START CENTER | STRATEGIC ANALYSIS, RESEARCH & TRAINING CENTER
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# VACCINE DELIVERY RESEARCH DIGEST

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

REPORT TO THE BILL & MELINDA GATES FOUNDATION

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1. Impact of measles supplementary immunisation activities on utilisation of maternal and child health services in low-income and middle-income countries.
{Abstract & START Scientific Comment} {Full article}

- An analysis of the impact of supplementary immunization activities on maternal delivery services and care-seeking for children in low-and middle-income countries.

2. Potential impact of introducing the pneumococcal conjugate vaccine into national immunisation programmes: an economic-epidemiological analysis using data from India.
{Abstract & START Scientific Comment} {Full article}

- A analytic study using agent-based modeling to assess S. pneumoniae project trends for pneumococcal infections, meningitis, and other related diseases, and to estimate the potential financial risk protection, cost and cost-effectiveness of introducing PCV for children under five in India.

3. Effect of maternal HIV status on vaccination coverage among sub-Saharan African children: A socio-ecological analysis.
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- An analytical study to examine the impact of maternal HIV status on childhood immunization rates for three doses of diphtheria-tetanus-pertussis containing vaccines (DTP3) in 27 countries in Sub-Saharan Africa.

4. Characteristics of mobile phone access and usage in rural and urban Guatemala: assessing feasibility of text message reminders to increase childhood immunizations.
{Abstract & START Scientific Comment} {Full article}

- A analysis of survey data collected from a randomized control trial (RCT) to determine factors related to mobile phone accessibility and usage for a SMS-based vaccination reminder system in Guatemala.

5. Sustainable vaccine development: a vaccine manufacturer's perspective.
{Abstract & START Scientific Comment} {Full article}

- An assessment of vaccine manufacturer’s perspectives on key considerations for decision-making when selecting vaccine development projects.

6. Socioeconomic drivers of vaccine uptake: An analysis of the data of a geographically defined cluster randomized cholera vaccine trial in Bangladesh.
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- A cluster randomized trial to analyze GIS use for cholera vaccine and to determine socioeconomic determinants of vaccine uptake in Dhaka, Bangladesh.

7. Highly targeted cholera vaccination campaigns in urban setting are feasible: The experience in Kalemie, Democratic Republic of Congo.
{Abstract & START Scientific Comment} {Full article}

- A cross-sectional survey to assess vaccine coverage rates after a vaccine campaign for children under 5 in Kalemie, Democratic Republic of Congo.

8. How can the use of data within the immunisation programme be increased in order to improve data quality and ensure greater accountability in the health system? A protocol for implementation science study.
{Abstract & START Scientific Comment} {Full article}

- An implementation science study to assess health information systems, community level engagement, and data-informed decision making inform immunization programs in North Gondar region in Northern Ethiopia.

9. Controlling epidemics with transmissible vaccines.
{Abstract & START Scientific Comment} {Full article}

- A study using compartmental models to assess vaccine impact on ongoing or impending epidemics globally.

10. The usability and effectiveness of mobile health technology-based lifestyle and medical intervention apps upporting healthcare during pregnancy: Systematic review.
{Abstract & START Scientific Comment} {Full article}

- A systematic review to determine feasibility, acceptability, and effectiveness of mobile lifestyle and medical apps to support maternal healthcare during pregnancy in high-income countries.

APPENDIX

## DETAILS OF ARTICLES

1. Impact of measles supplementary immunisation activities on utilisation of maternal and child health services in low-income and middle-income countries.
   Postolovska I, Helleringer S, Kruk ME, Verguet S.
   BMJ Glob Health. 2018 May 7;3(3):e000466.
   PubMed ID: 29755760

**ABSTRACT**
Background:
Measles supplementary immunisation activities (SIAs) are an integral component of measles elimination in low-income and middle-income countries (LMICs). Despite their success in increasing vaccination coverage, there are concerns about their negative consequences on routine services. Few studies have conducted quantitative assessments of SIA impact on utilisation of health services.
Methods:
We analysed the impact of SIAs on utilisation of selected maternal and child health services using Demographic and Health Surveys and Multiple Indicator Cluster Surveys from 28 LMICs, where at least one SIA occurred over 2000-2014. Logistic regressions were conducted to investigate the association between SIAs and utilisation of the following services: facility delivery, postnatal care and outpatient sick child care (for fever, diarrhoea, cough).
Results:
SIAs do not appear to significantly impact utilisation of maternal and child services. We find a reduction in care-seeking for treatment of child cough (OR 0.67; 95% CI 0.48 to 0.95); and a few significant effects at the country level, suggesting the need for further investigation of the idiosyncratic effects of SIAs in each country.
Conclusion:
The paper contributes to the debate on vertical versus horizontal programmes to ensure universal access to vaccination. Measles SIAs do not seem to affect care-seeking for critical conditions.

