

Using artificial intelligence to improve vaccination strategies

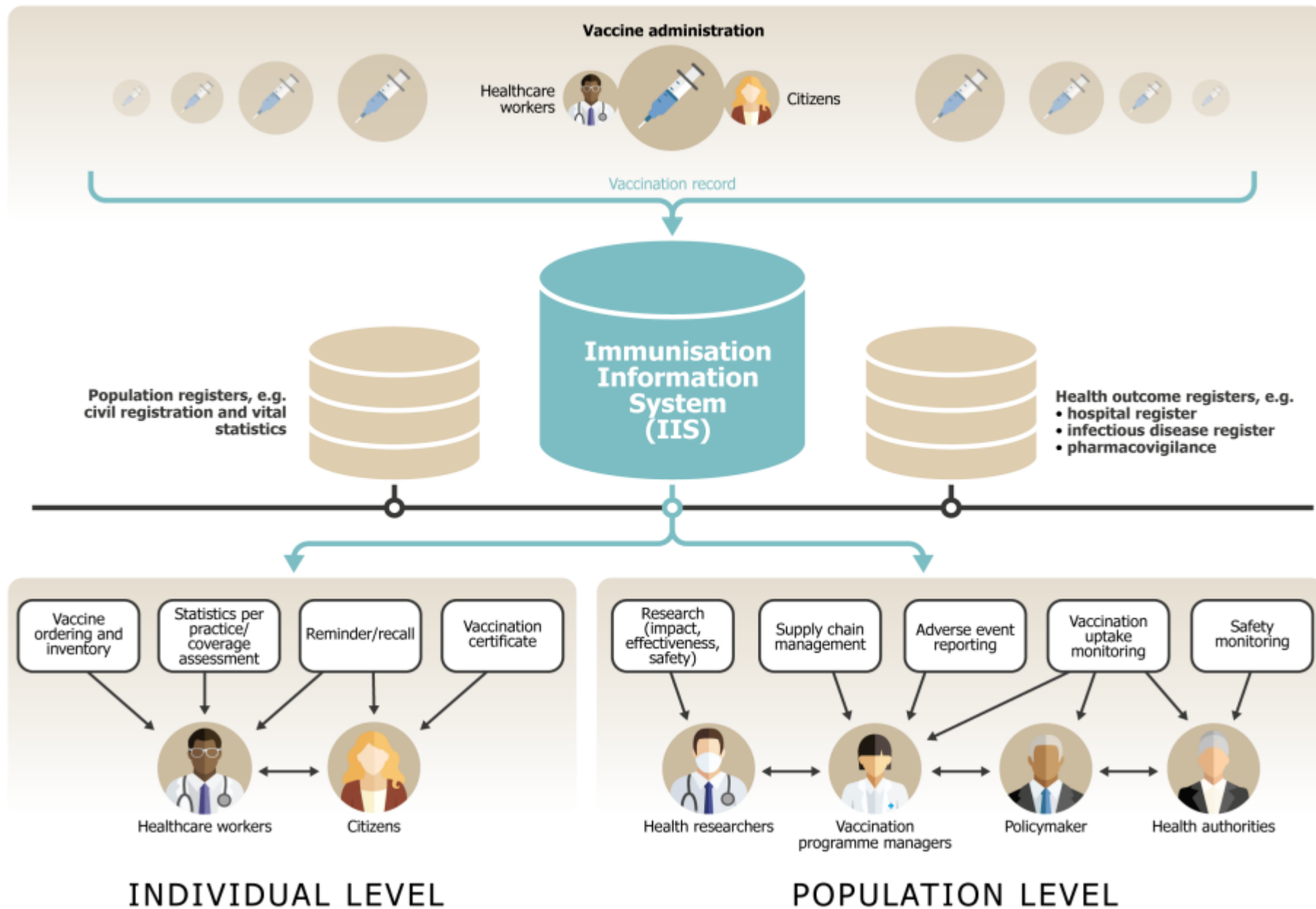
Future challenges and opportunities

Alberto E Tozzi

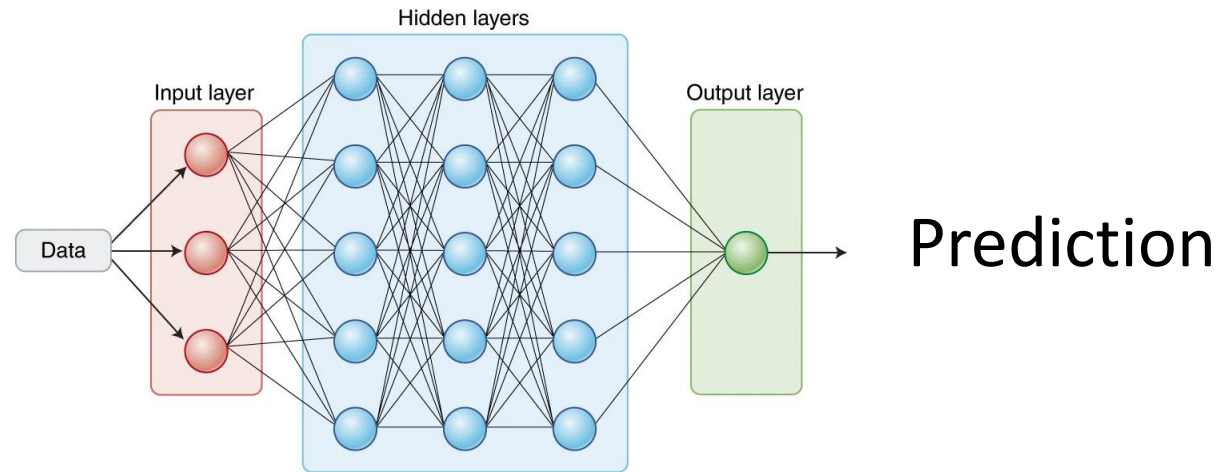
Predictive and Preventive Medicine Research Unit

International Society for Pediatric Innovation





Immunization registries
AEFI surveillance
