VACCINE DELIVERY RESEARCH DIGEST

UNIVERSITY OF WASHINGTON STRATEGIC ANALYSIS, RESEARCH & TRAINING (START) CENTER

REPORT TO THE GATES FOUNDATION

PRODUCED BY: SUTTON, A. & SHARMA, M.

JANUARY 2025

Want the Vaccine Delivery Research Digest delivered directly to your inbox?

Subscribe on the Digest website: http://uwstartcenter.org/publication-digests/vaccine-digest

List of Articles

1 Vaccination coverage and access among children and adult migrants and refugees in the Middle East and North African region: a systematic review and meta-analysis.

{Abstract & START Commentary} {Full Article}

- This systematic review gathered evidence on coverage, acceptance, drivers of uptake, and policies pertaining to vaccination for children and adult migrants in the Middle East and North African region.

2 Progress Toward Poliomyelitis Eradication - Afghanistan, January 2023-September 2024.

{Abstract & START Commentary} {Full Article}

- Immunization, surveillance data, and progress toward polio eradication in Afghanistan during January 2023-September 2024 were described.

3 How has co-design been used to address vaccine hesitancy globally? A systematic review.

{Abstract & START Commentary} {Full Article}

- This systematic review synthesized literature on co-design studies used to reduce vaccine hesitancy.

4 The need for novel influenza vaccines in low- and middle-income countries: A narrative review.

{Abstract & START Commentary} {Full Article}

- This narrative review provides an overview of influenza epidemiology in low- and middle-income countries.

5 The importance of quality of health campaign information for outcome evaluation. A case study from Guinea-Bissau and Bangladesh.

{Abstract & START Commentary} {Full Article}

- Quality of information available on supplementary immunization activity campaigns and its implication for outcome evaluations was assessed.

6 Integrating graph and reinforcement learning for vaccination strategies in complex networks.

{Abstract & START Commentary} {Full Article}

- A new framework integrating Graph Neural Network (GNN) and Deep Reinforcement Learning (DRL) for vaccination distribution was described.

7 How mathematical modelling can inform outbreak response vaccination.

{Abstract & START Commentary} {Full Article}

- Contributions of mathematical modelling to effective outbreak response are described.

8 Exploring Chatbot contributions to enhancing vaccine literacy and uptake: A scoping review of the literature.

{Abstract & START Commentary} {Full Article}

- This scoping review examined the current literature assessing chatbot use to enhance vaccine literacy and combat vaccine hesitancy.

9 Timeliness of 24 childhood immunisations and evolution of vaccination delay: Analysis of data from 54 low- and middle-income countries.

{Abstract & START Commentary} {Full Article}

- Vaccination status and timing from Demographic and Health Surveys data collected since 2010 from 54 countries was used to assess childhood vaccination delay.

10 Poor vaccine responders mask the true trend in vaccine effectiveness against progression to severe disease.

{Abstract & START Commentary} {Full Article}

- The impact of heterogeneity of vaccine response on calculations for vaccine effectiveness in preventing progression to severe disease was explored.

11 Coverage and distributional benefit-cost of rotavirus vaccine in Uganda: an analysis of routine health facility aggregated data.

{Abstract & START Commentary} {Full Article}

- Multiple data sources were used to analyze coverage and cost-benefit of rotavirus vaccine in Uganda.

12 Measles vaccine effectiveness in African children: a systematic review and meta-analysis.

{Abstract & START Commentary} {Full Article}

- The vaccine effectiveness of measles vaccines among African children was estimated in this meta-analysis.

13 Impact of rotavirus vaccination in Malawi from 2012 to 2022 compared to model predictions.

{Abstract & START Commentary} {Full Article}

- Rotavirus vaccine coverage and effectiveness were evaluated in Malawi.

14 Estimating the optimal age for infant measles vaccination.

{Abstract & START Commentary} {Full Article}

- The optimal age for recommending MCV1 was estimated for multiple countries using a model incorporating vaccination delays and age variations in MCV1 effectiveness.

Appendix

Details of Articles

1. Vaccination coverage and access among children and adult migrants and refugees in the Middle East and North African region: a systematic review and meta-analysis.

Bouaddi O, Seedat F, Hasaan Mohammed H, Evangelidou S, Deal A, Requena-Méndez A, et al. *EClinicalMedicine*. 2025 Jan 04;78:102950.

PubMed ID: 39687424

ABSTRACT

BACKGROUND: The Middle East and North African (MENA) region is a major global hotspot for migration with more than 40 million migrants, who may be an under-vaccinated group because of barriers to vaccination within countries of origin, transit, and destination. We systematically synthesised the evidence on coverage, acceptance, drivers of uptake, and policies pertaining to vaccination for children and adult migrants in the region, in order to explore tailored interventions for these groups.

METHODS: We searched six databases (including Medline, Embase) for peer-reviewed literature, and other websites (including WHO, IOM, ministries of health) for grey literature on coverage, acceptance, drivers of uptake and policies for any vaccination in migrants in the MENA region from between 2000 and 27 August 2024 in any language. We included studies reporting primary data on coverage, acceptance, and drivers of uptake, and any relevant articles on policies. We defined migrants as individuals who move away from their place of habitual residence, within or across international borders, temporarily or permanently. Studies without disaggregated migrant data were excluded. Primary outcomes were coverage (% individuals receiving ≥1 doses of any vaccine) and acceptance (% individuals accepting any vaccine). We separately synthesised data on children (<18 years) and adults (≥18). Estimates were pooled using a random-effects meta-analysis where possible or narratively synthesised, and drivers of uptake were synthesised using the WHO Behavioural and Social Drivers model. PROSPERO protocol: CRD42023401694.