**WEB:** 10.1136/bmjgh-2017-000466
**IMPACT FACTOR:** 3.47
**CITED HALF-LIFE:** 9.40

**START EDITORIAL COMMENT:** This study included an assortment of 28 low-income and lower-middle-income countries that conducted supplementary immunization activities (SIA) between 2000-2014. Primary results (Table 4) demonstrates that 63% of women delivered at a facility, approximately 77% of mothers received a postnatal check after delivery, and care-seeking was most prevalent by mothers who had a child with a fever (54%). However, study results varied by country. In Guinea, women were more likely to deliver at a health facility if SIAs were conducted on their delivery day compared with a non-SIA day (OR 2.30; 95% CI 1.08 to 4.88) while in Ghana, women were more likely to receive postnatal care during SIAs within one week of giving birth (OR 3.81; 95% CI 1.18 to 12.29). Results from this study suggests SIAs have an affect on care-seeking for minor conditions, but no affect on mothers care-seeking for critical conditions.

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2. Potential impact of introducing the pneumococcal conjugate vaccine into national immunisation programmes: an economic-epidemiological analysis using data from India.
   Megiddo I, Klein E, Laxminarayan R.
   BMJ Glob Health. 2018 May 9;3(3):e000636.
   PubMed ID: 29765775

**ABSTRACT**
Pneumococcal pneumonia causes an estimated 105 000 child deaths in India annually. The planned introduction of the serotype-based pneumococcal conjugate vaccine (PCV) is expected to avert child deaths, but the high cost of PCV relative to current vaccines provided under the Universal Immunization Programme has been a concern. Cost-effectiveness studies from high-income countries are not readily comparable because of differences in the distribution of prevalent serotypes, population and health systems. We extended IndiaSim, our agent-based simulation model representative of the Indian population and health system, to model the dynamics of Streptococcus pneumoniae. This enabled us to evaluate serotype and overall disease dynamics in the context of the local population and health system, an aspect that is missing in prospective evaluations of the vaccine. We estimate that PCV13 introduction would cost approximately US$240 million and avert US$48.7 million in out-of-pocket expenditures and 34 800 (95% CI 29 600 to 40 800) deaths annually assuming coverage levels and distribution similar to DPT (diphtheria, pertussis and tetanus) vaccination (~77%). Introducing the vaccine protects the population, especially the poorest wealth quintile, from potentially catastrophic expenditure. The net-present value of predicted money-metric value of insurance for 20 years of vaccination is US$160 000 (95% CI US$151 000 to US$168 000) per 100 000 under-fives, and almost half of this protection is for the bottom wealth quintile (US$78 000; 95% CI 70 800 to 84 400). Extending vaccination to 90% coverage averts additional lives and provides additional financial risk protection. Our estimates are sensitive to immunity parameters in our model; however, our assumptions are conservative, and if willingness to pay per years of life lost averted is US$228 or greater, then introducing the vaccine is more cost-effective than our baseline (no vaccination) in more than 95% of simulations.

**WEB:** 10.1136/bmjgh-2017-000636
**IMPACT FACTOR:** 3.47
**CITED HALF-LIFE:** 9.40

**START EDITORIAL COMMENT:** In this study, a sample size of approximately 25,000 individuals and 4,300 households were analyzed to determine care-seeking behavior. Three using scenarios were evaluated: 1) no vaccination; 2) introducing PCV13 at DPT3 coverage levels; and 3) increasing PCV13 coverage to 90%. In the DPT level vaccine coverage scenario, approximately 558 (95% CI 457 to 656) deaths could be averted per 100 000 under-fives over 20 years, however annual cost could exceed US$240 million annually for vaccine implementation. Additional research and data is necessary, however researchers support this intervention due to projected lives saved and cost over time.

