

Unleashing the power of AI for public health

Alberto E Tozzi

Preventive and Predictive Medicine Research Unit

President of the International Society for Pediatric Innovation



Enhanced surveillance



- Monitoring key aspects of visitors of VSN web sites as if it was a **unique communication channel**
- Improving **digital dissemination** of vaccine safety information on a global scale
- Rapidly adapt communication strategy to **context**

Multiple data sources

- Web analytics
- Google trends
- Google search
- Scientific publications
- Epidemiologic data
- Social media

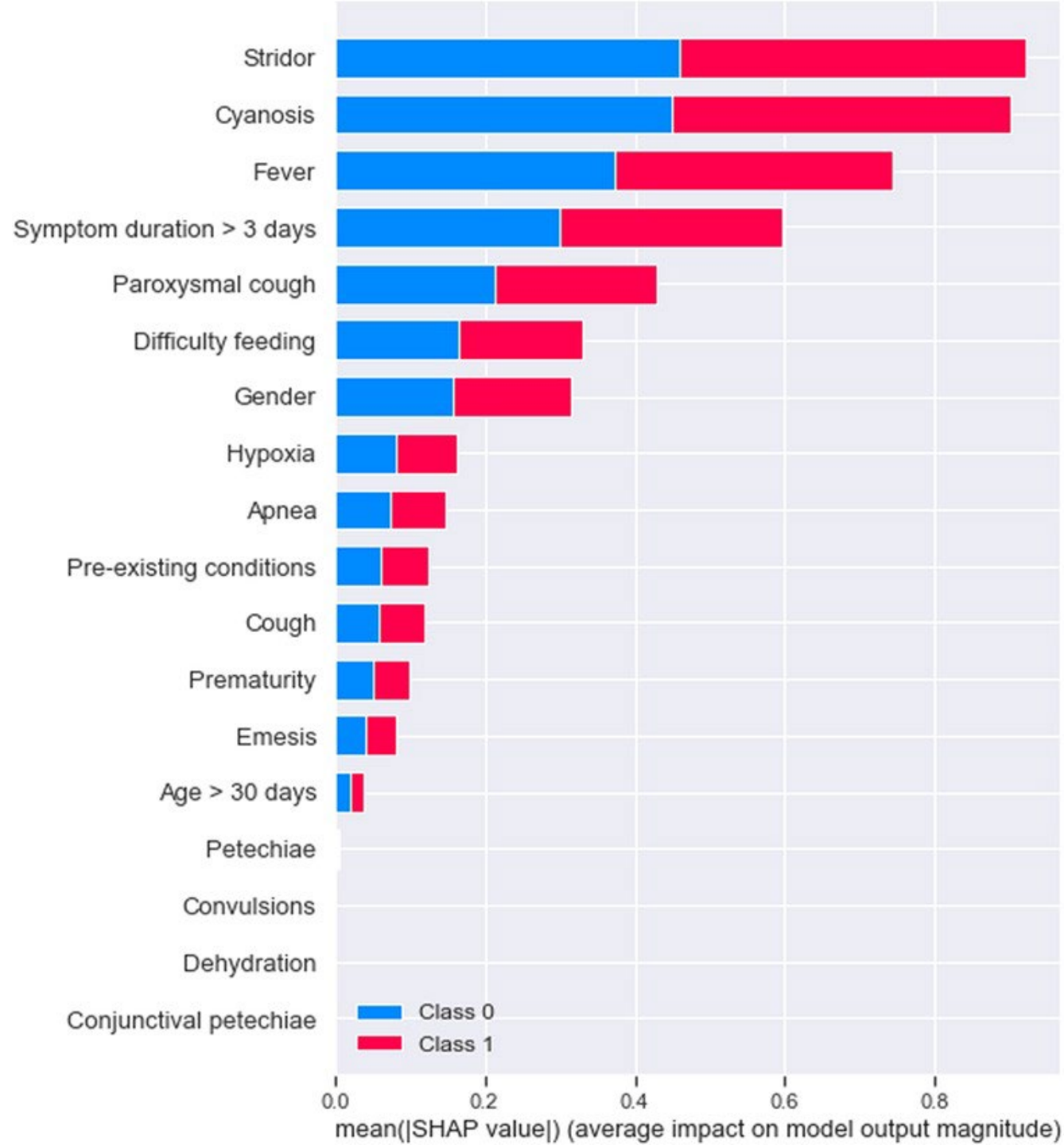
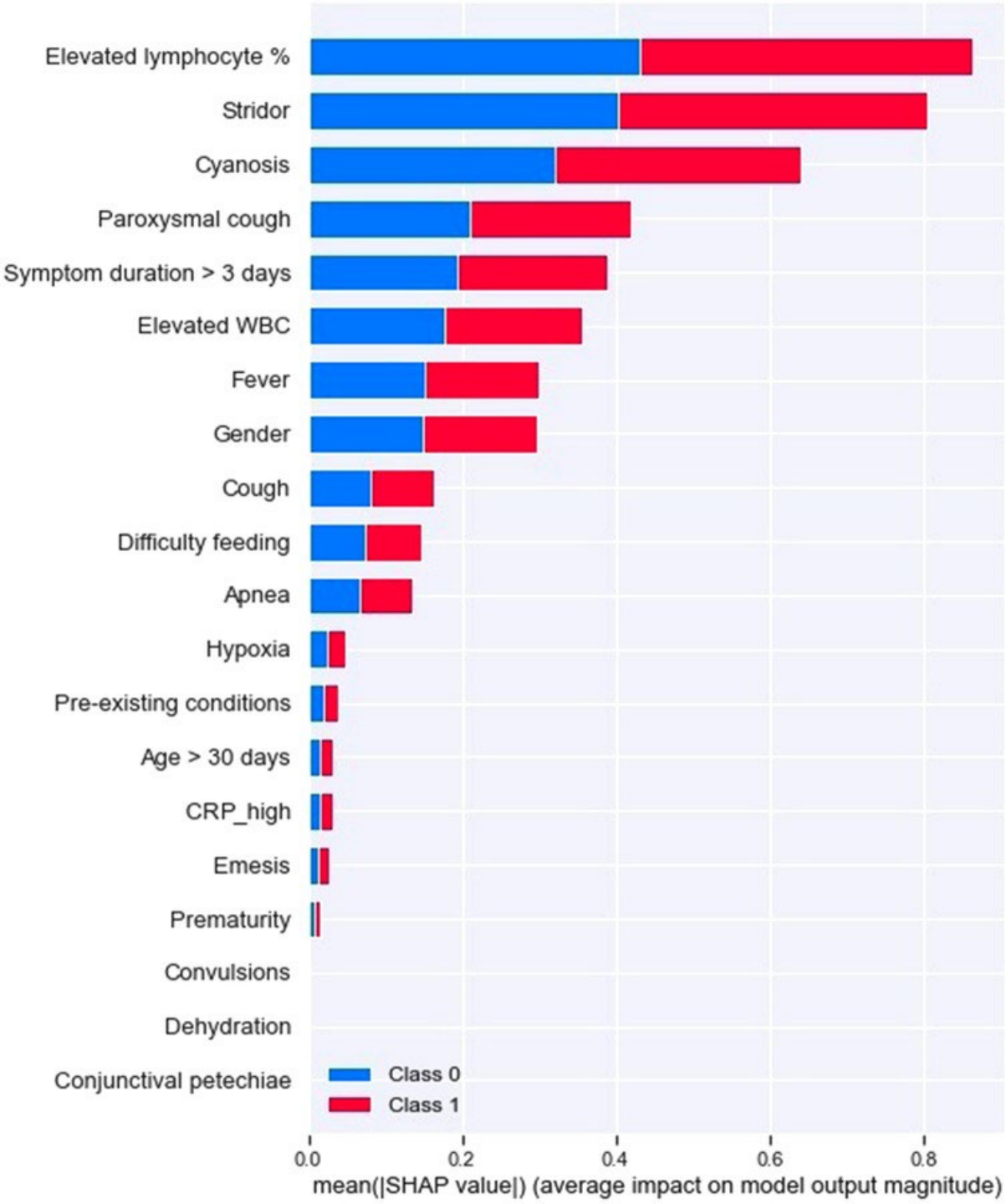
What AI can do