VPD surveillance
Individual contact matrix
Electronic health records
Web analytics
Google trends
Scientific publications
Social media
....



For decades, we envisioned
the ability to simulate
believable human behavior.

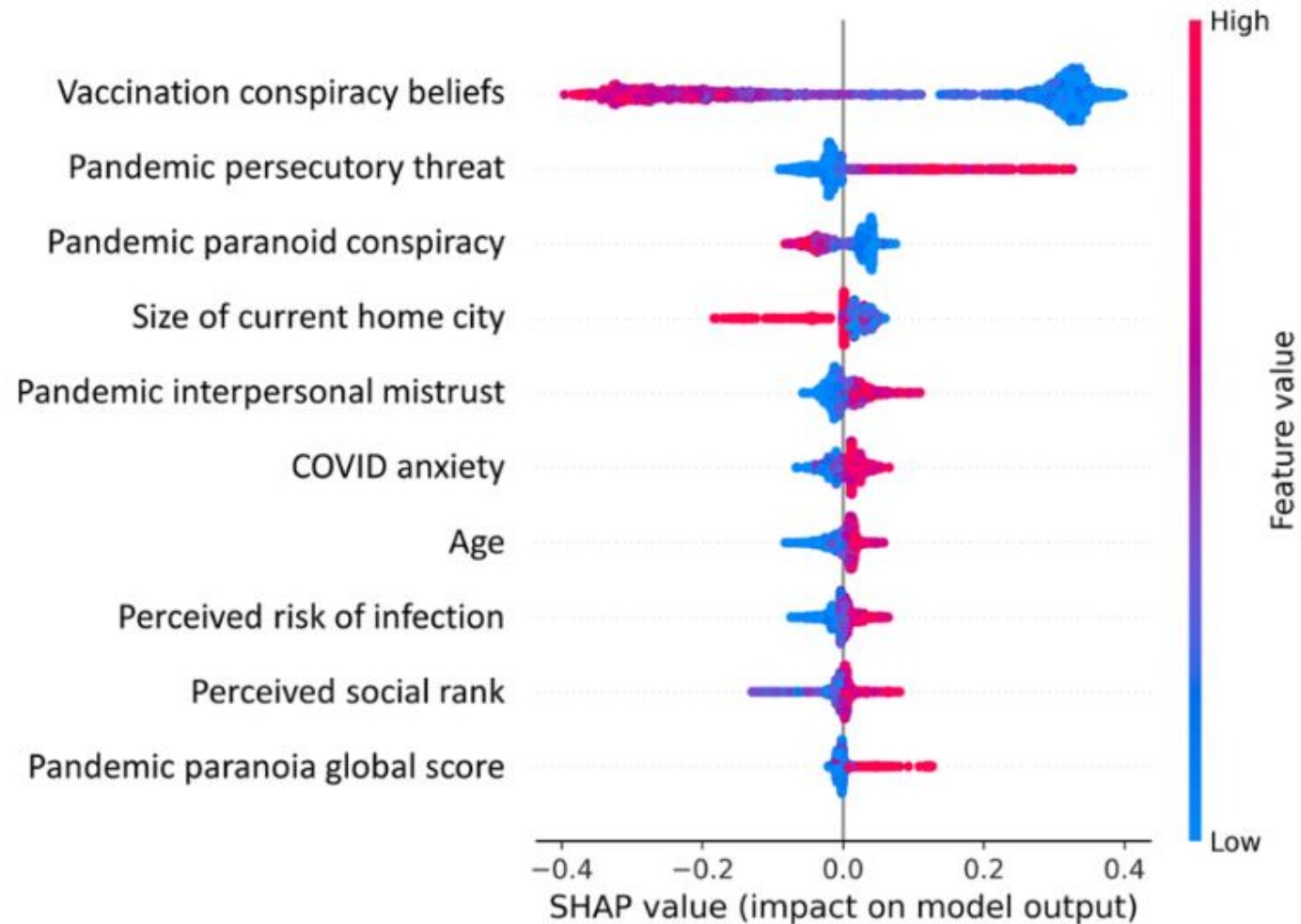
Identifying individuals who will not follow routine immunization schedules by predictive analytics

