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VACCINE DELIVERY RESEARCH DIGEST

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

REPORT TO THE BILL & MELINDA GATES FOUNDATION

AUGUST 15, 2016

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   Oyo-Ita A, Wiysonge CS, Oringanje C, Nwachukwu CE, Oduwole O, et al.

   Cochrane Database Syst Rev. 2016 Jul 10;7:CD008145. [Epub ahead of print]

   PMID: 27394698

ABSTRACT *(ABRIDGED)*

BACKGROUND: Immunisation is a powerful public health strategy for improving child survival, not only by directly combating key diseases that kill children but also by providing a platform for other health services. However, each year millions of children worldwide, mostly from low- and middle-income countries (LMICs), do not receive the full series of vaccines on their national routine immunisation schedule. This is an update of the Cochrane review published in 2011 and focuses on interventions for improving childhood immunisation coverage in LMICs.

SEARCH METHODS: We searched the Cochrane Central Register of Controlled Trials 2016,; MEDLINE In-Process and Other Non-Indexed Citations, MEDLINE Daily and MEDLINE, OvidSP; CINAHL, EbscoHost; Embase, OvidSP; LILACS, VHL; Sociological Abstracts, ProQuest. We did a citation search for all included studies in Science Citation Index and Social Sciences Citation Index; Emerging Sources Citation Index, ISI Web of Science. We also searched the two Trials Registries: ICTRP and ClinicalTrials.gov. SELECTION CRITERIA: Eligible studies were randomised controlled trials (RCT), non-RCTs, controlled before-after studies, and interrupted time series conducted in LMICs involving children aged from birth to four years, caregivers, and healthcare providers. DATA COLLECTION AND ANALYSIS: We independently screened the search output, reviewed full texts of potentially eligible articles, assessed risk of bias, and extracted data. We then conducted random-effects meta-analyses and used GRADE to assess the certainty of evidence.

MAIN RESULTS: Fourteen studies met our inclusion criteria. These were conducted in Georgia, Ghana, Honduras, India, Mali, Mexico, Nicaragua, Nepal, Pakistan, and Zimbabwe. One study had an unclear risk of bias, and 13 had high risk of bias. The interventions evaluated in the studies included community-based health education, facility-based health education, household incentives, regular immunisation outreach sessions, home visits, supportive supervision, information campaigns, and integration of immunisation services with intermittent preventive treatment of malaria. We found moderate-certainty evidence that health education at village meetings or at home probably improves coverage with three doses of diphtheria-tetanus-pertussis vaccines (DTP3). We also found low-certainty evidence that facility-based health education plus redesigned vaccination reminder cards may improve DTP3 coverage. Household monetary incentives may have little or no effect on full immunisation coverage. Regular immunisation outreach may improve full immunisation coverage which may substantially improve if combined with household incentives. Home visits to identify non-vaccinated children and refer them to health clinics may improve uptake of three doses of oral polio vaccine. There was low-certainty evidence that integration of immunisation with other services may improve DTP3 coverage.

AUTHORS' CONCLUSIONS: Providing parents and other community members with information on immunisation, health education at facilities in combination with redesigned immunisation reminder cards, regular immunisation outreach with and without household incentives, home visits, and integration of immunisation with other services may improve childhood immunisation coverage in LMIC. Most of the evidence was of low certainty, which implies a high likelihood that the true effect of the interventions will be substantially different.

WEB: http://www.dx.doi.org/10.1002/14651858.CD008145.pub3

IMPACT FACTOR: 6.22

CITED HALF-LIFE: 4.80

UW EDITORIAL COMMENT: IAuthors note that the interventions evaluated were extremely heterogeneous, and varied in how delivery intensity, and point out that extrapolating results to different settings or different populations would be inappropriate, and thus generalizability is limited. A limited number of studies are available, thus questions remain about the feasibility and optimal delivery and implementation strategies. Authors also caution that long-term follow-up wasn't conducted, and thus sustainability isn't well understood.

2. THE ECONOMIC AND OPERATIONAL VALUE OF USING DRONES TO TRANSPORT VACCINES.

Haidari LA, Brown ST, Ferguson M, Bancroft E, Spiker M, et al.

Vaccine. 2016 Jul 25;34(34):4062-7. Epub 2016 Jun 20.

PMID: 27340098

ABSTRACT

BACKGROUND: Immunization programs in low and middle income countries (LMICs) face numerous challenges in getting life-saving vaccines to the people who need them. As unmanned aerial vehicle (UAV) technology has progressed in recent years, potential use cases for UAVs have proliferated due to their ability to traverse difficult terrains, reduce labor, and replace fleets of vehicles that require costly maintenance.