- Precisely classifying population segments
- Identifying complex trends and patterns
- Making predictions about future scenarios

Improving sensitivity and
specificity of case definitions for
surveillance

Case definitions

- Universal case definitions for surveillance
- Role of laboratory confirmation
- Need of adapting to recent advancements (EHR, etc)



Accuracy of models for pertussis and RSV

	Pertussis (model 1)		RSV (model 2)	
	Model A	Model B	Model A	Model B
Sensitivity	0.83	0.75	0.69	0.74
Specificity	0.61	0.72	0.67	0.66
Total test set (<i>n</i>)	117	117	117	117
True positives (<i>n</i>)	22	26	12	12
True negatives (<i>n</i>)	67	61	68	74
False positives (<i>n</i>)	14	20	31	25
False negatives (<i>n</i>)	14	10	6	6

Model A refers to the main model including basic laboratory data (hospital/clinic), model B refers to the alternative model including only syndromic data (for outpatient settings without availability of performing laboratory data).

A simple decision tree

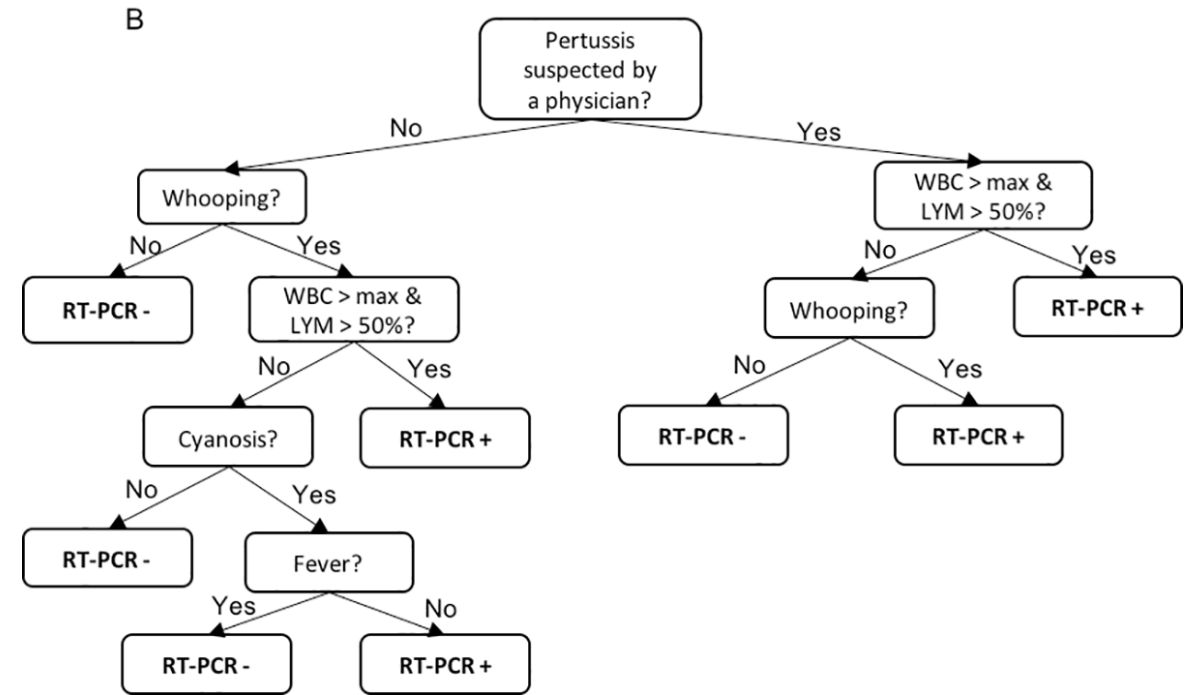
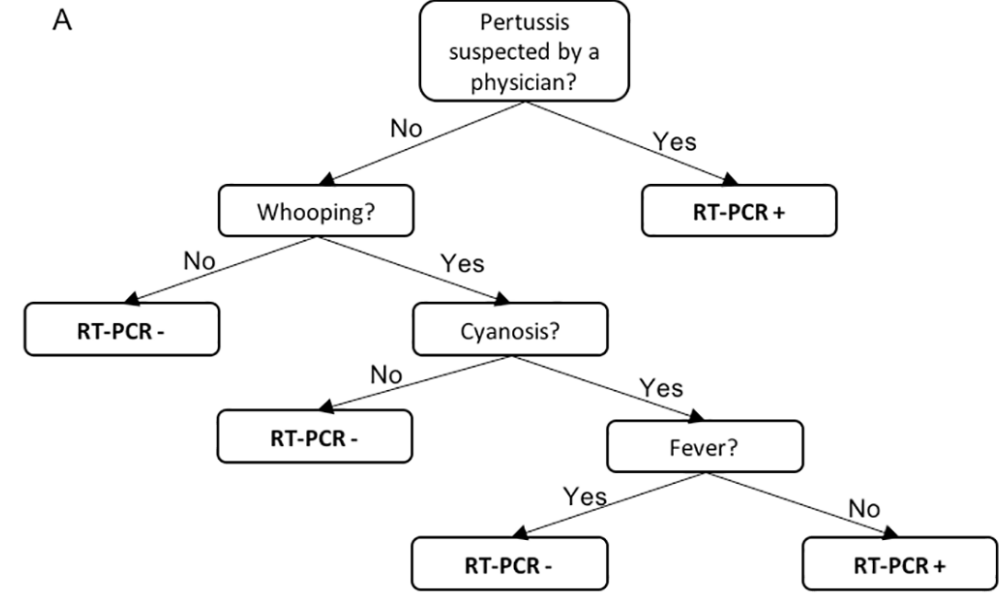


Table 4. Comparison of accuracy of algorithms with some clinical surveillance case definitions for pertussis.

