and can functionally deliver them into human cells. Therefore, PVCs are programmable protein delivery devices with applications in gene therapy, cancer therapy and biocontrol.

*Research is to see what
everybody else has seen,
and to think what
nobody else has thought.*

—Albert Szent-Gyorgyi



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Last updated on 10/09/2023

<https://web.mit.edu/search/?q=Shoumen+Datta>

Three respiratory viruses could make you sick this season – but for the first time, there are vaccines against all of them

By Brenda Goodman, CNN

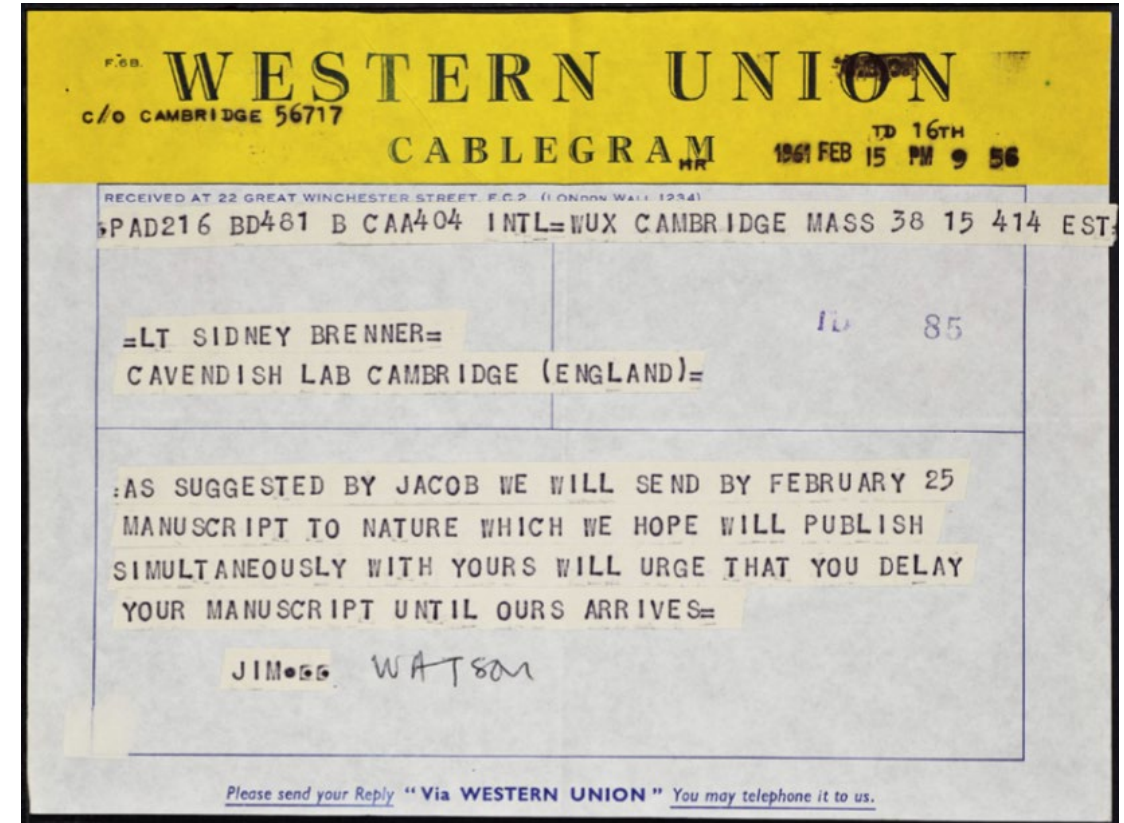
Updated 8:42 AM EDT, Fri August 18, 2023



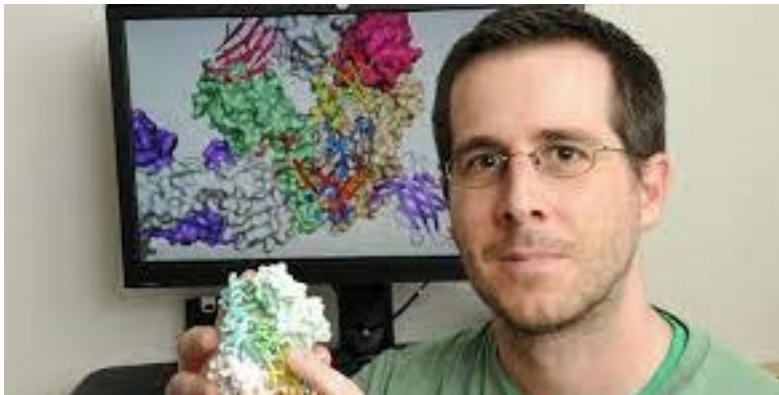
**WHO
DISCOVERED
MESSENGER
RNA TO MAKE
IT POSSIBLE TO
PRODUCE THE
MESSENGER
RNA VACCINE
FOR COVID-19**