Large number of features taken from longitudinal studies + Immunization records

Table 4: Prediction models performance for test scenario 1

Algorithms	Confusion matrix	Accuracy (%)	Sensitivity (%)	Specificity (%)	Precision (+ve) (%)	Precision (-ve) (%)
Logistic Regression	$\begin{bmatrix} 1 & 186 \\ 0 & 592 \end{bmatrix}$	76.1	0.5	100.0	100.0	76.1
K-Nearest Neighbors (K-NN)	$\begin{bmatrix} 31 & 156 \\ 74 & 518 \end{bmatrix}$	70.5	16.6	87.5	29.5	76.9
Support Vector Machine (SVM)	$\begin{bmatrix} 0 & 187 \\ 0 & 592 \end{bmatrix}$	76.0	0.0	100.0	-	76.0
Kernel SVM	$\begin{bmatrix} 4 & 183 \\ 2 & 590 \end{bmatrix}$	76.3	2.1	99.7	66.7	76.3
Naive Bayes	$\begin{bmatrix} 33 & 154 \\ 38 & 554 \end{bmatrix}$	75.4	17.6	93.6	46.5	78.2
Decision Tree Classification	$\begin{bmatrix} 77 & 110 \\ 149 & 443 \end{bmatrix}$	66.8	41.2	74.8	34.1	80.1
Random Forest Classification	$\begin{bmatrix} 42 & 145 \\ 82 & 510 \end{bmatrix}$	70.9	22.5	86.1	33.9	77.9
XG Boost	$\begin{bmatrix} 24 & 163 \\ 27 & 565 \end{bmatrix}$	75.6	12.8	95.4	47.1	77.6
Artificial Neural Network (ANN)	$\begin{bmatrix} 0 & 187 \\ 0 & 592 \end{bmatrix}$	76.0	0.0	100.0	-	76.0