	WHO (14)	CDC (15)	ECDC (16)	Algorithm A	Algorithm B
Accuracy	73.30%	70.53%	55.25%	79.93%	78.39%
Sensitivity	40.63%	30.63%	75.62%	46.30%	41.70%
Specificity	86.95%	87.21%	46.74%	94.00%	94.00%
PPV	56.52%	50%	37.20%	76.30%	74.70%
NPV	77.80%	75.06%	82.10%	80.70%	79.10%
LR+	3.11	2.39	1.42	7.72	6.95
LR-	0.68	0.795	0.52	0.571	0.62

PPV: Positive Predictive Value.

NPV: Negative Predictive Value.

LR+: Positive Likelihood Ratio.

LR-: Negative Likelihood Ratio.

WHO: World Health Organization.

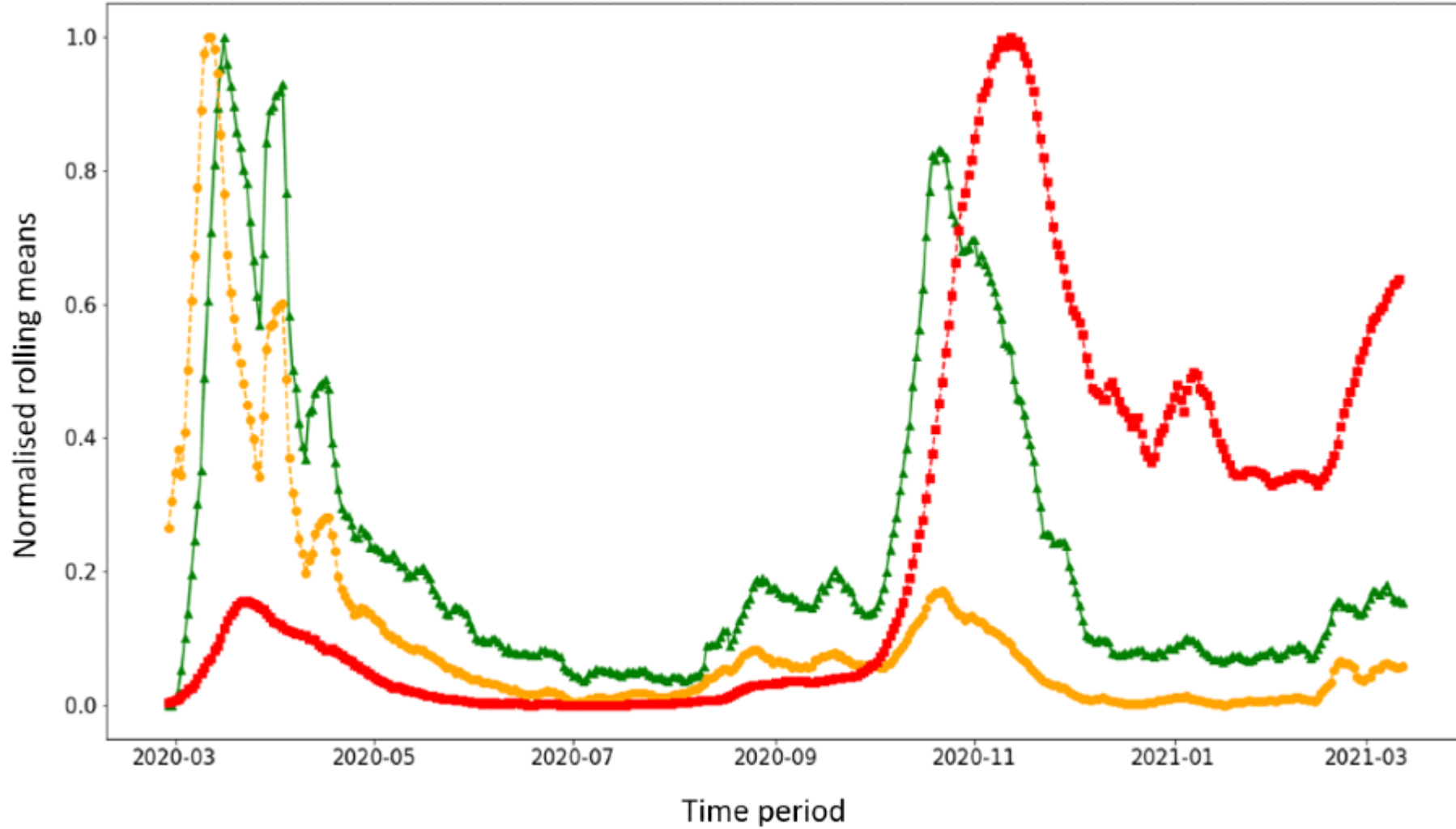
ECDC: European Centre for Disease Prevention and Control.

<https://doi.org/10.1371/journal.pone.0236041.t004>

Tozzi AE, Gesualdo F, Rizzo C, Carloni E, Russo L, et al. (2020) A data driven clinical algorithm for differential diagnosis of pertussis and other respiratory infections in infants. PLOS ONE 15(7): e0236041. <https://doi.org/10.1371/journal.pone.0236041>
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0236041>

Can we detect an epidemic
surge in advance?