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3. Effect of maternal HIV status on vaccination coverage among sub-Saharan African children: A socio-ecological analysis.
   Adetokunboh OO, Uthman OA, Wiysonge CS.
   Hum Vaccin Immunother. 2018 May 2:1-9. [Epub ahead of print]
   PubMed ID: 29718769

**ABSTRACT**
We investigated the relationship between maternal HIV status and uptake of the full series of three doses of diphtheria-tetanus-pertussis containing vaccines (DTP3) in sub-Saharan African children. We used data obtained from demographic and health surveys conducted in sub-Saharan Africa. We conducted meta-analysis and calculated pooled odds ratios (OR) for the association between maternal HIV status and DTP3 vaccination status for each country. A total of 4,187 out of 5,537 children of women living with HIV received DTP3 (75.6%), compared to 71,290 of 113,513 (62.8%) children of HIV negative women. National DTP3 coverage among children of HIV-positive women varied between 24% and 96% while among children of HIV negative women it was between 26% and 92%. Overall pooled result showed no significant difference in DTP3 coverage between the two groups (OR = 1.05; 95% confidence interval 0.91 - 1.22), with statistically significant heterogeneity (Chi 2 = 91.63, P = 0.000, I2 = 71.6%). There was no significant association between DTP3 coverage and maternal HIV status in sub-Saharan Africa. However, DTP3 coverage for both HIV-exposed and non-exposed children were below the required target. Meta-regression revealed no significant association between DTP3 coverage and country characteristics (e.g. HIV prevalence among women, antiretroviral therapy coverage, gross domestic product per capita, human development index, adult literacy rate and sub-region). Improved prevention of mother-to-child transmission services might have contributed to some extent to the higher DTP3 vaccination coverage among the HIV-exposed children. There is also need to address barriers impeding uptake of vaccination among HIV-exposed and non-exposed children.

**WEB:** 10.1080/21645515.2018.1467204
**IMPACT FACTOR:** 2.15
**CITED HALF-LIFE:** 2.30

**START EDITORIAL COMMENT:** Data from 119,050 across 27countries from 2013-2016 were included in the study cohort. Overall, results showed no significant difference in diphtheria-tetanus-pertussis containing vaccine (DTP3) coverage for infants of mothers living with HIV and for infants of mothers without HIV. Coverage of antiretroviral drugs used during PMTCT was not significantly associated with childhood DTV vaccination coverage (p=0.543). Although support for mother-child pairs has increased, especially in the time period after the launch of the *"Global Plan towards the elimination of new HIV infections among children by 2015 and keeping their mother alive"*, the reality on the ground signified barriers faced by mothers and caregivers, such as immunization such as poor socioeconomic status, stigma, and community-level discrimination. Improved PMTCT, enhanced maternal child health services, and a collaborative effort to remove barriers to immunization is necessary to improve vaccination coverage of HIV-exposed children.

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4. Characteristics of mobile phone access and usage in rural and urban Guatemala: assessing feasibility of text message reminders to increase childhood immunizations.
Hanson CM, Mirza I, Kumapley R, Ogbuanu I, Kezaala R, et al.
Vaccine. 2018 May 31;36(23):3260-3268.
PubMed ID: 29731113

**ABSTRACT**
BACKGROUND:
Delivering vaccination services during the second year of life (2YL)1 provides countries with an opportunity to achieve greater coverage, to provide booster doses and vaccines missed during the first year of life, as well as contribute towards disease control and elimination goals.
METHODS:
Using data from demographic health surveys (DHSs) conducted during 2010 to 2016, this paper explores the proportion of missed opportunities for vaccinations generally provided during routine immunization among children in their 2YL.
RESULTS:
DHS data in 46 countries surveyed 478,737 children, from which 169,259 children were 12-23 months old and had vaccination/health cards viewed by surveyors. From this group, 69,489 children aged 12-23 months had contact with health services in their 2YL. Three scenarios for a missed opportunity for vaccinations were analysed: (1) a child received one vaccine in the immunization schedule and was eligible for another vaccine, but did not receive any further vaccination, (2) a child received a vitamin A supplementation (VAS) and was due for a vaccine, but did not receive vaccines that were due, and (3) a child was taken to a health facility for a sick visit and was due (and eligible) for a vaccine, but did not receive the vaccine. A total of 16,409 (24%) children had one or more missed opportunities for vaccinations.
CONCLUSION:
This analysis highlights the magnitude of the problem of missed opportunities in the 2YL. The global community needs to provide better streamlined guidance, policies and strategies to promote vaccination screenings at well-child and sick child visits in the 2YL. Where they do not exist, well-child visits in the 2YL should be established and strengthened.