SCIENCE AS A SERVICE TO SOCIETY

- First person: DNA produces RNA which in turn leads to protein synthesis was André Boivin, 1947.
- First suggestion: small RNA molecules move from nucleus to cytoplasm and associate with ribosomes where they drive protein synthesis was made by Raymond Jeener, 1950.
- First reports: what we would now identify as mRNA were from Al Hershey, 1953 and by Volkin and Astrachan, 1956.
- First realization: mRNA might exist - insight of Brenner and Crick; Jacob and Monod claimed to name “m” RNA
- First unambiguous description of mRNA: Brenner, Crick and Meselson; later Jim Watson’s team, see cablegram →
- First to prove mRNA’s biological function: Nirenberg and Matthaei (they did not frame their results in these terms).

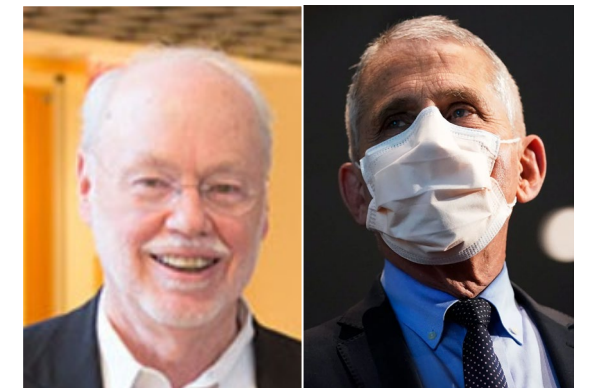
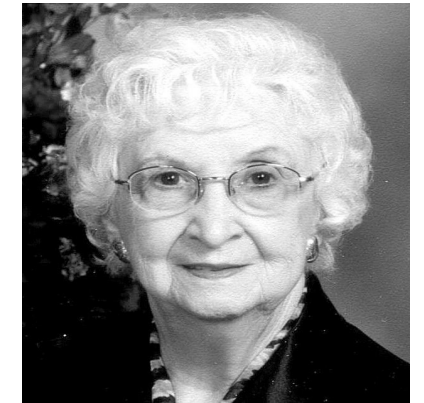


AN ODE TO A FEW OF MANY PIONEERS OF mRNA VACCINE

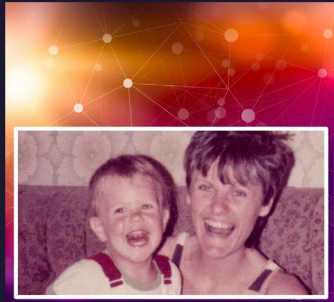


From top: (Susan Francia) Katalin Kariko, Jason McLellan, Kizzmekia Corbett, Barney Graham

It took almost 50 years, but the grand convergence of basic science research made it possible to produce and implement mRNA vaccines for CoVID-19 in order to immunize humans against SARS-CoV-2[n]. It is a brilliant beacon of research excellence and science in the service of society, when it was needed the most, during the pandemic of the 21st century.



From top: Bob Langer, Marilyn Kozak, Phil Sharp, Anthony Fauci



What we do
in life, echoes
in eternity ...

Rowing Mom Wins Nobel

Submitted by: Susan Francia
(October 3, 2023)



Longtime rowing mom Dr. Katalin Kariko won the Nobel Prize for Medicine, achieved during a time she sent in Photos of the Day to row2k over the years, really impressive. row2k asked Susan for a photo of the family at a rowing race, and she sent this one taken by her aunt, along with the following note.