FINDINGS: We identified 6088 database and 282 grey literature records and included 55 studies and 1,906,975 migrants across 15 countries (including mostly refugees in the Middle East and expatriates in Gulf Cooperation Council countries). COVID-19 vaccination was reportedly provided free of charge to migrants in all countries whereas childhood vaccinations were reportedly provided to migrant children in seven countries. However, for adolescents and adults, there were wide variations across countries, and we found no policies relating to catch-up vaccination. Coverage for childhood vaccination amongst migrants was reportedly low, with only 36.0% of 589 migrant children fully vaccinated according to national schedules (95% CI 35.0%-43.0%, I 2 = 67%; data from migrants in Lebanon, Morocco, Sudan). Likewise, data on specific routine vaccines in children was

generally low: measles containing vaccines (MCV): MCV dose 1 63.9%-66.9%; MCV dose 2 25.4%-85.6%; oral polio vaccine (OPV): OPV dose 3 65.1%-76.4%; diphtheria, tetanus and pertussis (DTP) containing vaccines: DTP dose 1 81.8%-86.7%; DTP dose 3 59.7%-76.6%). Drop-out rates across all routine vaccines for subsequent vaccine doses ranged from 12.4 to 38.5%, suggesting that migrants face a range of barriers to vaccine uptake beyond the first dose, that need to be better considered when designing interventions. For adults, we found eleven studies on coverage (including 9 on COVID-19) showing that COVID-19 vaccination coverage ranged 33.5-84.8% in migrants and 25.0-59.0% in host populations. Drivers of uptake of childhood vaccination in migrants included limited availability of vaccines and vaccination personnel, communication and administrative barriers, financial difficulties, lack of caregiver knowledge about services, and concerns expressed by caregivers around safety and benefits. For adults, drivers were mainly related to the COVID-19 vaccine and included concerns around safety, quality, side effects, and mistrust in vaccines and the systems that deliver them.

INTERPRETATION: Migrants have unique risk factors for under-immunisation in the MENA region and have low vaccination coverage despite some level of entitlement to services. Data on vaccination coverage, drivers of uptake and policies for migrants in the MENA region is limited to small-scale studies among accessible groups, mostly focusing on COVID-19 compared to routine childhood and adult vaccination. There is an urgent need to strengthen data collection to better understand coverage across different migrant groups, ages, and MENA countries, especially on adult and catch-up vaccinations for routine immunisations, and develop innovative co-designed strategies to address specific drivers of vaccine uptake among this group.

FUNDING: La Caixa, LCF/PR/SP21/52930003.

WEB: 10.1016/j.eclinm.2024.102950

IMPACT FACTOR: 9.6

CITED HALF-LIFE: 2.4

START COMMENTARY

Vaccine coverage for among children was assessed for nine vaccines: measles (MCV) (n=5), polio (IPV/OPV) (n=4), Diphtheria, Tetanus and Pertussis (DTP) (n=3), hepatitis B (HepB) (n=2), and one each assessing rotavirus (RV), meningococcal (MV), oral cholera (OCV), and *Haemophilus influenzae* b (Hib) vaccine. Higher drop-out rate between the first and last dose in the primary series for MCV, OPV, DTP, HepB, MV, and Hib vaccines were found when comparing migrant children to host children in two studies. Only three studies were included in the meta-analysis assessing full vaccination among children, so results should be interpreted with caution.

Return to List of Articles

2. Progress Toward Poliomyelitis Eradication - Afghanistan, January 2023-September 2024.

Hardy C, Rathee M, Chaudhury S, Wadood M, Ather F, Henderson E, et al.

MMWR Morb Mortal Wkly Rep. 2024 Dec 12;73(49):1129-1134.

PubMed ID: 39666643

ABSTRACT

Since the Global Polio Eradication Initiative began in 1988, wild poliovirus (WPV) types 2 and 3 have been eradicated, and annual polio case numbers have decreased by >99.9%. WPV type 1 (WPV1) transmission remains endemic in Afghanistan and Pakistan, two countries that share a 1,600-mile (2,600-km) border. This report describes immunization and surveillance activities and progress toward polio eradication in Afghanistan during January 2023-September 2024. As of November 1, Afghanistan reported 23 WPV1 cases in 2024, with onset during January-September 30, 2024. During the 3 previous years, 12 WPV1 cases were reported, including six during 2023. In August 2021, the Taliban took control nationwide and allowed increased geographic access for poliovirus vaccination campaigns. Multiple challenges have affected polio eradication activities in Afghanistan, including mandated repatriation of approximately 1 million Afghans by Pakistan beginning in late 2023, the ongoing humanitarian crisis that limits international agency effectiveness, polio program constraints imposed by authorities, and increased restrictions on female participation in vaccination activities. House-to-house vaccination coverage reached 90%-98% of children during June-July 2024. Beginning in 2021, authorities had progressively lifted restrictions on house-to-house campaigns, but abruptly reverted to national restrictions in September 2024. Both nationwide house-to-house activities and strengthening of the routine childhood immunization program would help ensure that every vulnerable child is vaccinated and provide a pathway to polio eradication in Afghanistan.

WEB: 10.15585/mmwr.mm7349a4

IMPACT FACTOR: 21.0

CITED HALF-LIFE: 3.6

START COMMENTARY

Children diagnosed with polio in 2024 were younger at onset than those diagnosed in 2023 (3 years, 3 months and 6 years, 7 months, respectively) and had received fewer doses of poliovirus vaccine. Three patients in 2024 had not received any oral poliovirus vaccine doses while all diagnosed in 2023 had been vaccinated. As only women are allowed to enter homes to vaccinate children in Afghanistan, tighter restrictions on women's freedom of movement make house-to-house immunization campaigns difficult to conduct and also make it difficult for female caregivers to seek vaccines for their children outside of the home.