**WEB:** 10.21037/mhealth.2018.03.05
**IMPACT FACTOR:** 3.41
**CITED HALF-LIFE:** 5.90

**START EDITORIAL COMMENT:** This study included equal numbers of urban and rural participants, with a specific focus on parents who owneds an active mobile phone capable of receiving SMS messages and parents who high literacy to read SMS messages. Current trends in mobile phone usage related to mHealth interventions shows that parents were more likely to make calls than sending texts (74.7% vs. 25.3%, P<0.0001); urban families demonstrated a preference for text messaging over calls (31.9% vs. 18.6%, P<0.0001). Participants spent an average of $9.50 USD per month on mobile phone service. Result suggest a combination of technological and traditional communication methods are appropriate for low-and-middle income countries, especially in resource limited settings.

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5. Sustainable vaccine development: a vaccine manufacturer's perspective.
   Rappuoli R, Hanon E.
   Curr Opin Immunol. 2018 May 8;53:111-118.
   PubMed ID: 29751212

**ABSTRACT**
Vaccination remains the most cost-effective public health intervention after clean water, and the benefits impressively outweigh the costs. The efforts needed to fulfill the steadily growing demands for next-generation and novel vaccines designed for emerging pathogens and new indications are only realizable in a sustainable business model. Vaccine development can be fast-tracked through strengthening international collaborations, and the continuous innovation of technologies to accelerate their design, development, and manufacturing. However, these processes should be supported by a balanced project portfolio, and by managing sustainable vaccine procurement strategies for different types of markets. Collectively this will allow a gradual shift to a more streamlined and profitable vaccine production, which can significantly contribute to the worldwide effort to shape global health.

**WEB:** 10.1016/j.coi.2018.04.019
**IMPACT FACTOR:** 8.38
**CITED HALF-LIFE:** 6.30

**START EDITORIAL COMMENT:** Public-private partnerships are integral to vaccine innovation and development. This study demonstrates how tiered pricing can support prequalification of vaccines by supranational organizations, which can support vaccine eligibility for consideration by UN agencies in addition to providing an early return on investment at both the national and international levels. 'Omic' technologies can be used to develop a more adaptive clinical trial design and may be reliable method to identify correlates or immunological pathways for vaccination protection. Results suggests that strengthening international collaborations and continued development of innovative technologies is necessary to improve vaccine production and could help to prevent infectious diseases globally.

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6. Socioeconomic drivers of vaccine uptake: An analysis of the data of a geographically defined cluster randomized cholera vaccine trial in Bangladesh.
   Saha A, Hayen A, Ali M, Rosewell A, MacIntyre CR, et al.
   Vaccine. 2018 May 8. pii: S0264-410X(18)30604-2. [Epub ahead of print]
   PubMed ID: 29752024