METHODS: Using a HERMES-generated simulation model, we performed sensitivity analyses to assess the impact of using an unmanned aerial system (UAS) for routine vaccine distribution under a range of circumstances reflecting variations in geography, population, road conditions, and vaccine schedules. We also identified the UAV payload and UAS costs necessary for a UAS to be favorable over a traditional multi-tiered land transport system (TMLTS).

RESULTS: Implementing the UAS in the baseline scenario improved vaccine availability (96% versus 94%) and produced logistics cost savings of $0.08 per dose administered as compared to the TMLTS. The UAS maintained cost savings in all sensitivity analyses, ranging from $0.05 to $0.21 per dose administered. The minimum UAV payloads necessary to achieve cost savings over the TMLTS, for the various vaccine schedules and UAS costs and lifetimes tested, were substantially smaller (up to 0.40L) than the currently assumed UAV payload of 1.5L. Similarly, the maximum UAS costs that could achieve savings over the TMLTS were greater than the currently assumed costs under realistic flight conditions.

CONCLUSION: Implementing a UAS could increase vaccine availability and decrease costs in a wide range of settings and circumstances if the drones are used frequently enough to overcome the capital costs of installing and maintaining the system. Our computational model showed that major drivers of costs savings from using UAS are road speed of traditional land vehicles, the number of people needing to be vaccinated, and the distance that needs to be traveled.

WEB: http://dx.doi.org/10.1016/j.vaccine.2016.06.022

IMPACT FACTOR: 3.62

CITED HALF-LIFE: 5.50

UW EDITORIAL COMMENT: the HERMES simulations represented every vaccine fial, facility, storage equipment, transport device, route and personnel in the supply chain. Authors modeled a scenario in which provincial stores deliver vaccines monthly to UAVs, which supply the health center in the region, using ongoing UAV shipments based on local demand, with assumptions about UAV capacity and distance based on currently available UAVs on the market. Vaccine availability was based on number of people receiving vaccines divided by number of people seeking vaccines at health centers, not the total population of vaccine-eligible individuals. Figure 1 is a visual depiction of the different model schemes for a range of different delivery scenarios (road distance; number and location of hubs, district and provincial stores and health centers; integration with TMLTS) by UAS and TMLS in one province in Mozambique. Sensitivity analysis varied the population served by the health center, population distribution in urban centers or throughout the district, road speed and road distance traveled for TMLTS routes, seasonality influences on accessibility of health centers, and introduction of additional vaccines to the EPI schedule. Figure 2 depicts the cost-savings estimated under each of these conditions. Assuming various flight delays, a 4-week delay post-vaccination introduction was the first scenario under which the UAS wasn't able to achieve cost savings (Figure 3). Authors report that the cost savings were primarily attributable to road speed, size of population demanding vaccine, and the travel distance capacity, compared with traditional land travel vehicles.

3. **EXPERIENCE OF INTEGRATING VITAMIN A SUPPLEMENTATION INTO POLIO CAMPAIGNS IN THE AFRICAN REGION.**

Chehab ET, Anya BM, Onyango AW, Tevi-Benissan MC, Okeibunor J, et al.

Vaccine. 2016 Jun 27. [Epub ahead of print]

PMID:27364094

ABSTRACT

INTRODUCTION: Vitamin A deficiency is a public health problem that affects children across the WHO African Region. Countries have integrated vitamin A supplementation in different child health interventions, most notably with polio campaigns. The integration of vitamin A in polio campaigns was documented as a best practice in Angola, Chad, Cote d'Ivoire, Tanzania, and Togo. There are potential risks to vitamin A supplementation associated with the polio endgame and certification in the African Region.

METHODS: We reviewed the findings from the documentation of best practices assessment that was conducted by the WHO Regional Office for Africa in 2014 and 2015 in the five countries that noted integration of vitamin A with polio as a best practice. In addition, we reviewed the coverage rates for oral poliovirus vaccine and vitamin A supplementation in Angola, Chad, Cote d'Ivoire, Tanzania, and Togo in 2014 and 2015.

RESULTS: Vitamin A deficiency in 2004 ranged from 35% in Togo to as high as 55% in Angola. All five countries integrated vitamin A supplementation in at least one campaign in 2013-2014 and all achieved over 80% coverage for vitamin A supplementation when it was integrated with polio.

DISCUSSION: Given the progress of the polio program, and decreasing campaigns, there is a risk that fewer children will be reached each year with vitamin A supplementation. We recommend that for countries strengthen the integration of vitamin A supplementation with routine immunization services.