Return to List of Articles

3. How has co-design been used to address vaccine hesitancy globally? A systematic review.

Alpeza F, Avermark H, Gobbo E, Herzig van Wees S.

Hum Vaccin Immunother. 2024 Dec 11;20(1):2431380.

PubMed ID: 39660656

ABSTRACT

Improving vaccine confidence is a topic of major public health importance. Reasons for vaccine hesitancy are multifactorial, making it challenging to find strategies to address them. This systematic review aimed to synthesize the literature on how co-design has been used to reduce vaccine hesitancy. We searched six databases in March and October 2024. Eligible studies described the co-design process used to develop interventions for addressing vaccine hesitancy and increasing vaccine confidence. We assessed the quality of included studies, extracted and descriptively summarized the key data. Twenty-seven articles were included, 20 of which were based in a high-income setting. Most studies centered on the COVID-19 (n = 9) and HPV (n = 9) vaccines. Co-design yielded diverse interventions, with videos being the most common intervention format (n = 11). We observed substantial variations in the reporting style and terminology used within the studies and limited attempts to assess intervention effectiveness.

WEB: 10.1080/21645515.2024.2431380

IMPACT FACTOR: 4.1

CITED HALF-LIFE: 4.1

START COMMENTARY

Co-design is defined as meaningful collaboration with the intended target population when developing interventions. Authors note inconsistent definitions for key terms and lack of standardization for impact measures across identified studies. Recommendations include acknowledging biases that might arise due to relationships with collaborators and outlining plans to minimize the risk of bias, providing more information on strategies employed to recruit individual collaborators, and further research on cost-effectiveness of co-design studies.

Return to List of Articles

4. The need for novel influenza vaccines in low- and middle-income countries: A narrative review.

Spinardi J, Thakkar K, Welch V, Jagun O, Kyaw M.

Braz J Infect Dis. 2025 Jan 04;29(1):104465.

PubMed ID: 39642677

ABSTRACT

Influenza viruses cause 3-5 million severe cases and 300,000-600,000 deaths worldwide. Most of the disease burden is in Low- and Middle-Income Countries (LMICs) owing to factors such as high population density, infrastructure challenges, poor quality healthcare, lack of consistent recommendations, less prioritization of all high-risk groups, and prevalent use of trivalent influenza vaccines. Although influenza vaccines are effective in reducing the annual influenza disease burden, existing vaccines have several limitations. In this narrative review, we address the unmet needs of existing influenza vaccines in LMICs in Africa, Asia Pacific, Latin America and the Middle East and discuss the characteristics of novel vaccines in clinical development. We also describe features of a successful vaccination program that LMICs could emulate to improve their current vaccination coverage and reduce the public health burden of influenza.

WEB: 10.1016/j.bjid.2024.104465

IMPACT FACTOR: 3.0

CITED HALF-LIFE: 7.8

START COMMENTARY

This article provides an overview of influenza virus biology, epidemiology, and vaccination strategies. Table 2 lists advantages and disadvantages of potential new influenza vaccine types, including viral vector, virus-like particle, RNA, and DNA vaccine platforms. Table 3 provides information on vaccines in development, including two mRNA vaccines by Pfizer and Moderna that are in phase 3 trials.

Return to List of Articles

5. The importance of quality of health campaign information for outcome evaluation. A case study from Guinea-Bissau and Bangladesh.

Nielsen S, Möller S, Benn C, Aaby P.

Vaccine X. 2024 Dec 07;21:100588.

PubMed ID: 39633852

ABSTRACT

BACKGROUND: Numerous national health intervention campaigns, e.g. supplementary immunization campaigns/activities (SIAs), have been conducted in low- and middle-income countries (LMIC) in the last decades. These campaigns are rarely evaluated for overall health outcomes. Information on campaigns is critical for evaluations. We investigated; 1) quality of campaign information sources and 2) implication of quality for outcome evaluations.

METHODS: We focused on three campaign types: oral polio vaccine (OPV), vitamin A supplementation (VAS) and measles vaccine (MV) campaigns in two case countries, for which "gold standard" information on campaigns collected regularly at Health and Demographic Surveillance Systems (HDSS) sites: Guinea-Bissau and Bangladesh. We compared the campaign information from HDSS with information from the World Health Organisation (WHO) and the Rotary Foundation (Rotary, only OPV campaigns). First, campaigns were matched and compared based on intervention type, date of campaign and target age group. Second, we assessed the implications of using various sources of campaign information on the estimated effect of OPV campaigns on all-cause under-3-year mortality in Cox proportional hazards regression models.

RESULTS: The proportion of matched OPV campaigns was highest between HDSS and Rotary. VAS campaigns (only information from HDSS and WHO) matched poorly. The estimated effect of OPV campaigns information on child mortality in Bangladesh went from being statistically significant (HR = 0.69 (0.52-0.90)) using HDSS campaign information to not being significant (HR = 0.93 (0.71-1.21) using WHO campaign information.

CONCLUSION: Compared with the HDSS, Rotary had the best campaign information on the conduct of OPV campaigns, whereas the WHO quality of campaign information was low for both OPV and VAS. A low quality of campaign information may alter conclusions of health outcome evaluations. Reliable and precise information on campaigns is essential to assess their effects. Public and private campaign stakeholders should track campaign information meticulously and support that publicly data is available for researchers.