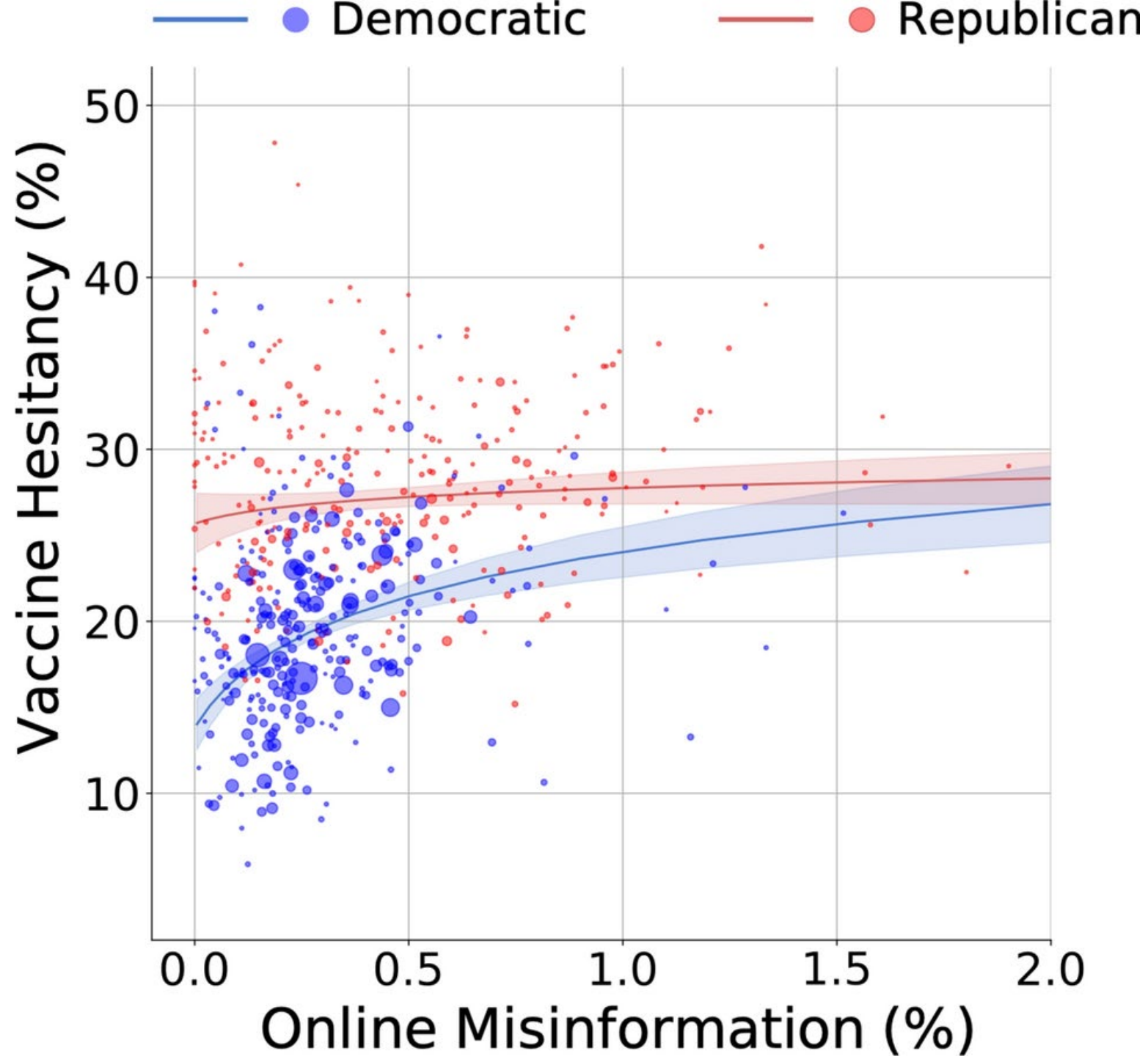
A Covid 19 chatbot

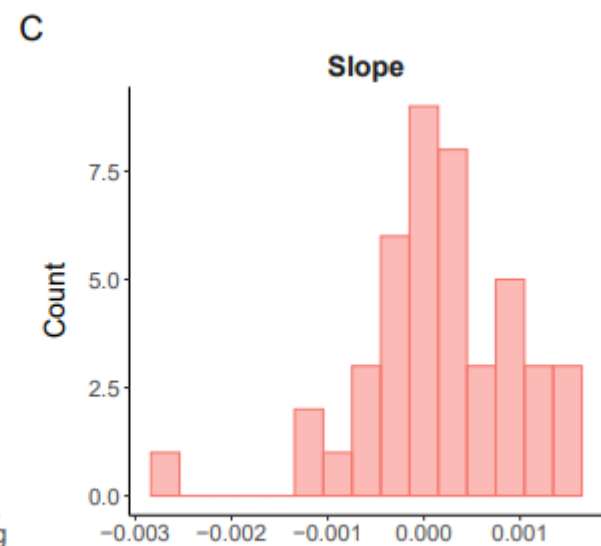
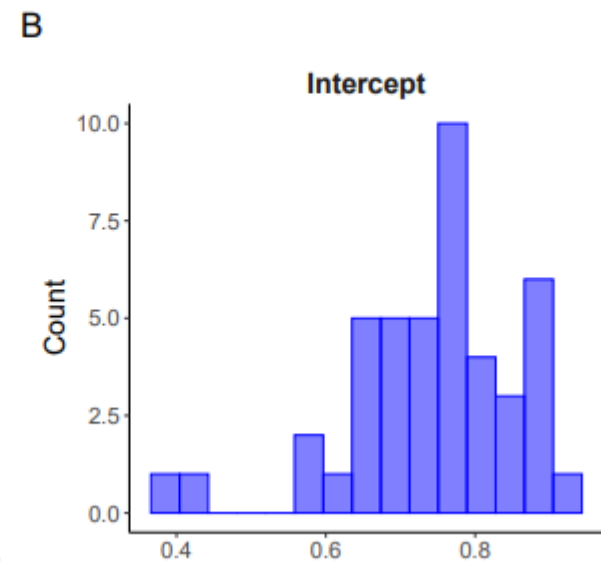
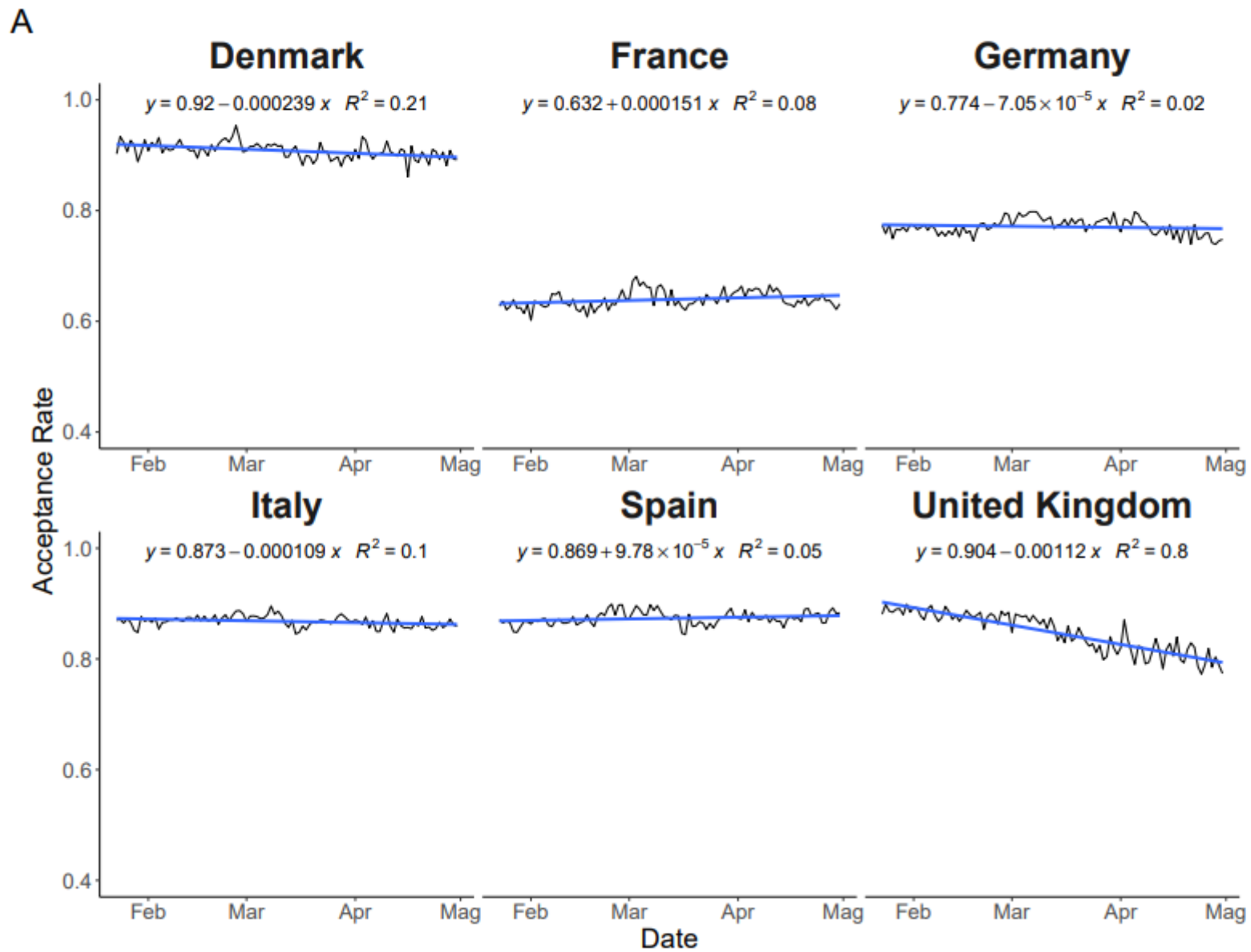