**ABSTRACT**
BACKGROUND:
Evaluations of oral cholera vaccines (OCVs) have demonstrated their effectiveness in diverse settings. However, low vaccine uptake in some settings reduces the opportunity for prevention. This paper identifies the socioeconomic factors associated with vaccine uptake in a mass vaccination program.
METHODS:
This was a three-arm (vaccine, vaccine plus behavioral change, and non-intervention) cluster randomized trial conducted in Dhaka, Bangladesh. Socio-demographic and vaccination data were collected from 268,896 participants. A geographical information system (GIS) was used to design and implement the vaccination program. A logistic regression model was used to assess the association between vaccine uptake and socioeconomic characteristics.
RESULTS:
The GIS supported the implementation of the vaccination program by identifying ideal locations of vaccination centres for equitable population access, defining catchment areas of daily activities, and providing daily coverage maps during the campaign. Among 188,206 individuals in the intervention arms, 123,686 (66%) received two complete doses, and 64,520 (34%) received one or no doses of the OCV. The vaccine uptake rate was higher in females than males (aOR: 1.80; 95% CI = 1.75-1.84) and in younger (<15 years) than older participants (aOR: 2.19; 95% CI = 2.13-3.26). Individuals living in their own house or having a higher monthly family expenditure were more likely to receive the OCV (aOR: 1.60; 95% CI = 1.50-1.70 and aOR: 1.14; 95% CI = 1.10-1.18 respectively). Individuals using treated water for drinking or using own tap as the source of water were more likely to receive the OCV (aOR: 1.23; 95% CI = 1.17-1.29 and aOR: 1.14; 95% CI = 1.02-1.25 respectively) than their counterpart. Vaccine uptake was also significantly higher in participants residing farther away from health facilities (aOR: 95% 1.80; CI = 1.36-2.37).
CONCLUSION:
The GIS was useful in designing field activities, facilitating vaccine delivery and identifying socioeconomic drivers of vaccine uptake in the urban area of Bangladesh. Addressing these socioeconomic drivers may help improve OCV uptake, thereby effectiveness of the OCV in a community.

**WEB:** 10.1016/j.vaccine.2018.04.084
**IMPACT FACTOR:** 3.41
**CITED HALF-LIFE:** 5.90

**START EDITORIAL COMMENT:** Study participants were divided into three arms: 1) the vaccine arm (n=95,115); 2) the vaccine plus behavior change arm (n= 93,091); and, the non-intervention arm (n= 80,690). Table 1 shows vaccine uptake was higher in females than males, and females had a higher odds ratio of receiving two doses than males (adjusted odds ratio aOR: 1.80; 95% CI = 1.75–1.84). Age was an additional determinant with younger participants (1 to <15 years) having a higher uptake of vaccines than older participants (aOR: 2.19; 95% CI = 2.13–3.26). Results highlight the impact of education, home ownership, and distance to health facility on vaccination uptake.

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7. Highly targeted cholera vaccination campaigns in urban setting are feasible: The experience in Kalemie, Democratic Republic of Congo.
   Massing LA, Aboubakar S, Blake A, Page AL, Cohuet S.
   PLoS Negl Trop Dis. 2018 May 7;12(5):e0006369.
   PubMed ID: 29734337

**ABSTRACT**
INTRODUCTION:
Oral cholera vaccines are primarily recommended by the World Health Organization for cholera control in endemic countries. However, the number of cholera vaccines currently produced is very limited and examples of OCV use in endemic countries, and especially in urban settings, are scarce. A vaccination campaign was organized by Médecins Sans Frontières and the Ministry of Health in a highly endemic area in the Democratic Republic of Congo. This study aims to describe the vaccine coverage achieved with this highly targeted vaccination campaign and the acceptability among the vaccinated communities.
METHODS AND FINDINGS:
We performed a cross-sectional survey using random spatial sampling. The study population included individuals one year old and above, eligible for vaccination, and residing in the areas targeted for vaccination in the city of Kalemie. Data sources were household interviews with verification by vaccination card. In total 2,488 people were included in the survey. Overall, 81.9% (95%CI: 77.9-85.3) of the target population received at least one dose of vaccine. The vaccine coverage with two doses was 67.2% (95%CI: 61.9-72.0) among the target population. The vaccine coverage was higher during the first round (74.0, 95%CI: 69.3-78.3) than during the second round of vaccination (69.1%, 95%CI: 63.9-74.0). Vaccination coverage was lower in male adults. The main reason for non-vaccination was to be absent during the campaign. No severe adverse events were notified during the interviews.
CONCLUSIONS:
Cholera vaccination campaigns using highly targeted strategies are feasible in urban settings. High vaccination coverage can be obtained using door to door vaccination. However, alternative strategies should be considered to reach non-vaccinated populations like male adults and also in order to improve the efficiency of the interventions.