WEB: 10.1016/j.jvacx.2024.100588
IMPACT FACTOR: 2.7
CITED HALF-LIFE: 1.9

START COMMENTARY

In Guinea-Bissau, 60% of World Health Organization (WHO) oral polio vaccine (OPV) campaign information (intervention type, date of campaign and targeted age) and 70% of Rotary campaign information fully matched Health and Demographic Surveillance Systems (HDSS) campaign information; 20% and 30% partially matched for WHO and Rotary campaigns, respectively, when small differences in date of campaign were allowed. Four campaigns in the HDSS were unmatched in WHO information, and one campaign each in WHO and Rotary data were unmatched in HDSS data. In Bangladesh, 79% of WHO and 89% of Rotary OPV campaign information fully matched HDSS campaign information. Information for all three measles-containing vaccine campaigns reported by HDSS was fully matched by WHO information in Guinea-Bissau, while 2 of 3 were campaigns were fully matched in Bangladesh (Figure 1).

Return to List of Articles

6. Integrating graph and reinforcement learning for vaccination strategies in complex networks.

Dong Z, Chen Y, Li C, Tricco T, Hu T.

Sci Rep. 2024 Dec 02;14(1):29923.

PubMed ID: 39622907

ABSTRACT

Pandemics like COVID-19 have a huge impact on human society and the global economy. Vaccines are effective in the fight against these pandemics but often in limited supplies, particularly in the early stages. Thus, it is imperative to distribute such crucial public goods efficiently. Identifying and vaccinating key spreaders (i.e., influential nodes) is an effective approach to break down the virus transmission network, thereby inhibiting the spread of the virus. Previous methods for identifying influential nodes in networks lack consistency in terms of effectiveness and precision. Their applicability also depends on the unique characteristics of each network. Furthermore, most of them rank nodes by their individual influence in the network without considering mutual effects among them. However, in many practical settings like vaccine distribution, the challenge is how to select a group of influential nodes. This task is more complex due to the interactions and collective influence of these nodes together. This paper introduces a new framework integrating Graph Neural Network (GNN) and Deep Reinforcement Learning (DRL) for vaccination distribution. This approach combines network structural learning with strategic decision-making. It aims to efficiently disrupt the network structure and stop disease spread through targeting and removing influential nodes. This method is particularly effective in complex environments, where traditional strategies might not be efficient or scalable. Its effectiveness is tested across various network types including both synthetic and real-world datasets, demonstrting a potential for real-world applications in fields like epidemiology and cybersecurity. This interdisciplinary approach shows the capabilities of deep learning in understanding and manipulating complex network systems.

WEB: 10.1038/s41598-024-78626-6

IMPACT FACTOR: 3.8

CITED HALF-LIFE: 4.8

START COMMENTARY

Five performance indicators are assessed: edge quantity, count of network components, size of the largest component, epidemic threshold, and average node connectivity. The Susceptible-Infected-Recovered (SIR) epidemic model is used to evaluate the influence of each node on network spread. In order to more closely align with real-world scenarios, future mathematical models could incorporate age, vaccination costs, and vaccine effectiveness.

Return to List of Articles

7. How mathematical modelling can inform outbreak response vaccination.

Shankar M, Hartner A, Arnold C, Gayawan E, Kang H, Kim J, et al.

BMC Infect Dis. 2024 Dec 02;24(1):1371.

PubMed ID: 39617902

ABSTRACT

Mathematical models are established tools to assist in outbreak response. They help characterise complex patterns in disease spread, simulate control options to assist public health authorities in decision-making, and longer-term operational and financial planning. In the context of vaccine-preventable diseases (VPDs), vaccines are one of the most-cost effective outbreak response interventions, with the potential to avert significant morbidity and mortality through timely delivery. Models can contribute to the design of vaccine response by investigating the importance of timeliness, identifying high-risk areas, prioritising the use of limited vaccine supply, highlighting surveillance gaps and reporting, and determining the short- and long-term benefits. In this review, we examine how models have been used to inform vaccine response for 10 VPDs, and provide additional insights into the challenges of outbreak response modelling, such as data gaps, key vaccine-specific considerations, and communication between modellers and stakeholders. We illustrate that while models are key to policy-oriented outbreak vaccine response, they can only be as good as the surveillance data that inform them.

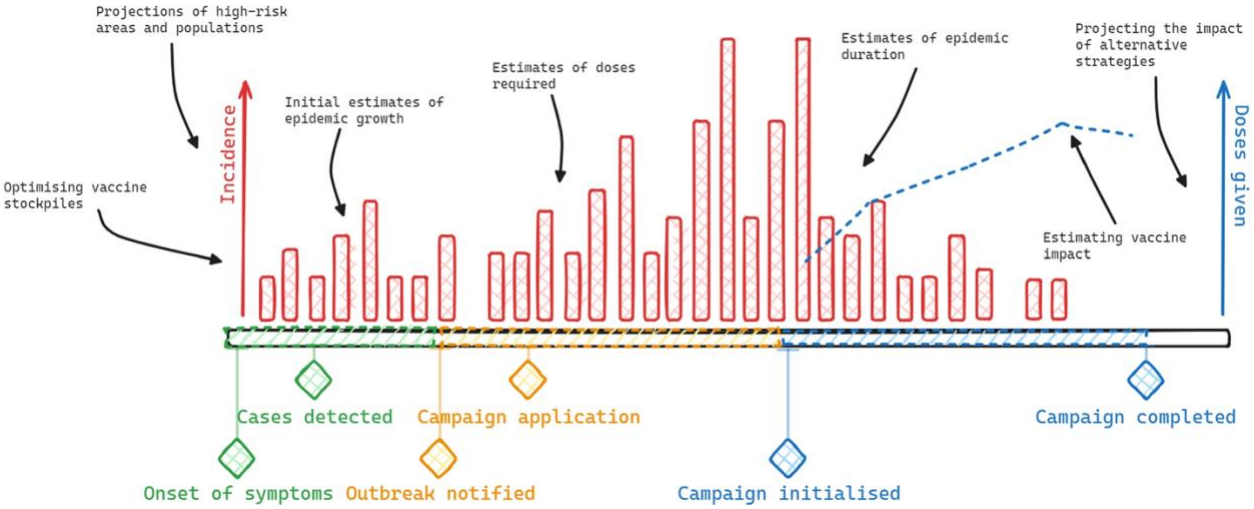
WEB: 10.1186/s12879-024-10243-0

IMPACT FACTOR: 3.4

CITED HALF-LIFE: 4.9

START COMMENTARY

Figure 1 below illustrates the timeline of an outbreak. Red vertical bars represent disease incidence. Vaccine coverage is shown by the blue dotted line. The diamonds below the timeline indicate key timepoints in the outbreak and the color indicates outbreak phases, with green being the investigative phase, yellow being the public health response scale-up phase, and blue being the disease control phase. Black text is potential modelling outputs at each outbreak phase.