<https://www.nobelprize.org/prizes/medicine/2023/kariko/interview/>



Photographer: Bela Francia

Dr. Katalin Karikó receiving call from Sweden at her home on Oct 2, 2023

<https://www.nobelprize.org/prizes/medicine/2023/summary/>

The Nobel Prize in Physiology Medicine 2023



Ill. Niklas Elmehed © Nobel Prize Outreach
Katalin Karikó
Prize share: 1/2



Ill. Niklas Elmehed © Nobel Prize Outreach
Drew Weissman
Prize share: 1/2

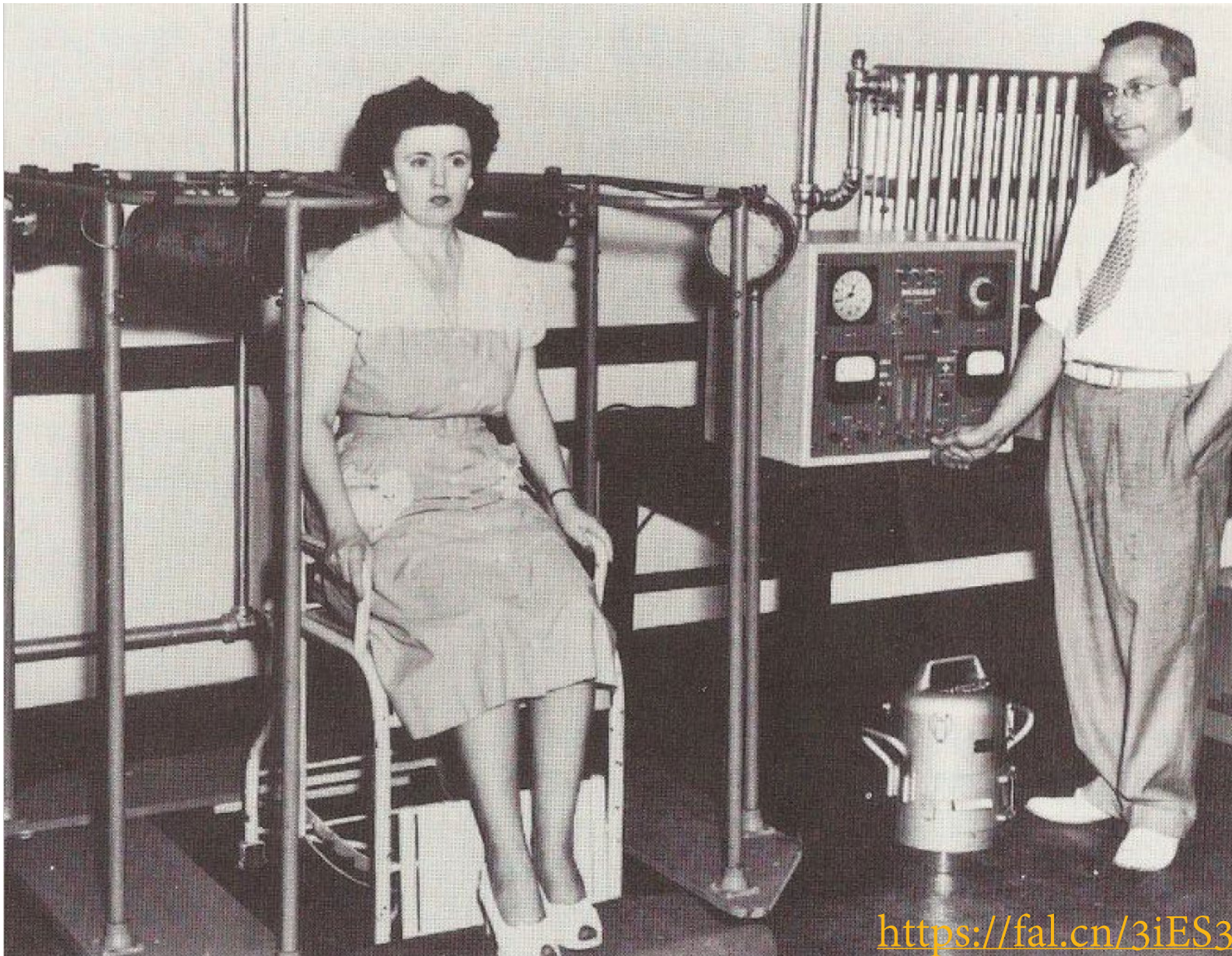
@kkariko @zfrancia



DEDICATION

TRACING HISTORICAL ROOTS





In 1937, MGH Thyroid Clinic director Saul Hertz, MD, teamed up with (MIT) Massachusetts Institute of Technology physicists to develop an early medical application of radiation. Hertz was testing his theory that iodine could deliver radiation to treat thyroid cancer, Graves' disease and goiter. The thyroid, a small gland in the neck, uses the nutrient iodine in making hormones that contribute to organ function and metabolism. When a patient drinks radioactive iodine it collects in the thyroid, destroying problem tissue without affecting neighboring organs. In this image from the 1940s, Hertz tests how much radiation his subject (colleague Doris Darby) absorbed when using radioiodine as a tracer. The radioiodine was prepared by Glenn Seaborg at the Radiation Lab, UC Berkeley.