**WEB:** 10.1371/journal.pntd.0006369
**IMPACT FACTOR:** 3.95
**CITED HALF-LIFE:** 3.5

**START EDITORIAL COMMENT:** This study assessed vaccine coverage rates and vaccine coverage estimates by age group, sex, and reasons for non-vaccination. Results showed vaccination coverage was higher among children (5 to 14 years old) than adults. In all age groups, vaccination coverage was higher among women 85.7% (95%CI: 81.1–89.4, deff = 2.2) than in among men 77.5% (95%CI: 72.8–81.5, deff = 1.5). A unexpected finding showed the coverage survey did not align with administrative coverage. Possible explanations for this discrepancy are: 1) individuals living in nearby areas travel to vaccine coverage areas for vaccinations and 2) an increase in the target population between the time of the census (October 2013) and the time of the vaccine implementation (July 2014). Results are particularly relevant for improving vaccination strategies for rural and outlying areas in the DRC.

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8. How can the use of data within the immunisation programme be increased in order to improve data quality and ensure greater accountability in the health system? A protocol for implementation science study.
   Tilahun B, Teklu A, Mancuso A, Abebaw Z, Dessie K, et al.
   Health Res Policy Syst. 2018 May 3;16(1):37.
   PubMed ID: 29724235

**ABSTRACT**
BACKGROUND:
Immunisation remains one of the most important and cost-effective interventions to reduce vaccine-preventable child morbidity, disability and mortality. Health programmes like the Expanded Program of Immunization rely on complex decision-making and strong local level evidence is important to effectively and efficiently utilise limited resources. Lack of data use for decision-making at each level of the health system remains the main challenge in most developing countries. While there is much evidence on data quality and how to improve it, there is a lack of sufficient evidence on why the use of data for decision-making at each level of the health system is low. Herein, we describe a comprehensive implementation science study that will be conducted to identify organisational, technical and individual level factors affecting local data use at each level of the Ethiopian health system.
METHODS:
We will apply a mixed methods approach using key informant interviews and document reviews. The qualitative data will be gathered through key informant interviews using a semi-structured guide with open- and closed-ended questions with four categories of respondents, namely decision-makers, data producers, data users and community representatives at the federal, regional, zonal, woreda and community levels of the health system. The document review will be conducted on selected reports and feedback documented at different levels of the health system. Data will be collected from July 2017 to March 2018. Descriptive statistics will be analysed for the quantitative study using SPSS version 20 software and thematic content analysis will be performed for the qualitative part using NVivo software.
DISCUSSION:
Appropriate and timely use of health and health-related information for decision-making is an essential element in the process of transforming the health sector. The findings of the study will inform stakeholders at different levels on the institutionalisation of evidence-based practice in immunisation programmes.

**WEB:** 10.1186/s12961-018-0312-2
**IMPACT FACTOR:** 2.27
**CITED HALF-LIFE:** NA

**START EDITORIAL COMMENT:** Data used in immunization programming is vital for accessibility and reliability of health system services, while remaining responsive to the health concerns of the community. Organized, timely, and accurate data for health decision-making can be affected by various factors at different levels and remains a challenge for the Ethiopian health system. Results suggest data use and data quality are interrelated. Improvements in data quality can be derived from verification and feedback systems and increased use and usability of data.

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9. Controlling epidemics with transmissible vaccines.
   Nuismer SL, May R, Basinski A, Remien CH.
   PLoS One. 2018 May 10;13(5):e0196978.
   PubMed ID: 29746504

**ABSTRACT**
As the density of human and domestic animal populations increases, the threat of localized epidemics and global pandemics grows. Although effective vaccines have been developed for a number of threatening pathogens, manufacturing and disseminating vaccines in the face of a rapidly spreading epidemic or pandemic remains a formidable challenge. One potentially powerful solution to this problem is the use of transmissible vaccines. Transmissible vaccines are capable of spreading from one individual to another and are currently being developed for a range of infectious diseases. Here we develop and analyze mathematical models that allow us to quantify the benefits of vaccine transmission in the face of an imminent or ongoing epidemic. Our results demonstrate that even a small amount of vaccine transmission can greatly increase the rate at which a naïve host population can be protected against an anticipated epidemic and substantially reduce the size of unanticipated epidemics if vaccination is initiated shortly after pathogen detection. In addition, our results identify key biological properties and implementation practices that maximize the impact of vaccine transmission on infectious disease.