Return to List of Articles

8. Exploring Chatbot contributions to enhancing vaccine literacy and uptake: A scoping review of the literature.

Cosma C, Radi A, Cattano R, Zanobini P, Bonaccorsi G, Lorini C, et al.

Vaccine. 2024 Dec 18;44:126559.

PubMed ID: 39615346

ABSTRACT

BACKGROUND: The increasing integration of chatbots across various sectors marks a significant shift in digital communication, and their role in healthcare makes no exception. This scoping review aims to systematically examine the role of chatbots in the perspective of organizational vaccine literacy, particularly in enhancing vaccine literacy and facilitating the dissemination of vaccine-related information, evaluating the potential of chatbots to transform vaccination communication strategies and improve health education outcomes.

METHODS: This scoping review adhered to the Joanna Briggs Institute methodology and the PRISMA-ScR checklist. A systematic search of MEDLINE, Embase, Scopus, and PsycInfo was conducted from January 2020 to October 30, 2024, using keywords related to "chatbots" and "vaccination." Study selection involved a two-stage screening process, focusing on studies reporting the use of chatbots to improve vaccine literacy and uptake. Data were thematically analyzed and presented in a narrative format.

RESULTS: Twenty-two studies were included in the review: these studies demonstrate the effectiveness of chatbots in enhancing vaccine literacy and acceptance, mainly focusing on COVID-19 but also addressing HPV and childhood vaccinations. They highlight chatbots' role in improving the vaccine-literate environment through countering misinformation and improving communication with healthcare professionals, showcasing their potential to significantly influence public health outcomes and their adaptability to diverse populations and geographic regions.

CONCLUSIONS: These digital assistants could provide personalized and up-to-date information, improving not only knowledge but also attitudes and intentions towards vaccinations.

WEB: 10.1016/j.vaccine.2024.126559

IMPACT FACTOR: 4.5

CITED HALF-LIFE: 7.9

START COMMENTARY

Almost all included studies were designed to evaluate use of chatbots to combat COVID-19 misinformation (Table 1). Studies were conducted in 15 countries/territories in multiple languages.

All but two studies were interventional studies. Overall, results supported the use of chatbots to improve vaccine knowledge, attitudes, ad behaviors. Barriers to increased chatbot use include difficulties integrating with existing healthcare practices, need for frequent updates, and need for additional languages and cultural adaptations.

Return to List of Articles

9. Timeliness of 24 childhood immunisations and evolution of vaccination delay: Analysis of data from 54 low- and middle-income countries.

Derqui N, Blake I, Gray E, Cooper L, Grassly N, Pons-Salort M, et al.

PLOS Glob Public Health. 2025 Jan 08;4(11):e0003749.

PubMed ID: 39591390

ABSTRACT

Vaccination timeliness is often not considered among standard performance indicators of routine vaccination programmes, such as vaccination coverage, yet quantifying vaccination delay could inform policies to promote in-time vaccination and help design vaccination schedules. Here, we analysed vaccination timeliness for 24 routine childhood immunisations for 54 countries. We extracted individual vaccination status and timing from Demographic and Health Surveys data from 54 countries with surveys from 2010 onwards. Individual data was used to estimate age at vaccination for <5 year-old children. Recommended age of vaccination for each country and vaccine was compared to the age at vaccination to determine vaccination delay. The evolution of vaccination delay over time was described using estimates from different birth cohorts. To identify socio-demographic indicators associated with delayed vaccination, we used multivariable Cox regression models with country as random effect and estimated the Hazard Ratio for vaccination with each vaccine-dose for each week post recommended vaccination age. Vaccine coverage at the recommended age was highest for birth and first doses (e.g. 50.5% BCG, 18.5% DTP-D1) and lowest for later doses (e.g. 5.5% DTP-D3, 16.3% MCV-D1, 8.2% MCV-D2). Median delay was lowest for birth doses, e.g. BCG (1 week (IQR: 0 to 4)), and it increased with later doses in vaccination courses: 1 (0, 4) week for DTP-D1 versus 4 (2, 9) weeks for DTP-D3. Although the median delay for each vaccine-dose remained largely constant over time, the range of delay estimates moderately decreased. Children living in rural areas, their countries' poorer wealth quintiles and whose mothers had no formal education were more likely to received delayed vaccinations. Although we report most children are vaccinated within the recommended age window, we found little reduction on routine immunisation delays over the last decade and that children from deprived socioeconomic backgrounds are more likely to receive delayed vaccinations.

WEB: 10.1371/journal.pgph.0003749

IMPACT FACTOR: N/A

CITED HALF-LIFE: N/A

START COMMENTARY

Children living in rural areas were more likely to have delayed birth and first doses of vaccines than those living in urban areas. However, living in a rural area was associated with higher likelihood of

being vaccinated on time with later doses in the schedule (Figure 5), perhaps due to focused vaccine campaigns. Odds of receiving the second and third dose were significantly lower with each week of delay in receiving the first dose of a vaccine (Table 1). No increase in vaccination delay was noted among children born during the COVID-19 pandemic in the 10 surveys conducted after 2020.
Return to List of Articles

10. Poor vaccine responders mask the true trend in vaccine effectiveness against progression to severe disease.

Dean N, Halloran M, Zarnitsyna V.