ML is helpful in the analysis of factors affecting vaccine hesitancy



Crowdbreaks

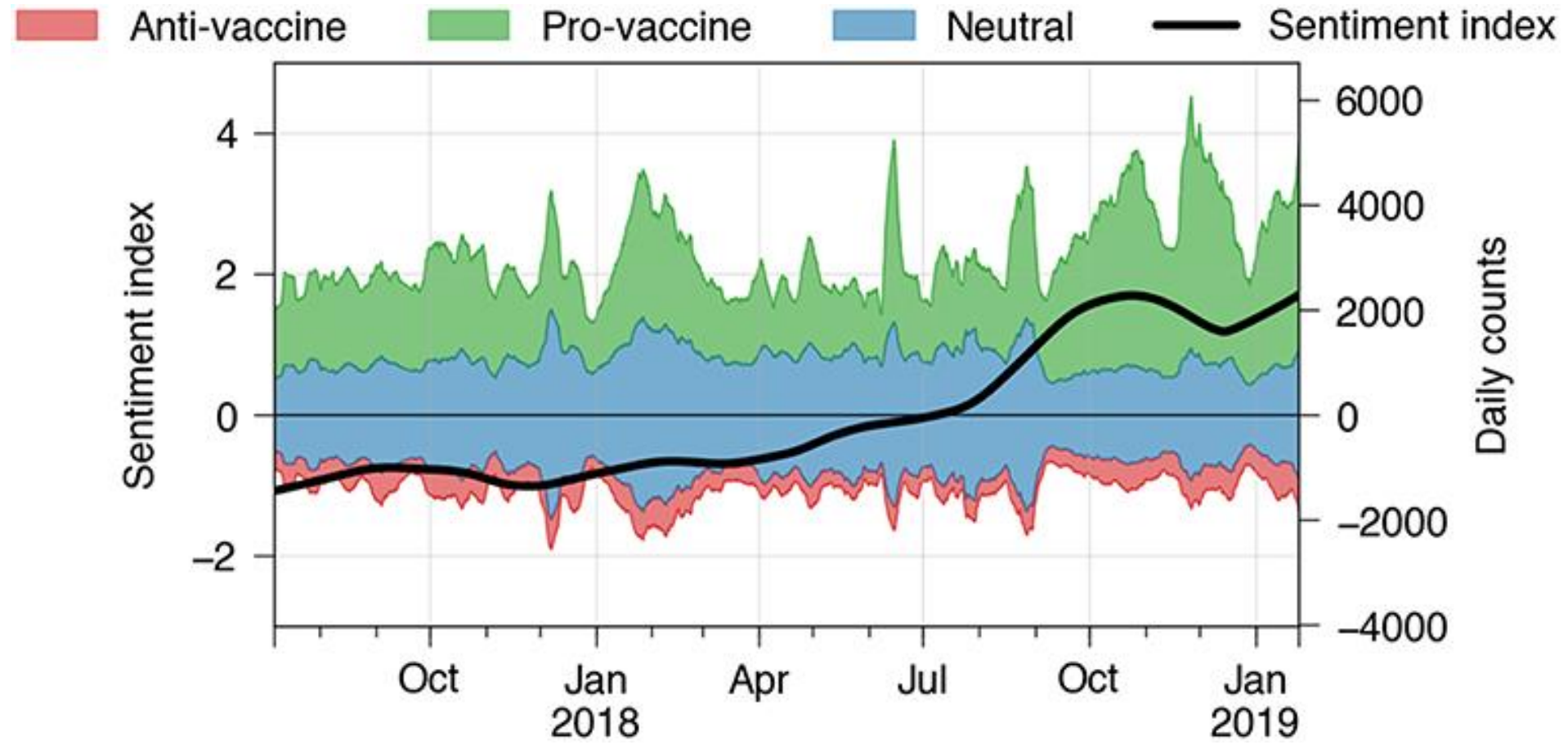
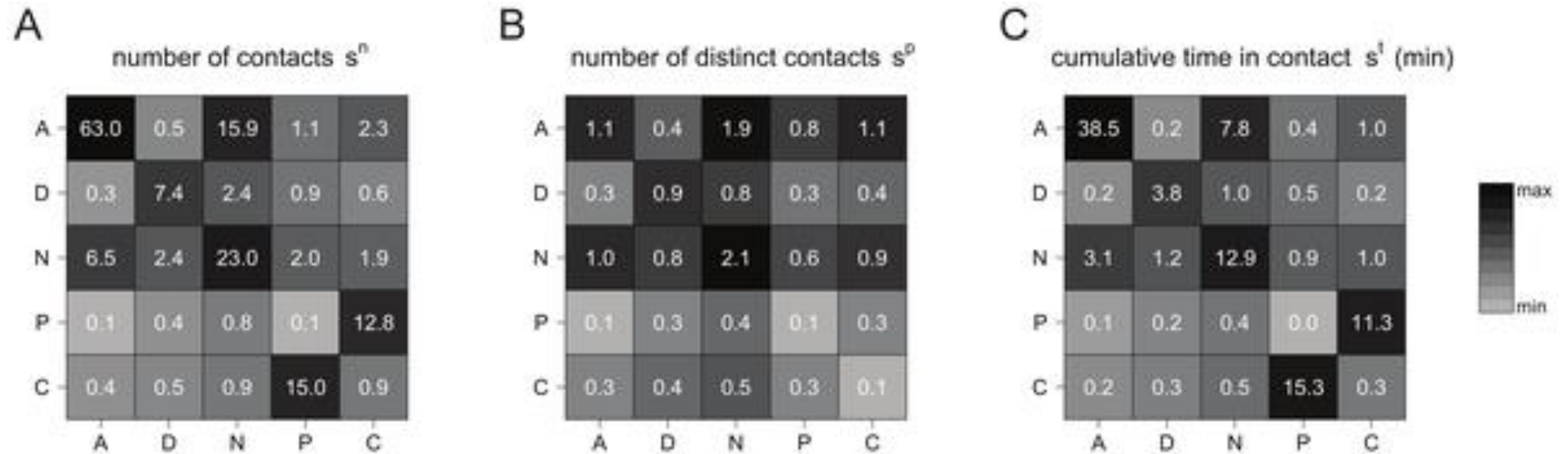
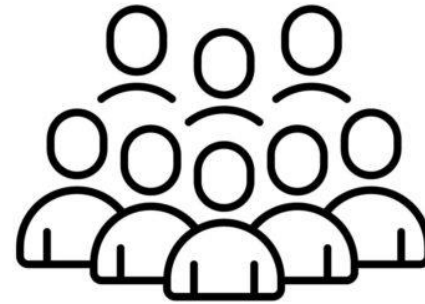
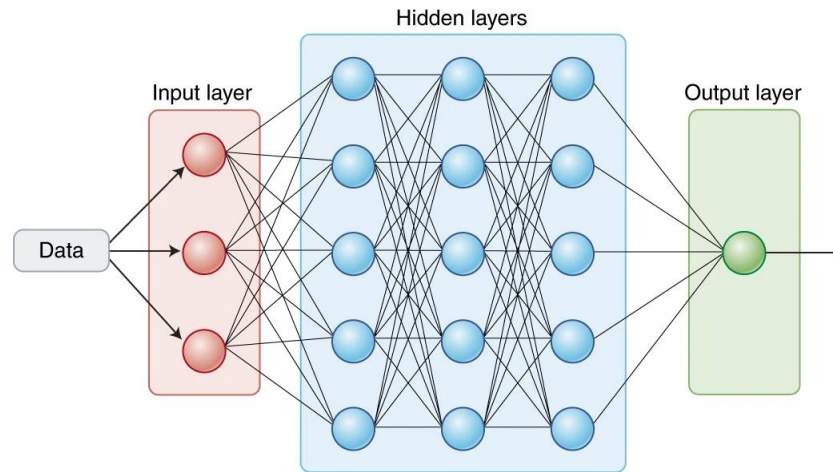


Figure 5. Contact matrices defined on the classes of individuals.