**WEB:** 10.1371/journal.pone.0196978
**IMPACT FACTOR:** 3.23
**CITED HALF-LIFE:** 2.70

**START EDITORIAL COMMENT:** In this study, a mathematical equation was used to analyze disease outbreaks and subsequent effects. The equation demonstrated that low levels of vaccine transmission can reduce the time needed to protect a population against infectious pathogens that may lead to an epidemic. Results show that transmissible vaccines could be beneficial when used prophylactically or at the beginning of an epidemic.

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10. The Usability and Effectiveness of Mobile Health Technology-Based Lifestyle and Medical Intervention Apps Supporting Health Care During Pregnancy: Systematic Review.
Overdijkink SB, Velu AV, Rosman AN, van Beukering MD, Kok M.
JMIR Mhealth Uhealth. 2018 Apr 24;6(4):e109
PubMed ID: 29691216

**ABSTRACT**
BACKGROUND:
A growing number of mobile health (mHealth) technology-based apps are being developed for personal lifestyle and medical health care support, of which several apps are related to pregnancy. Evidence on usability and effectiveness is limited but crucial for successful implementation.
OBJECTIVE:
This study aimed to evaluate the usability, that is, feasibility and acceptability, as well as effectiveness of mHealth lifestyle and medical apps to support health care during pregnancy in high-income countries. Feasibility was defined as the actual use, interest, intention, and continued use; perceived suitability; and ability of users to carry out the activities of the app. Acceptability was assessed by user satisfaction, appreciation, and the recommendation of the app to others.
METHODS:
We performed a systematic review searching the following electronic databases for studies on mHealth technology-based apps in maternal health care in developed countries: EMBASE, MEDLINE Epub (Ovid), Cochrane Library, Web of Science, and Google Scholar. All included studies were scored on quality, using the ErasmusAGE Quality Score or the consolidated criteria for reporting qualitative research. Main outcome measures were usability and effectiveness of mHealth lifestyle and medical health care support apps related to pregnancy. All studies were screened by 2 reviewers individually, and the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement were followed.
RESULTS:
Our search identified 4204 titles and abstracts, of which 2487 original studies remained after removing duplicates. We performed full-text screening of 217 studies, of which 29 were included in our study. In total, 19 out of 29 studies reported on mHealth apps to adopt healthy lifestyles and 10 out of 29 studies to support medical care. The lifestyle apps evaluated in 19 studies reported on usability and effectiveness: 10 studies reported positive on acceptability, and 14 studies reported on feasibility with positive results except one study. In total, 4 out of 19 studies evaluating effectiveness showed significant results on weight gain restriction during pregnancy, intake of vegetables and fruits, and smoking cessation. The 10 studies on medical mHealth apps involved asthma care, diabetic treatment, and encouraging vaccination. Only one study on diabetic treatment reported on acceptability with a positive user satisfaction. In total, 9 out of 10 studies reported on effectiveness. Moreover, the power of most studies was inadequate to show significant effects.
CONCLUSIONS:
Most studies on mHealth apps to support lifestyle and medical care for high-income countries reveal the usability of these apps to reduce gestational weight gain, increase intakes of vegetables and fruit, to quit smoking cessation, and to support health care for prevention of asthma and infections during pregnancy. In general, the evidence on effectiveness of these apps is limited and needs further investigation before implementation in medical health care.

**WEB:** 10.2196/mhealth.8834
**IMPACT FACTOR:** 5.82
**CITED HALF-LIFE:** 3.80

**START EDITORIAL COMMENT:** This study provides an analysis of 28 articles included in a systematic review. Results demonstrate the feasibility of lifestyle apps and online resources for women during their pregnancy, and were especially favorable women with complicated pregnancies. There was sufficient short- and long-term use of the apps as well as positive intentions to continue using these apps. While results were promising, recommendations highlighted increased development and evaluation of mHealth apps for maternal healthcare and lifestyle support for prenatal and postnatal care.

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## APPENDIX

(((((vaccine[tiab] OR vaccines[tiab] OR vaccination[tiab] OR immunization[tiab] OR immunisation[tiab] OR vaccine[mesh] OR immunization[mesh]) 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])) 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[LA]) ("2018/3/15"[PDAT] : "2018/4/14"[PDAT]))

* April 30, 2018, this search of English language articles published between April 15, 2018 and May 14, 2018 and indexed by the US National Library of Medicine resulted in 221 unique manuscripts.