Infodemics

Table 1. The main analogies between epidemics and infodemics

Features	Epidemics	Infodemics
Agent	Infectious agent (i.e., virus, bacterium, fungus, parasite...)	Type of message in a given medium (e.g., particular conspiracy theory in a viral video, a statistic on vaccine efficacy in a tweet)
Medium	Route of transmission (respiratory, oral-fecal route, sexual contacts...)	Communication channel (news, social media platform, newsgroup, radio program, blog...)
Timescale	Infectious period, reproductive number	How quickly information spreads and accumulates, including the persistence of mis- and dis-information
Network of interaction	The pattern of contacts along which transmission occurs (individuals who have a contact at risk for transmission)	Communication network for the user and content interaction (nodes of transmission, interconnectedness, clustering, homophily, content filtering algorithms)
Control measures	Actions to limit the epidemic (vaccination campaigns, non-pharmaceutical interventions, epidemiological surveillance)	Actions to limit the infodemic (skill building, science and media literacy, pre-bunking)





Text

Stance

My children are vaccinated against #chickenpox. There's been an epidemic in their school and they've been fine, happy, did not have any symptom. Davide was born in 2012, we payed for the vaccine because it was not free for his age. Renounce everything but #vaccinate, for your children and for the others.

Promotional

Coronavirus, WHO: For the vaccine we'll have to wait at least for 18 months.

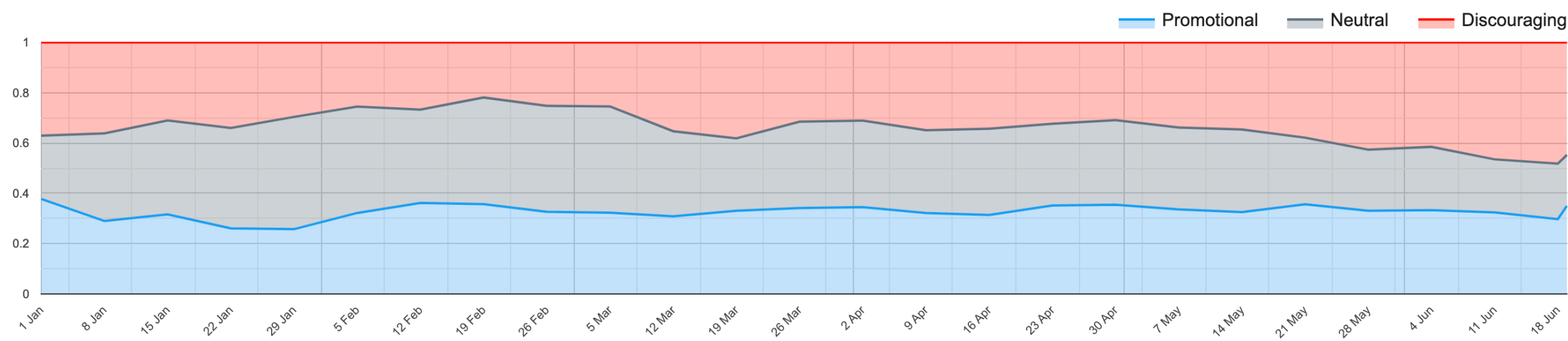
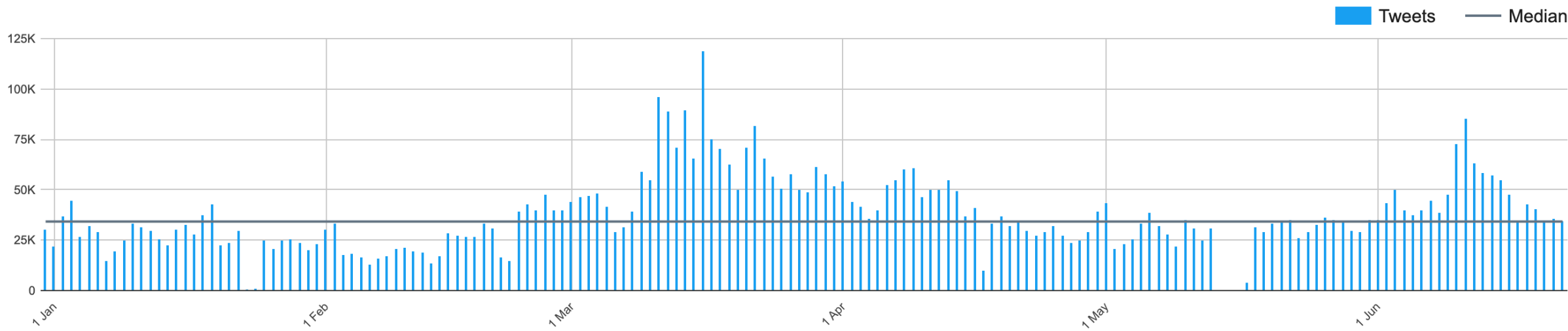
Neutral

#vaccines DISABLED for a #fluvaccine. Ministry of Health condemned to pay. Vaccines are DRUGS. Be wary of all those that say that vaccines are safe and do not have #sideeffects. You can't go back.