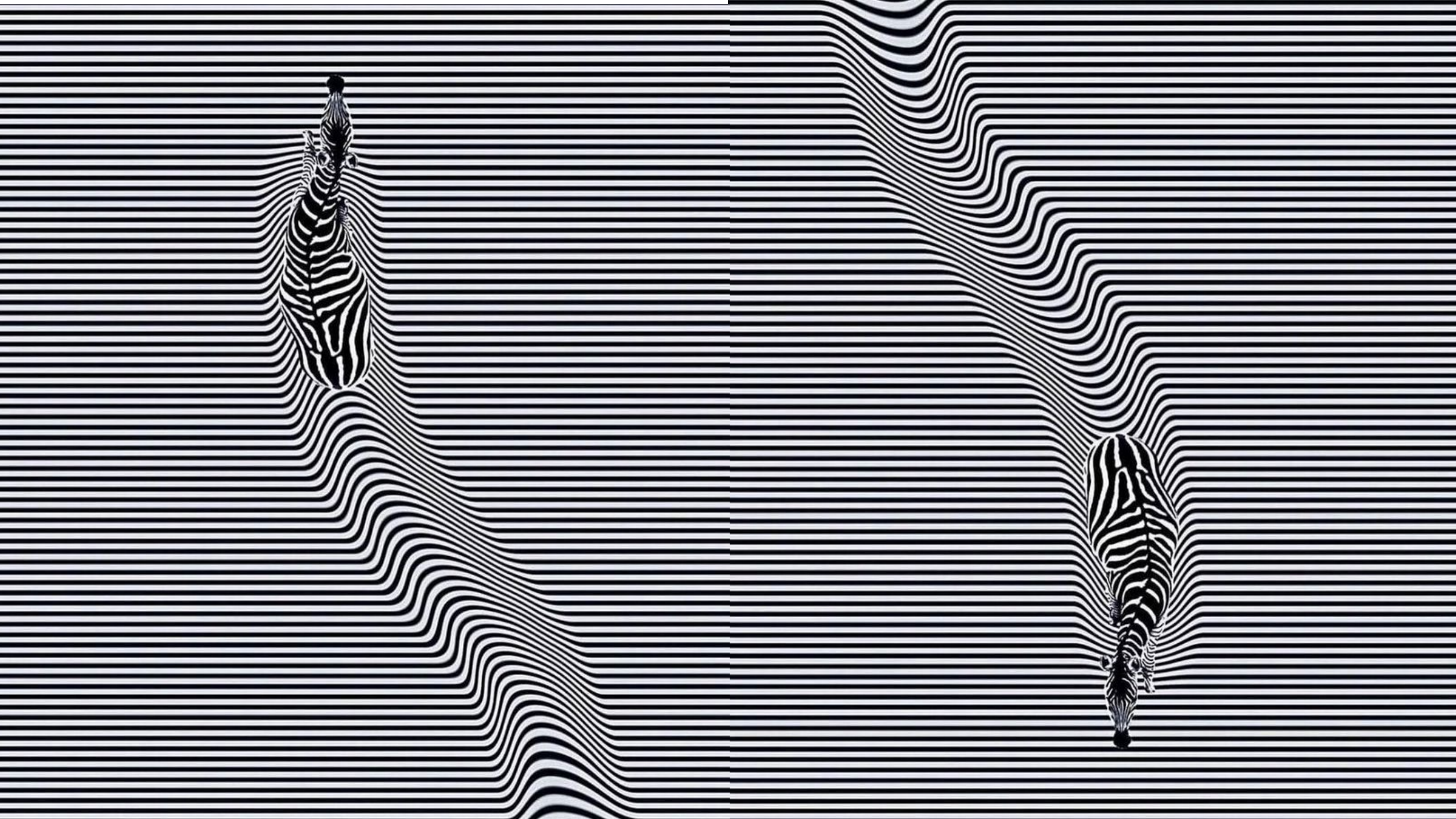


J. Larry Jameson

Anne Klibanski

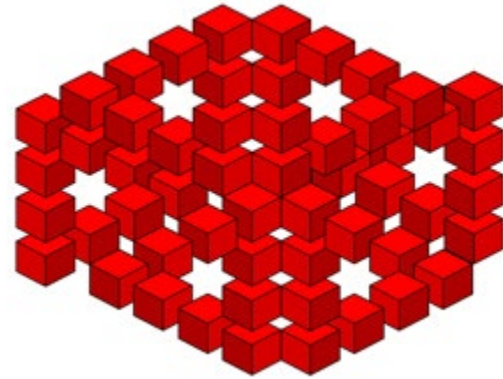
<https://www.med.upenn.edu/evpdean/jameson.html>

www.massgeneralbrigham.org/en/about/leadership-and-governance/anne-klibanski



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