Isella L, Romano M, Barrat A, Cattuto C, Colizza V, et al. (2011) Close Encounters in a Pediatric Ward: Measuring Face-to-Face Proximity and Mixing Patterns with Wearable Sensors. PLOS ONE 6(2): e17144. <https://doi.org/10.1371/journal.pone.0017144>
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0017144>



We still have organizational issues
in the vaccine supply chain.

How precisely can we forecast vaccine use by site?

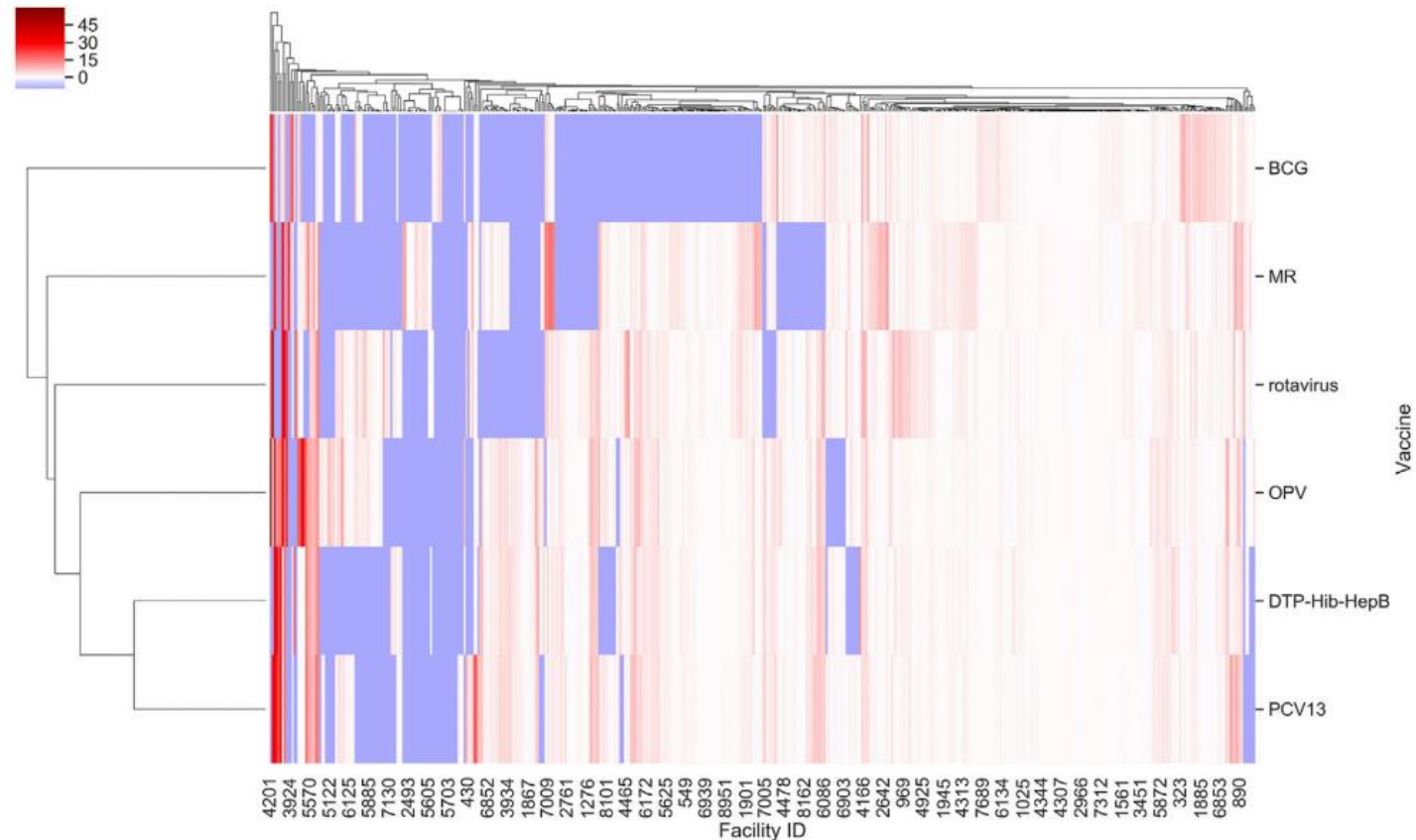
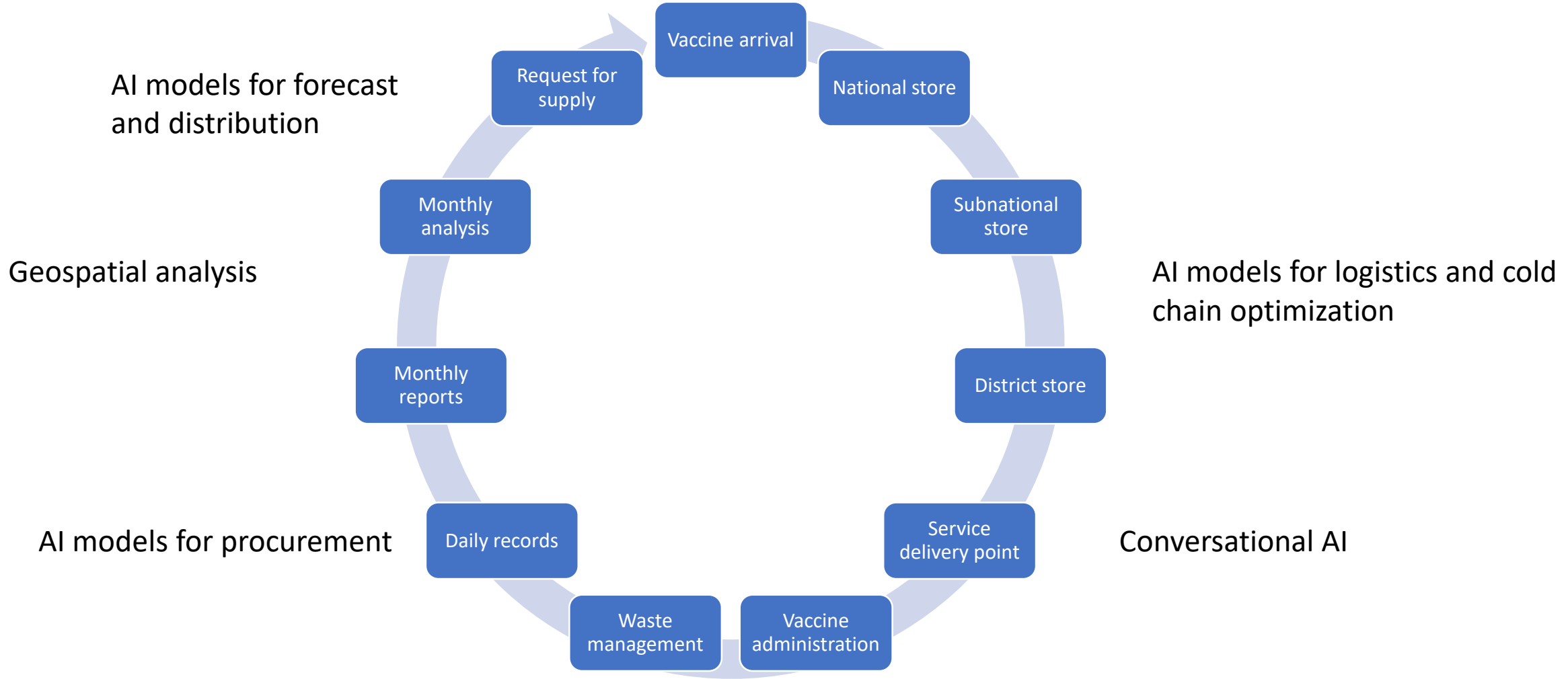