Vaccine. 2024 Dec 14;43(Pt 2):126516.

PubMed ID: 39586191

ABSTRACT

Vaccines can reduce an individual's risk of infection and their risk of progression to severe disease given infection. The latter effect is less commonly estimated but is relevant for vaccine impact modeling and cost-effectiveness calculations. Using a motivating example from the COVID-19 literature, we note how vaccine effectiveness against progression to severe disease can appear to increase from below 0 % to over 70 % within 8 months. With true biological strengthening of this magnitude being unlikely, we use a mathematical modeling framework to identify parameter combinations where this phenomenon can occur. Fundamental features are an immunocompetent population with high initial protection against infection, contrasted with a vulnerable subpopulation with poor vaccine response against infection and progression. As a result, the earliest infections are among those with the weakest protection against severe disease. This work highlights methodological challenges in isolating a vaccine's effect on progression to severe disease after infection, and it signals the need for refined analytical methods to adjust for differences between the vaccinated infected and the unvaccinated infected populations.

WEB: 10.1016/j.vaccine.2024.126516

IMPACT FACTOR: 4.5

CITED HALF-LIFE: 7.9

START COMMENTARY

This study highlights the importance of heterogeneity of vaccine response when calculating vaccine effectiveness in preventing progression to severe disease (VE_P) since vulnerable subpopulations with poor vaccine response contribute to low initial estimates of VE_P. Earliest vaccinated persons were skewed toward the vulnerable population but shifted to predominantly persons among the immunocompetent population over time; thus, estimating VE_P from early breakthrough infections could provide a biased estimate of VE_P for the overall population. The observed rise in VE_P is largest when the vaccine provides little protection against infection and progression to severe disease for the vulnerable group while providing high protection against infection and progression to severe disease for the immunocompetent group.

Return to List of Articles

11. Coverage and distributional benefit-cost of rotavirus vaccine in Uganda: an analysis of routine health facility aggregated data.

Kananura R, de Broucker G, Ssebagereka A, Mutebi A, Kiracho E, Patenaude B.

Cost Eff Resour Alloc. 2024 Nov 25;22(1):85.

PubMed ID: 39578806

ABSTRACT

INTRODUCTION: Owing to the lack of local cost and clinical effectiveness data in sub-Saharan Africa, economic evaluations of the rotavirus vaccine are still limited in the region. In this study, we utilize different data sources, including aggregated routine health information system data to examine the net benefits of the rotavirus vaccine in Uganda. We also present ways in which health facility data can be used to assess subnational vaccination coverage as well as the effect of the vaccine on diarrhoea hospitalization.

METHODS: We used monthly health facility data collected between 2015 and 2021 to study the relationship between rollout of rotavirus vaccine and diarrhoea hospitalization. We gathered information from empirical studies on the cost of diarrhoea (household and health facility) and vaccine administration to estimate the costs averted due to the rotavirus vaccine. As household costs, we considered out-of-pocket payments associated with the episodes of diarrhoea and the productivity loss associated with time spent on treatment and with mortality using a human capital approach. Finally, we employed an interrupted time series analysis to examine the effect of rotavirus vaccine on diarrhoea hospitalization. Costs are presented in 2018 US dollars.

RESULTS: As of 2021, nationwide coverage of the first and second doses of the rotavirus vaccine (RV) in Uganda was estimated at 89% and 65% respectively, with variations observed across the regions. The study revealed a decrease in diarrhoea hospitalization by 1% for each 1% increase in RV coverage. Moreover, the study showed that diarrhoea hospitalization reduced by 2% for each additional month post- vaccine rollout. Excluding productivity losses due to mortality, the analyses of costs averted due to the RV reveal that between 2018 and 2021, Uganda saved approximately $57 million ($7 per capita) in expenses associated with diarrhoea. The return on investment (ROI) due to RV was calculated to be $1.48 per dollar invested. When including mortality costs, the net benefit reached up to $3 billion in economic cost ($385 per capita), and an ROI of $78 overall. Furthermore, the study demonstrated that RV provided substantial health benefits, particularly for socially disadvantaged groups. Excluding mortality costs, the ROI for the two most disadvantaged groups ranged from $1.71 to $2.03 per dollar spent, while for the remaining groups, it ranged from $1.10 to $1.14.

CONCLUSION: This manuscript stresses the importance of RV in alleviating the burden of diarrhoeal diseases and associated costs in Uganda. The study not only emphasizes the tangible benefits derived from the vaccine but also highlights the role of routine aggregated healthcare information systems in systematically monitoring the effectiveness and coverage of interventions.

WEB: 10.1186/s12962-024-00586-5
IMPACT FACTOR: 1.7
CITED HALF-LIFE: 5.0

START COMMENTARY

Quintiles of disadvantage were generated with data from the 2016 Uganda Demographic and Health Survey (DHS) using the VERSE Equity Toolkit methodology, which ranks households based on sociodemographic variables that unfairly impact the distribution of vaccines. The estimated proportion of acute and persistent diarrhea cases caused by rotavirus was 40% with a case fatality rate of 2.5%. Household costs for treatment included any cost incurred at a medical facility, travel costs, and lost income. Government treatment costs included all treatment costs, medications, facility overhead, and labor for medical treatment in a public facility. Immunization program costs were estimated by adding the UNICEF vaccine price for rotavirus vaccine and estimates of the economic cost of vaccine delivery.