Discouraging

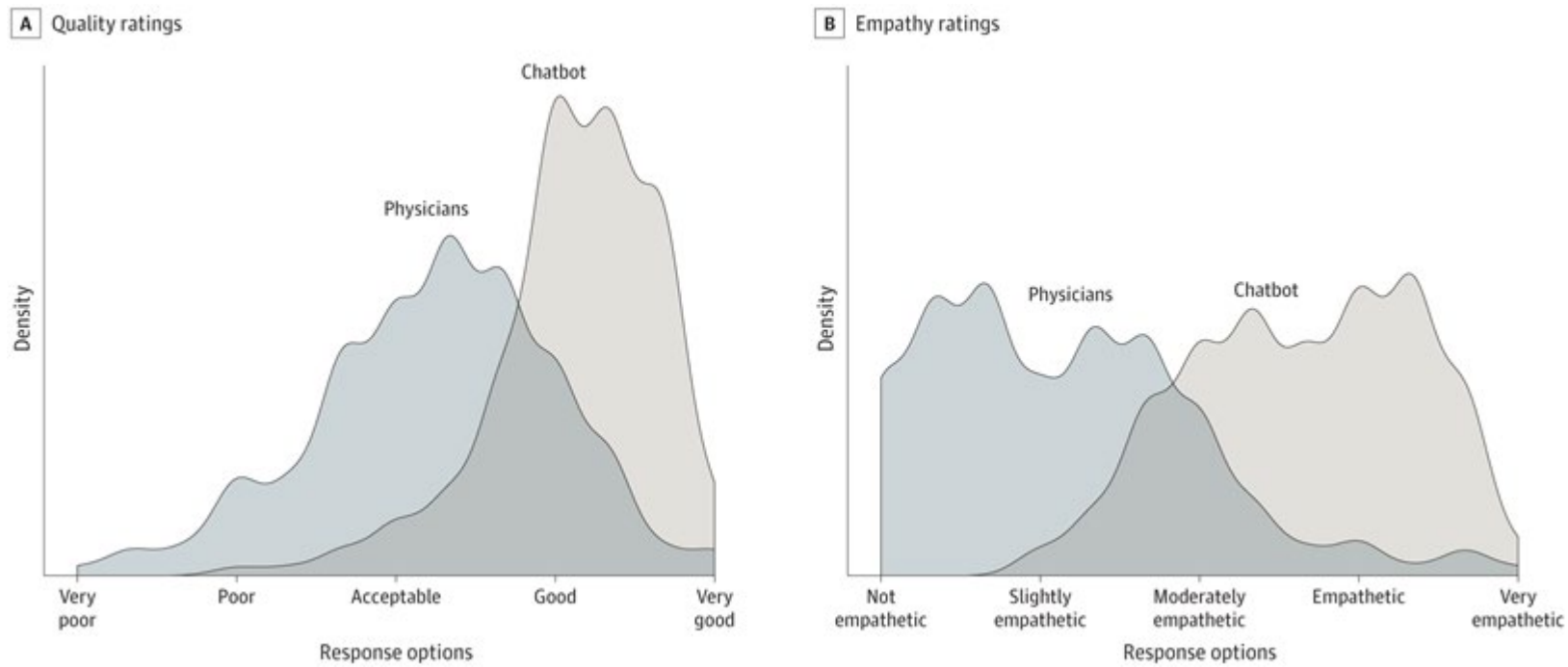
I still have to decide and I'm scared...if I get the vaccine, I don't know side effects...but what if I don't get the vaccine and I get covid? for how long will I be in danger? If I get vaccinated, how long is the vaccine going to work? I'm scared...any advice?

Ambiguous



Large Language Models

Is AI better than medical doctors?



The tetanus vaccine is important because it helps protect against tetanus, a serious bacterial infection that can be potentially life-threatening. Here are a few key points explaining its significance:

1. **Disease Prevention:** Tetanus is caused by the bacterium *Clostridium tetani*, which is commonly found in soil, dust, and animal feces. The infection occurs when the bacteria enter the body through a wound or cut, particularly if it is deep or contaminated. Tetanus can cause severe muscle stiffness and spasms, leading to difficulty in breathing, swallowing, and potentially resulting in death.

2. **Vaccine Effectiveness:** The tetanus vaccine is highly effective in preventing tetanus. It stimulates the immune system to produce protective antibodies against the toxin produced by the bacteria. These antibodies neutralize the toxin, preventing it from causing the characteristic symptoms of tetanus.

3. **Routine Immunization:** The tetanus vaccine is typically administered as part of routine childhood immunization schedules. In many countries, it is given as a combination vaccine called the DTaP vaccine, which protects against diphtheria, tetanus, and pertussis (whooping cough). Booster doses are recommended throughout life to maintain protection.

4. **Wound Management:** Vaccination is especially crucial for individuals who sustain wounds that could potentially expose them to tetanus-causing bacteria. The vaccine helps ensure that they are adequately protected in case of any bacterial contamination, reducing the risk of developing tetanus.

5. **Public Health Importance:** Widespread tetanus vaccination has significantly reduced the incidence of the disease worldwide. It is an essential component of public health efforts to control and eradicate tetanus.

Remember, if you have a deep or dirty wound and are unsure of your vaccination status, it's essential to seek medical attention promptly. A healthcare professional can assess the need for a tetanus booster or other appropriate medical intervention.

The tetanus vaccine is like a special medicine that helps protect us from a really bad infection called tetanus. Tetanus is caused by tiny germs called bacteria that can get inside our bodies when we have a cut or wound.

These bacteria live in things like soil, dust, and poop. When they get inside our bodies, they can make us very sick. They can make our muscles become very stiff and make it hard to breathe or swallow, which is really dangerous.

But don't worry! The tetanus vaccine helps our bodies fight against these bacteria. It tells our body's defense system, called the immune system, to make special fighters called antibodies. These antibodies are like superheroes that can stop the bacteria from hurting us.

When we get the tetanus vaccine, it helps our body remember how to make these superheroes, so they are ready to protect us if we ever get hurt again. That's why it's important to get the vaccine when we're young and also get booster shots as we grow up.

Getting the vaccine is part of staying healthy and making sure we don't get sick from tetanus. It's like wearing armor to protect ourselves from getting hurt by the bad bacteria. Doctors and scientists work hard to make sure we stay safe from tetanus by giving us this special vaccine.

If you ever have a deep or dirty cut, it's important to tell a grown-up and get it cleaned and checked by a doctor. They will make sure you're protected and take care of you.

Remember, the tetanus vaccine is like a superhero shield that keeps us safe from a bad infection called tetanus.