FIGURE 2 | F. E for vaccine types across facilities in Tanzania based on model I. Values were derived from prediction of bi-weekly vaccine doses applying our random forest regressor. Facility ID annotations on the x-axis are sparse owing to space limitations.

The vaccine supply chain



We need help
in vaccine communication.



Act as a **vaccination doctor**. A man over 65 enters your office but doesn't want to receive his influenza vaccine. Provide information that can be **useful to change his mind** in **simple words** with a **gentle tone** and in a **short format** that can be **printed** and given to him.



Dear [Patient's Name],

I understand that getting vaccinated isn't everyone's favorite thing, but it's my job to help you stay healthy. Here are a few reasons why the influenza vaccine is a good idea, especially for someone over 65:

- 1. Flu Can Be Serious:** The flu can hit harder as we age, leading to severe illness and complications. The vaccine significantly reduces the risk of getting sick.
- 2. Protect Yourself and Others:** By getting vaccinated, you're not only protecting yourself but also those around you, especially those who may be more vulnerable to the flu.
- 3. Stay Active and Enjoy Life:** Nobody wants to spend their golden years feeling under the weather. The flu vaccine helps keep you active and enjoying life without the interruption of illness.
- 4. Quick and Easy:** The vaccine is a quick and simple way to boost your immune system against the flu. It's a small step that can make a big difference in your well-being.

If you have any concerns or questions, I'm here to address them. Let's work together to keep you in the best health possible.