WEB: http://dx.doi.org/10.1016/j.vaccine.2016.05.056

IMPACT FACTOR: 3.62

CITED HALF-LIFE: 5.50

UW EDITORIAL COMMENT: Integration of vitamin A included integration in the campaign planning, implementation and post-campaign activities.

Authors describe the following "lessons learnt" regarding integration of vitamin A supplementation with OPV in the Cote d'Ivoire context: importance of grassroots micro planning, good local coordination, involvement of all stakeholders at the district and national levels in the campaign as well as in social mobilization, involvement of local authorities including civil society, religious leaders, military, and involvement of local radio stations. Challenges in the Cote d'Ivoire context included "slowing down of vaccination teams as they had to administer the two interventions, the additional resources from the nutrition program not always arriving on time, the rounds being very close together, and the low daily allowances paid to vaccinators."

Authors caution that with the "winding down" of polio eradication efforts, coverage data and reporting of Vitamin A supplementation may suffer, since reporting is often linked currently. Four of the five countries evaluated use polio eradication activities to deliver Vitamin A, and thus authors caution that as eradication is reached and polio activities are rolled back, the coverage of Vitamin A supplementation and quality and consistency of coverage data on supplementation may suffer. Authors recommend linking Vitamin A supplementation with other health delivery platforms to improve sustainability and maintain coverage, and recommend countries further integrate vitamin A supplementation into their EPI schedules, to avoid interruptions in coverage following planned eradication in 2019.

*This article (as well as articles 4 & 5) is part of a special section in the publication this month featuring multiple articles about the influence of polio on elimination activities in sub-Saharan Africa on different aspects of the health system.

4. **CONTRIBUTION OF POLIO ERADICATION INITIATIVE TO STRENGTHENING ROUTINE IMMUNIZATION: LESSONS LEARNT IN THE WHO AFRICAN REGION.**

Anya BM, Moturi E, Aschalew T, Carole Tevi-Benissan M, Akanmori BD, et al.

Vaccine. 2016 Jul 7. [Epub ahead of print]

PMID:27396492

ABSTRACT

BACKGROUND: Important investments were made in countries for the polio eradication initiative. On 25 September 2015, a major milestone was achieved when Nigeria was removed from the list of polio-endemic countries. Routine Immunization, being a key pillar of polio eradication initiative needs to be strengthened to sustain the gains made in countries. For this, there is a huge potential on building on the use of polio infrastructure to contribute to RI strengthening.

METHODS: We reviewed estimates of immunization coverage as reported by the countries to WHO and UNICEF for three vaccines: BCG, DTP3 (third dose of diphtheria-tetanus toxoid- pertussis), and the first dose of measles-containing vaccine (MCV1).We conducted a systematic review of best practices documents from eight countries which had significant polio eradication activities.

RESULTS: Immunization programmes have improved significantly in the African Region. Regional coverage for DTP3 vaccine increased from 51% in 1996 to 77% in 2014. DTP3 coverage increased >3 folds in DRC (18-80%) and Nigeria from 21% to 66%; and >2 folds in Angola (41-87%), Chad (24-46%), and Togo (42-87%). Coverage for BCG and MCV1 increased in all countries. Of the 47 countries in the region, 18 (38%) achieved a national coverage for DTP3 ⩾90% for 2years meeting the Global Vaccine Action (GVAP) target. A decrease was noted in the Ebola-affected countries i.e., Guinea, Liberia and Sierra Leone.

CONCLUSIONS: PEI has been associated with increased spending on immunization and the related improvements, especially in the areas of micro planning, service delivery, program management and capacity building. Continued efforts are needed to mobilize international and domestic support to strengthen and sustain high-quality immunization services in African countries. Strengthening RI will in turn sustain the gains made to eradicate poliovirus in the region.

WEB: http://dx.doi.org/10.1016/j.vaccine.2016.05.062.

IMPACT FACTOR: 3.62

CITED HALF-LIFE: 5.50

UW EDITORIAL COMMENT: Best practices were grouped into the following categories: microplanning, implementation and service delivery, capacity building and program management. While the countries assessed are diverse, best practices in these settings may not be completely representative of all settings, and countries were not randomly selected for this review. .Note that while immunization coverage trends in the focus countries over time are informative, coverage is likely influenced by a range of factors in addition to the influence of polio eradication activities, and trends over time should not be assumed to be caused exclusively by support and infrastructure of polio eradication activities, but may also be influenced by other factors, such as other health system strengthening activities, targeted EPI activities, and economic changes in the country. Without comparison to similar countries without polio eradication initiatives during the same time period, it is not possible to attribute changes exclusively to polio eradication initiatives.