PERSPECTIVE article

Front. Public Health, 25 April 2023

Sec. Digital Public Health

Volume 11 - 2023 | <https://doi.org/10.3389/fpubh.2023.1166120>

This article is part of the Research Topic

Computational and Explainable Artificial Intelligence Approaches for Fact-Checking Mis/disinformation

[View all Articles >](#)

ChatGPT and the rise of large language models: the new AI-driven infodemic threat in public health



Luigi De Angelis^{1†},



Francesco Baglivo^{1†},



Guglielmo Arzilli^{1*},



Gaetano Pierpaolo Privitera^{1,2},



Paolo Ferragina³,



Alberto Eugenio Tozzi⁴ and



Caterina Rizzo¹

¹ Department of Translational Research and New Technologies in Medicine and Surgery, University of Pisa, Pisa, Italy

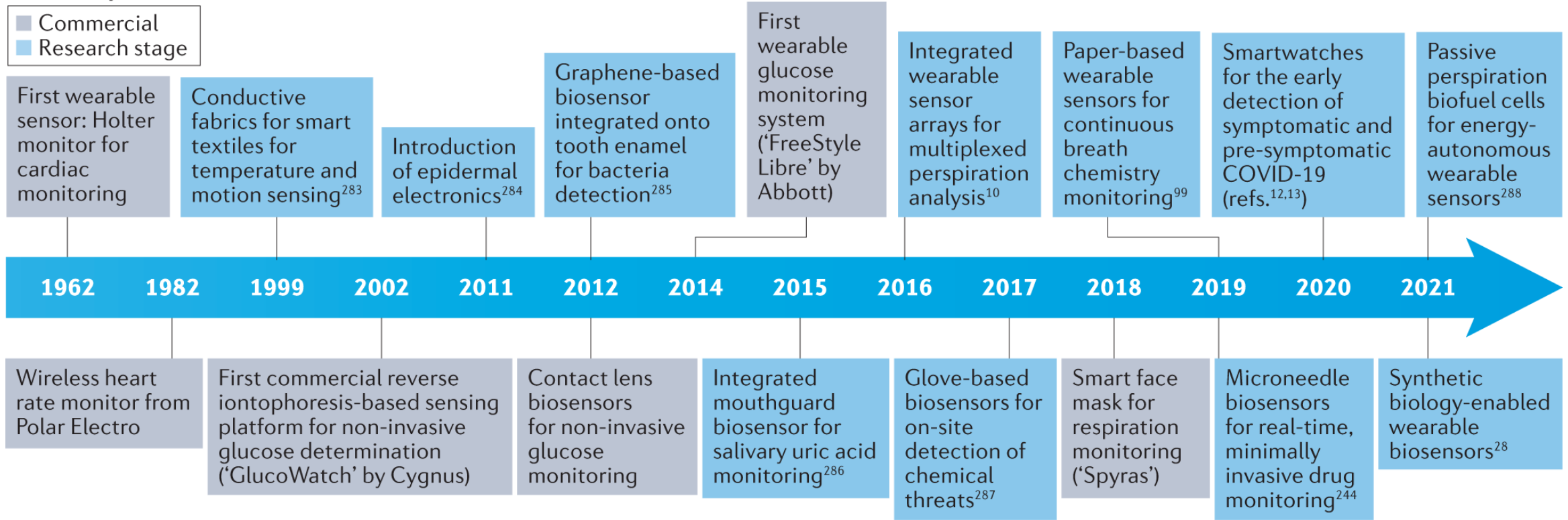
² Training Office, National Institute of Health, Rome, Italy

³ Department of Computer Science, University of Pisa, Pisa, Italy

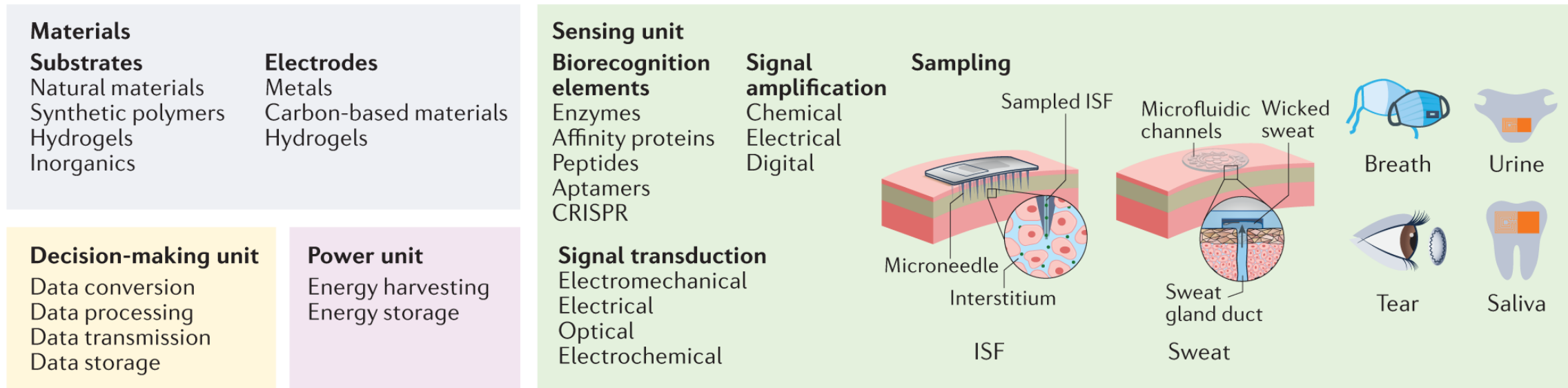
⁴ Fetal, Neonatal and Cardiologic Science Research Area, Predictive and Preventive Medicine Research Unit, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy

Digital twins

a Development of wearable sensors



b Building blocks of wearable sensors



Environmental monitoring scenarios

Landslide detection

Greenhouses

Air pollution

Structural health

Earthquake detection

Toxic gas monitoring

Gases monitoring

Radiation level

Water monitoring

Animal tracking

Noise maps

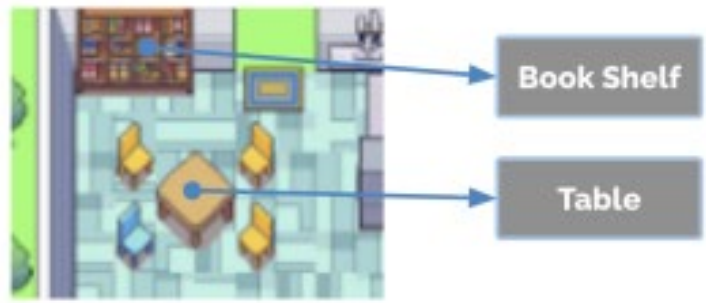
Indoor monitoring

Rural & Agricultural Monitoring

Urban & Industrial Monitoring



Family House



Common Room

Morning routine



Waking up



Brushing teeth



Taking a shower



Cooking breakfast

Catching up



Packing



Beginning workday



6:00 am

...