Return to List of Articles

12. Measles vaccine effectiveness in African children: a systematic review and meta-analysis.

Endalamaw D, Nibret E, Munshea A, Mekonnen F, Tadesse S, Zeru T, et al.

BMC Infect Dis. 2024 Nov 22;24(1):1330.

PubMed ID: 39574018

ABSTRACT

INTRODUCTION: Measles is an extremely contagious viral disease that can be prevented through vaccination. It is caused by the measles virus and presents with symptoms such as high fever, cough, runny nose, conjunctivitis, and a distinctive rash. Complications may include pneumonia, diarrhoea, and neurological issues. The disease spreads through respiratory droplets and continues to pose a significant public health challenge, especially in Africa, despite vaccination efforts.

OBJECTIVE: This systematic review and meta-analysis aim to estimate the pooled vaccine effectiveness of measles vaccines among African children, providing insights into immunization program success and informing policy decisions on vaccine distribution and resource allocation.

METHODS: Following PRISMA guidelines, search was conducted in databases including PubMed/Medline, Science Direct, HINARI, Cochrane/Wiley library, Europe PMC, and grey literatures like Google Scholar up to March 2024. Cross-sectional studies assessed measles vaccine effectiveness in African children aged nine months and above were included. Data was extracted using JBI extraction tool and entered into microsoft excel and analysed via STATA version 20.1 using random effect model.

RESULTS: From 5295 identified articles, 18 met the inclusion criteria, encompassing 26,470 children from 13 African countries. The pooled measles vaccine effectiveness was 68.58%, with significant heterogeneity ($I2 = 99.66\%$, $p < 0.001$). Subgroup analysis showed variability in vaccine effectiveness by study period, with higher effectiveness in studies conducted after the Global Vaccine Action Plan (GVAP) in 2012.

CONCLUSION: Measles vaccine effectiveness varies in African regions, ranging from 98.4% in Nigeria to 36.5% in Mozambique, with an overall effectiveness of 68.58% and high heterogeneity among studies. Optimizing vaccine distribution, increasing coverage, and prompt administration are important for enhancing effectiveness. Continued support for GVAP strategies and further research is needed to understand factors affecting vaccine performance and improve immunization efforts in Africa.

WEB: 10.1186/s12879-024-10239-w

IMPACT FACTOR: 3.4

CITED HALF-LIFE: 4.9

START COMMENTARY

Seven articles were identified from eastern Africa, five from western Africa, and one each from north and south Africa. Vaccine effectiveness was defined as the percentage reduction in measles among those who received the measles vaccine compared to those who were unvaccinated. Seven of the 8 articles published prior to 2000 reported vaccine effectiveness of <70% while 10 of 11 subsequently published articles reported vaccine effectiveness of >70%, suggesting that research needs to be conducted to provide current accurate estimates.

Return to List of Articles

13. Impact of rotavirus vaccination in Malawi from 2012 to 2022 compared to model predictions.

Pitzer V, Ndeketa L, Asare E, Hungerford D, Lopman B, Jere K, et al.

NPJ Vaccines. 2024 Nov 26;9(1):227.

PubMed ID: 39562592388853885

ABSTRACT

Rotarix® vaccine was introduced into the Malawi national immunization program in October 2012. We analyzed data on children <5 years old hospitalized with acute gastroenteritis from January 2012 to June 2022, and compared to pre-vaccination data from 1997 to 2009. We estimated vaccine coverage before, during, and after the COVID-19 pandemic using data from rotavirus-negative children. We compared the observed weekly number of rotavirus-associated gastroenteritis (RVGE) cases by age to predictions from a previously developed mathematical model to estimate overall vaccine effectiveness. The number of RVGE and rotavirus-negative acute gastroenteritis cases declined substantially following vaccine introduction. Vaccine coverage among rotavirus-negative controls was >90% with two doses by July 2014, and declined to a low of ~80% in October 2020 before returning to pre-pandemic levels by July 2021. Our models captured the post-vaccination trends in RVGE incidence. Comparing observed RVGE cases to the model-predicted incidence without vaccination, overall effectiveness was estimated to be modest at 36.0% (95% prediction interval: 33.6%, 39.9%), peaking in 2014, and was highest in infants (52.5%; 95% prediction interval: 50.1%, 54.9%). Our mathematical models provide a validated platform for assessing strategies to improve rotavirus vaccine impact in low-income settings.

WEB: 10.1038/s41541-024-01008-6

IMPACT FACTOR: 7.0

CITED HALF-LIFE: 2.7

START COMMENTARY

Reduction in rotavirus-associated gastroenteritis (RVGE) incidence was primarily driven by decreased incidence in children <1 year. However, RVGE incidence increased in both 1–2-year-olds and 2–5-year-olds, with post-vaccination incidence higher than incidence predicted under the no-vaccination scenario. Overall vaccine effectiveness has remained fairly consistent since 2016 with the exception of 2020 due to an increase in cases among 1-2 year-olds (Figure 3).

Return to List of Articles

14. Estimating the optimal age for infant measles vaccination.

Goult E, Barrero Guevara L, Briga M, Domenech de Cellès M.

Nat Commun. 2024 Nov 16;15(1):9919.
PubMed ID: 39548065

ABSTRACT

The persistence of measles in many countries demonstrates large immunity gaps, resulting from incomplete or ineffective immunization with measles-containing vaccines (MCVs). MCV impact is determined, in part, by vaccination age. Infants who receive dose 1 (MCV1) at older ages have a reduced risk of vaccine failure, but also an increased risk of contracting infection before vaccination. Here, we designed a new method-based on a mathematical transmission model incorporating realistic vaccination delays and age variations in MCV1 effectiveness-to capture the MCV1 age risk trade-off and estimate the optimal age for recommending MCV1. We applied this method to a range of synthetic populations representing lower- and higher-income populations. We predict a large heterogeneity in the optimal MCV1 ages (range: 6-20 months), contrasting the homogeneity of observed recommendations worldwide. Furthermore, we show that the optimal age depends on the local epidemiology of measles, with a lower optimal age predicted in populations having lower vaccination coverage or suffering higher transmission. Overall, our results suggest the scope for public health authorities to tailor the recommended schedule for better measles control.