5. **CONTRIBUTION OF POLIO ERADICATION INITIATIVE TO EFFECTIVE NEW VACCINE INTRODUCTION IN AFRICA, 2010-2015.**

Carole Tevi-Benissan M, Moturi E, Anya BM, Aschalew T, Dicky AB, et al.

Vaccine. 2016 Jul 5. [Epub ahead of print]

PMID:27396517

ABSTRACT

BACKGROUND: Significant progress has been made to increase access to vaccines in Africa since the 1974 launch of the Expanded Programme on Immunization (EPI). Successes include the introduction of several new vaccines across the continent and likely eradication of polio. We examined the contribution of polio eradication activities (PEI) on new vaccine introduction in the countries of the African Region.

METHODS: We reviewed country specific PEI reports to identify best practices relevant to new vaccine introduction (NVI), and analyzed trends in vaccine coverage during 2010-2015 from immunization estimates provided by WHO/UNICEF.

RESULTS: Of the 47 countries in African Region 35 (74%) have introduced PCV, 27 (57%) have introduced rotavirus, and 14 (30%) have introduced IPV. National introductions for HPV vaccine have been done in 5 countries, while 15 countries have held demonstration and pilot projects. In 2014, the regional coverage for the third dose of PCV (PCV3) and rotavirus vaccines was 50% and 30% respectively. By end of 2015, all countries within the meningitis belt will have introduced MenAfriVac™ vaccine.

CONCLUSIONS: PEI activities had a positive effect in strengthening the process of new vaccine introduction in the African Region. The major contribution was in availing immunization funding and providing trained and experienced technical staff to introduce vaccines. More investment is needed to advocate and sustain funding levels to maintain the momentum gained in introducing new vaccines in the region.

WEB: http://dx.doi.org/10.1016/j.vaccine.2016.05.063

IMPACT FACTOR: 3.62

CITED HALF-LIFE: 5.50

UW EDITORIAL COMMENT: Authors describe a range of important contributions of the polio eradication initiative to systems that supported successful introduction of other vaccines and programs to improve coverage. However, it is important to note that that while the successful national introduction of multiple new vaccination programs in the Africa region have occurred since polio eradication initiatives were scaled up in the region, introduction was also likely influenced by a range of other factors in addition to polio eradication activities, and successful introduction should not be assumed to be caused exclusively by support and infrastructure from the polio eradication activities. Other factors that changed over time, such as other health system strengthening activities and infrastructure support, and economic changes in the countries and the region all likely influenced decisions to introduce other vaccines and supported successful introduction and scale-up. Without comparison to similar countries without polio eradication initiatives during the same time period, it is not possible to attribute changes exclusively to the influence of polio eradication initiatives.

6. **FRAMEWORK FOR OPTIMAL GLOBAL VACCINE STOCKPILE DESIGN FOR VACCINE-PREVENTABLE DISEASES: APPLICATION TO MEASLES AND CHOLERA VACCINES AS CONTRASTING EXAMPLES.**

Thompson KM, Duintjer Tebbens RJ.

Risk Anal. 2016 Jul;36(7):1487-509. Epub 2014 Aug 11.

PMID:25109229

ABSTRACT

Managing the dynamics of vaccine supply and demand represents a significant challenge with very high stakes. Insufficient vaccine supplies can necessitate rationing, lead to preventable adverse health outcomes, delay the achievements of elimination or eradication goals, and/or pose reputation risks for public health authorities and/or manufacturers. This article explores the dynamics of global vaccine supply and demand to consider the opportunities to develop and maintain optimal global vaccine stockpiles for universal vaccines, characterized by large global demand (for which we use measles vaccines as an example), and nonuniversal (including new and niche) vaccines (for which we use oral cholera vaccine as an example). We contrast our approach with other vaccine stockpile optimization frameworks previously developed for the United States pediatric vaccine stockpile to address disruptions in supply and global emergency response vaccine stockpiles to provide on-demand vaccines for use in outbreaks. For measles vaccine, we explore the complexity that arises due to different formulations and presentations of vaccines, consideration of rubella, and the context of regional elimination goals. We conclude that global health policy leaders and stakeholders should procure and maintain appropriate global vaccine rotating stocks for measles and rubella vaccine now to support current regional elimination goals, and should probably also do so for other vaccines to help prevent and control endemic or epidemic diseases. This work suggests the need to better model global vaccine supplies to improve efficiency in the vaccine supply chain, ensure adequate supplies to support elimination and eradication initiatives, and support progress toward the goals of the Global Vaccine Action Plan.

WEB: http://dx.doi.org/10.1111/risa.12265.