7:30 am

7:45 am

8:00 am

What about the data?



SNOWFLAKE MARKETPLACE

Find, try, and buy the data and applications you need to power innovative business solutions

SNOWFLAKE MARKETPLACE

BROWSE MARKETPLACE LISTINGS

[Learn More >](#)

APRIL 4 - MAY 5

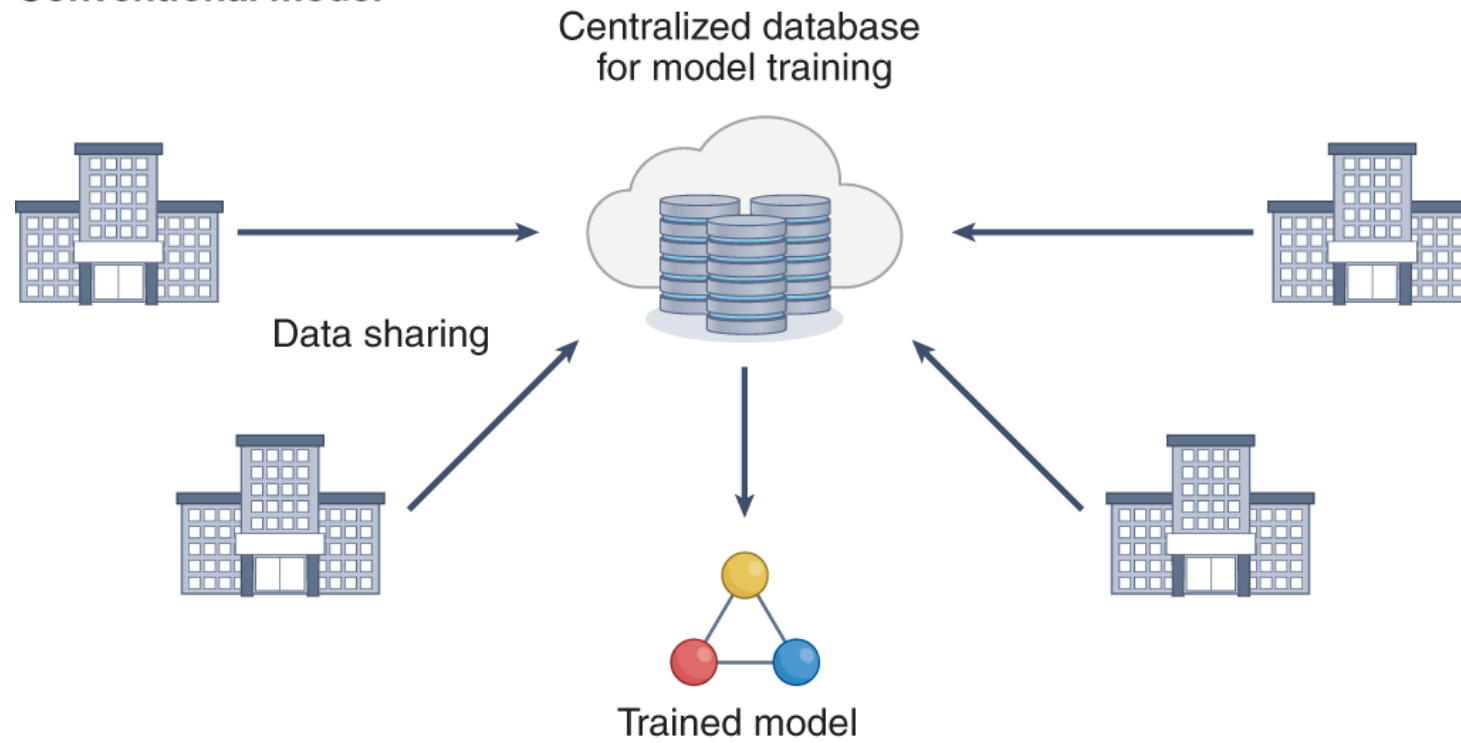
THE GREAT MARKETPLACE SCAVENGER HUNT

[Learn More >](#)

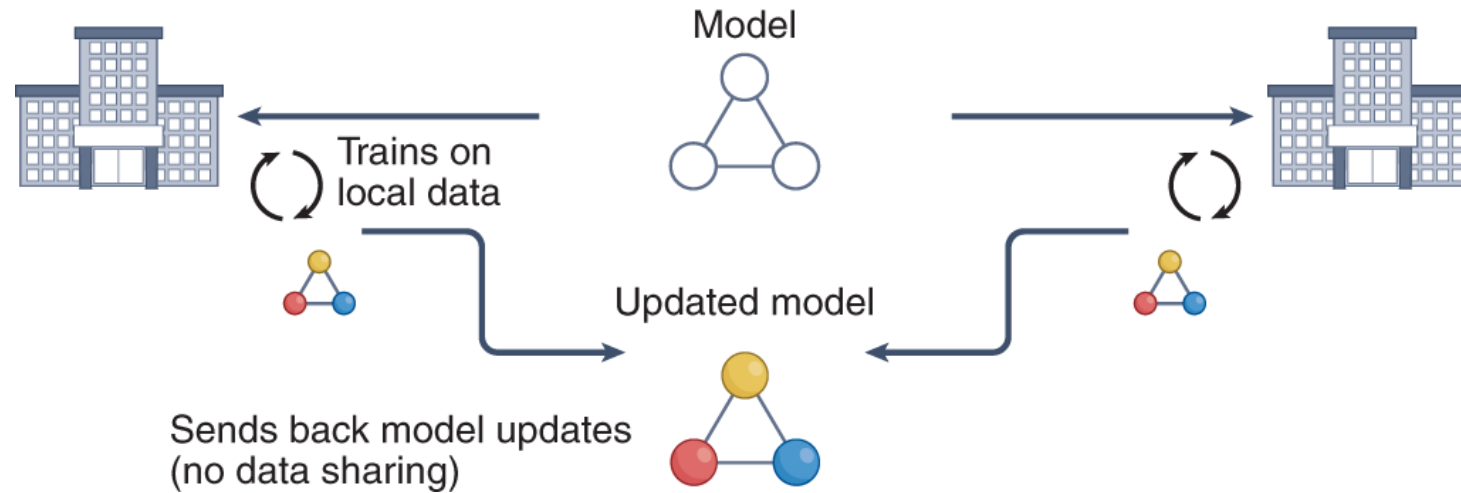


<https://www.snowflake.com/en/data-cloud/marketplace/>

Conventional model



Federated model



Challenges

- Background culture about AI
- Data access
- Interoperability of systems
- National and international regulations
- Data infrastructure