Best regards,
[Your Name] Vaccination Doctor



I am over 65, and I am healthy. I do not see a reason for receiving an influenza vaccine. I am also concerned about the side effects of the vaccine. Can you explain the advantages and risks of this vaccine?



Certainly! I understand your concerns, and it's essential to make informed decisions about your health. Let's discuss the advantages and risks of the influenza vaccine.

Advantages of the Influenza Vaccine:

- 1.Preventing Severe Illness:** The influenza vaccine is designed to reduce the risk of contracting the flu virus. For individuals over 65, the flu can lead to severe illness and complications. Vaccination can significantly lower this risk.
- 2.Protecting Others:** Getting vaccinated not only safeguards your health but also helps protect those around you, especially individuals who may be more susceptible to severe flu-related complications.
- 3.Maintaining Well-Being:** The flu can be particularly challenging for older adults. By getting vaccinated, you increase your chances of staying healthy and maintaining an active lifestyle.
- 4.Reducing Hospitalization Risk:** Influenza can lead to hospitalization, especially in older adults. The vaccine has been shown to reduce the likelihood of severe illness and the need for hospitalization.



Risks of the Influenza Vaccine:

1. Mild Side Effects: The most common side effects are mild and temporary, such as soreness at the injection site, low-grade fever, or muscle aches. These symptoms typically resolve on their own within a few days.

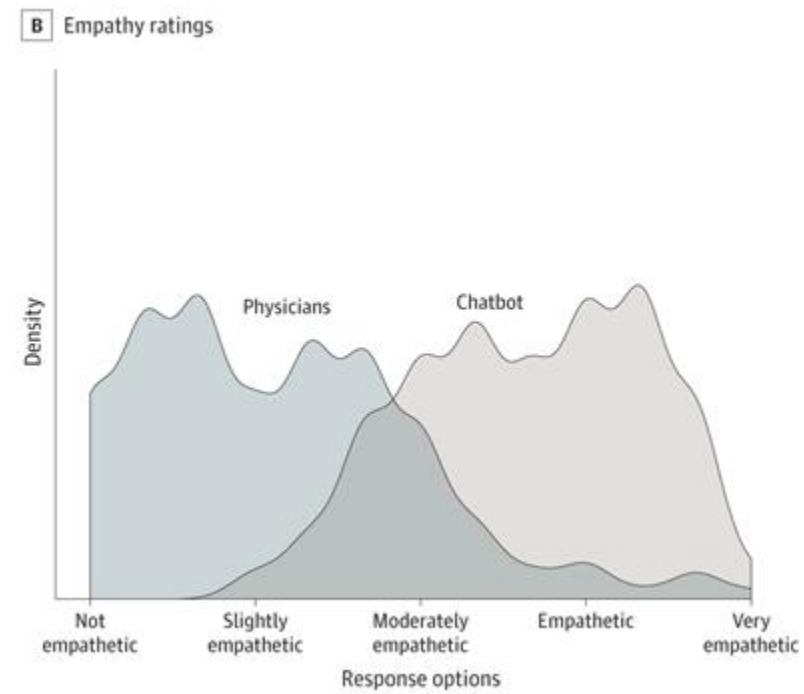
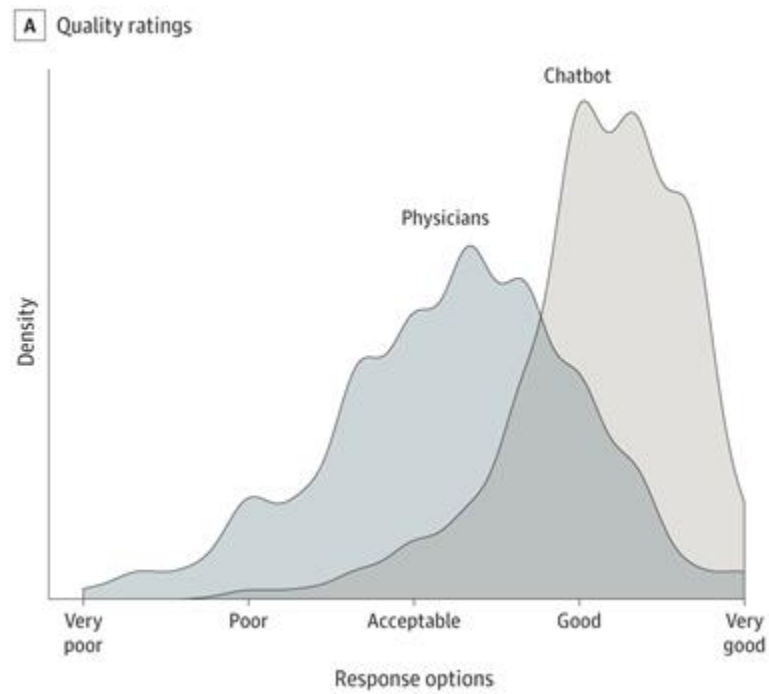
2. Serious Side Effects (Rare): Serious side effects are extremely rare. While they can occur, the risk is outweighed by the potential benefits of vaccination, particularly in preventing severe flu-related complications.