WEB: 10.1038/s41467-024-53415-x
IMPACT FACTOR: 14.7
CITED HALF-LIFE: 4.3

START COMMENTARY

Variables used to parameterize the mechanistic model used include 1) measles incidence, 2) social contact matrices, 3) coverage with dose 1 of measles containing vaccine (MCV1), 4) vaccination delay distribution, and 5) vaccine effectiveness variation. The model accounted for vaccine delay which is common in the 43 countries included. Estimates for the optimal MCV1 age in Ghana, Sierra Leone, Uganda, and Zambia are presented in Figure 6.

Return to List of Articles

Additional Articles of Interest

1 Uptake of Measles Second Dose Vaccine and Its Associated Factors Among Children Age 24-35 Months in Merhabete Woreda, Ethiopia: 2022: A Cross-Sectional Study. {Full Article}

2 Factors associated with tetanus toxoid vaccine utilization among reproductive-age women in Debre Markos town, Ethiopia, 2021: a cross-sectional study. {Full Article}

3 Cost-effectiveness of human papillomavirus (HPV) vaccination in Tunisia: a modelling study. {Full Article}

4 Current innovations in mRNA vaccines for targeting multidrug-resistant ESKAPE pathogens. {Full Article}

5 Global epidemiology of serogroup Y invasive meningococcal disease: a literature review. {Full Article}

6 HPV vaccine knowledge, attitude, and programme satisfaction among parents and caregivers of vaccine recipients in Ogun state Nigeria. {Full Article}

7 Further analysis of determinants of Pentavalent and Measles immunizations dropouts among children under five years of age in Ethiopia from Mini-EDHS 2019. {Full Article}

8 Pneumococcal disease in children in the Middle East and Northern Africa: A systematic literature review of clinical burden, serotype distribution, and vaccination programs. {Full Article}

9 Trends and inequalities in BCG immunisation coverage among one-year-olds in Sierra Leone, 2008-2019. {Full Article}

10 The evidence base for rotavirus vaccination in India: Current status, future needs. {Full Article}

11 Timely Vaccination and Its Associated Factors Among Parents With Children Aged From 0 to 23 Months in Wolaita Zone Public Hospitals, Southern Ethiopia, 2024: A Facility-Based Cross-Sectional Study. {Full Article}

12 Conspiracy narratives and vaccine hesitancy: a scoping review of prevalence, impact, and interventions. {Full Article}

13 Human Papillomavirus (HPV) Vaccination: Progress, Challenges, and Future Directions in Global Immunization Strategies. {Full Article}

14 Promoters and Barriers of Vaccine Hesitancy. {Full Article}

15 Exploring determinants of vaccination status among pediatric populations in East Gojam, Amhara Region, Ethiopia. {Full Article}

16 Myths and misinformation associated with vaccine incompleteness: A survey study. {Full Article}

17 Cost of delivering childhood RSV prevention interventions to the health system in Kenya: a prospective analysis. {Full Article}

18 How do national immunization technical advisory groups assess and use evidence: Findings from the SYSVAC survey. {Full Article}

19 Modeling the health and economic implications of adopting a 1-dose 9-valent human papillomavirus vaccination program in adolescents in low/middle-income countries: An analysis of Indonesia. {Full Article}

Appendix

The literature search for the January 2025 Vaccine Delivery Research Digest was conducted on December 21, 2024. We searched English language articles indexed by the US National Library of Medicine and published between November 15, 2024 and December 14, 2024. The search resulted in 425 items.

SEARCH TERMS

((((“vaccine”[tiab] OR “vaccines”[tiab] OR “vaccination”[tiab] OR “immunization”[tiab] OR “immunisation”[tiab] OR “vaccines”[MeSH Terms] OR (“vaccination”[MeSH Terms] OR “immunization”[MeSH Terms])) AND (“logistics”[tiab] OR “supply”[tiab] OR “supply chain”[tiab] OR “implementation”[tiab] OR “expenditures”[tiab] OR “financing”[tiab] OR “economics”[tiab] OR “Cost effectiveness”[tiab] OR “coverage”[tiab] OR “attitudes”[tiab] OR “belief”[tiab] OR “beliefs”[tiab] OR “refusal”[tiab] OR “Procurement”[tiab] OR “timeliness”[tiab] OR “systems”[tiab])) OR “vaccine delivery”[tiab] OR “vaccination refusal”[MeSH Terms] OR “immunization programs”[MeSH Terms] OR “zero dose”[tiab] OR “unvaccinated children”[tiab] OR “gavi”[tiab]) NOT (“in vitro”[tiab] OR “immune response”[tiab] OR “gene”[tiab] OR “chemistry”[tiab] OR “genotox*”[tiab] OR “sequencing”[tiab] OR “nanoparticle*”[tiab] OR “bacteriophage”[tiab] OR “exome”[tiab] OR “exogenous”[tiab] OR “electropor*“[tiab] OR”systems biology”[tiab] OR “animal model”[tiab] OR “cattle”[tiab] OR “sheep”[tiab] OR “goat”[tiab] OR “rat”[tiab] OR “pig”[tiab] OR “mice”[tiab] OR “mouse”[tiab] OR “murine”[tiab] OR “porcine”[tiab] OR “ovine”[tiab] OR “rodent”[tiab] OR “fish”[tiab])) AND “English”[Language] AND 2024/11/15:2024/12/14[Date - Publication]