3. Allergic Reactions (Very Rare): Some people may have an allergic reaction to a component of the vaccine. However, severe allergic reactions are exceptionally rare.

It's important to note that the influenza vaccine is generally safe for most people, and the benefits of vaccination in preventing flu-related complications often outweigh the potential risks. If you have specific health concerns or conditions, it's advisable to discuss them with your healthcare provider, who can provide personalized advice based on your individual health status.

Remember, the decision to get vaccinated is a personal one, and your healthcare provider is there to help address any concerns and guide you in making the best choice for your health.

Is AI better than MDs?



New chat 


Previous 7 Days


- Convince No-Vax Adult: Influenza
- Carbonara: Ricetta Semplice
- AI Overfitting and External Validat
- AI Training for Pediatric Cancer


Previous 30 Days

- OMOP CDM for Predictive Models
- Vax Strat Low Res
- AI Challenges in Healthcare
- Pediatric AI Data Review
- Pediatric Cancer AI Datasets
- No external website access.
- Influenza Vaccine Information Car
- AI in Infectious Disease Surveillan
- ECCMID 2024 Collaboration Discu
- IA in Pediatria: Evidenze ed Etica

October

- Innovative Idea Workshop 

 **Upgrade**
Get GPT-4, DALL-E, and more

 **Alberto Tozzi**

My Vaccine chatGTP



How can I help you today?

Immunization schedule

Vaccines for travellers

Side effects

Message ChatGPT...



We can do better
in marketing.

LLMs for Marketing?

- Immediate translation into foreign languages
- Public awareness messages in context
- Identification of influencers
- Audience segmentation
- Personalized information systems
- Sentiment Analysis
- Communication efficacy (A/B Testing)
- Behavioral analysis
- Adaptive information campaigns



Act as the director of public health office of a town with **scarce resources** to invest in immunizations. You should design an **information campaign** for the influenza vaccine for the elderly for the next winter season. Provide the **essential elements** to plan the information strategy.



Influenza Vaccine Information Campaign for the Elderly:

1. Campaign Theme: Develop a compelling and relatable theme that emphasizes community well-being and the importance of individual health. For example, "Stay Strong, Stay Healthy: Protecting Our Community Together."

2. Target Audience: Clearly define the target audience, focusing on individuals aged 65 and older. Tailor messaging to address the specific concerns and priorities of this age group.

3. Key Messages: Craft clear and concise key messages that highlight the benefits of influenza vaccination for the elderly:

- "Protect Yourself: The flu can be severe, but the vaccine helps reduce the risk of illness."
- "Community Protection: Your vaccination contributes to the health of our entire community."
- "Simple and Safe: The influenza vaccine is a quick and safe way to stay healthy."



4. Communication Channels: Identify the most effective communication channels considering the scarce resources. Utilize a mix of the following:

- Local Media:** Collaborate with local newspapers, radio stations, and community newsletters.
- Community Events:** Attend local fairs, health expos, and senior center gatherings to provide information.
- Social Media:** Leverage social media platforms to reach a broader audience with engaging visuals and informational posts.
- Community Partnerships:** Work with local healthcare providers, pharmacies, and senior organizations to amplify the campaign.

5. Educational Materials: Create visually appealing and easy-to-understand materials, including:

- Brochures:** Simple brochures outlining the benefits of vaccination, where to get vaccinated, and debunking common myths.
- Posters:** Eye-catching posters with key messages strategically placed in community centers, pharmacies, and healthcare facilities.
- Online Resources:** Develop a dedicated webpage with detailed information, FAQs, and links to local vaccination resources.



6. Local Influencers and Testimonials: Enlist local influencers, community leaders, or respected figures to share their positive experiences with the influenza vaccine. Personal testimonials can be powerful motivators.

7. Community Workshops and Webinars: Organize informative workshops or webinars in collaboration with local healthcare professionals. Address common concerns, provide accurate information, and offer a platform for Q&A sessions.

8. Mobile Vaccination Clinics: Implement mobile vaccination clinics to increase accessibility, especially for those with limited mobility. Collaborate with local healthcare providers and organizations to make this initiative feasible.

9. Feedback Mechanism: Establish a system for feedback to gauge the effectiveness of the campaign. Encourage community members to share their thoughts and concerns, allowing for adjustments and improvements.

10. Evaluation and Adaptation: Regularly assess the campaign's impact through vaccination rates and community feedback. Use this information to adapt strategies for continuous improvement.

By combining these elements, the information campaign can effectively reach and motivate the elderly population to prioritize influenza vaccination, contributing to the overall health and well-being of the community.

All good?

Challenges

- Evidence
- Social equity
- Sustainability
- Ethics
- Liability
- Organization
- Technology
- Data sharing
- Education