IMPACT FACTOR: 2.50

CITED HALF-LIFE: 9.40

UW EDITORIAL COMMENT: Figure 1is a simple schematic of the main components of vaccine supply management for a global stockpile, which considers components of the global disease management strategy, potential stockpile demand, vaccine supply optimization components, and the associated financial costs and health and economic benefits.

Figure 2 is a conceptual model of the "stocks (current amounts or levels of vaccine in the supply chain) and flows (incoming and outcoming)" for vaccine production, filling, storage processes of a global vaccine stockpile over time. The 7 stocks include vaccine in production, bulk vaccine, bulk stockpile, other vaccine bulk (for combined formulations), vaccine in filling, filled vaccine and filled stockpile. Authors describe dynamic optimization of a stockpile as the process by which the difference between public health benefits and total financial costs is maximized. Figure 3 is a similar conceptual model of the stocks and flows to support optimization of total social costs, accounting for the balance between cases of illness averted/public health benefits, and total financial costs, assuming financial constraints exists. This supports a "dynamic transmission model" that accounts for the disease incidence in a population and consideration of the incidence with and without vaccination, which is both influenced by and influences the decision process for stockpile distribution.

7. **BEYOND VERTICAL AND HORIZONTAL PROGRAMS: A DIAGONAL APPROACH TO BUILDING NATIONAL IMMUNIZATION PROGRAMS THROUGH MEASLES ELIMINATION.**

Orenstein WA, Seib K.

Expert Rev Vaccines. 2016 Jul;15(7):791-3. Epub 2016 Mar 28.

PMID: 26967373

ABSTRACT

Plans for reducing and eventually eradicating measles globally include achieving and maintaining high vaccination coverage with two doses of measles containing vaccines (via routine and mass vaccination), monitoring disease, responding to outbreaks, building good communications, and implementing research and development to improve overall programs (e.g. health systems strengthening). Global progress on measles vaccination has saved millions of lives – an estimated 17.1 million between 2000 and 2014 – and has the potential to save many more, especially if countries begin using measles elimination to build up their overall national immunization programs.

WEB: http://dx.doi.org/10.1586/14760584.2016.1165614

IMPACT FACTOR: 3.46

CITED HALF-LIFE: 4.60

UW EDITORIAL COMMENT: A "diagonal approach" refers to the application of disease-specific or targeted "vertical" resources to build up the platforms for the delivery of comprehensive prevention and treatment services, via a more "horizontal" approach. Use of such resources to build and develop more comprehensive health care services or integrated approaches to strengthen the health system is a "vertical approach." Authors describe how measles elimination can be addressed using a diagonal approach that also strengthens the system for delivering other key interventions. Authors explain that measles is an ideal candidate for a diagonal approach because of its highly infectious nature (and thus the high coverage necessary to prevent outcomes), it's cyclical outbreak nature, and the ease with which it is clinically identified. For these reasons, coverage is a priority and gaps in coverage and in the delivery system overall are easily and quickly identified, which can be used to inform needs and opportunities for leveraging resources to address such gaps. The importance of monitoring and surveillance so that outbreaks can be identified early and intervention targeted to prevent larger outbreaks has also led to the development of a surveillance system that can be leveraged to build a more comprehensive surveillance infrastructure for tracking other incident illness regionally and over time.

8. FEASIBILITY AND LIMITATIONS OF VACCINE TWO-DIMENSIONAL BARCODING USING MOBILE DEVICES.

Bell C, Guerinet J, Atkinson KM, Wilson K.

J Med Internet Res. 2016 Jun 23;18(6):e143.

PMID:27339043

ABSTRACT

BACKGROUND: Two-dimensional (2D) barcoding has the potential to enhance documentation of vaccine encounters at the point of care. However, this is currently limited to environments equipped with dedicated barcode scanners and compatible record systems. Mobile devices may present a cost-effective alternative to leverage 2D vaccine vial barcodes and improve vaccine product-specific information residing in digital health records.

OBJECTIVE: Mobile devices have the potential to capture product-specific information from 2D vaccine vial barcodes. We sought to examine the feasibility, performance, and potential limitations of scanning 2D barcodes on vaccine vials using 4 different mobile phones.

METHODS: A unique barcode scanning app was developed for Android and iOS operating systems. The impact of 4 variables on the scan success rate, data accuracy, and time to scan were examined: barcode size, curvature, fading, and ambient lighting conditions. Two experimenters performed 4 trials 10 times each, amounting to a total of 2160 barcode scan attempts.

RESULTS: Of the 1832 successful scans performed in this evaluation, zero produced incorrect data. Five-millimeter barcodes were the slowest to scan, although only by 0.5 seconds on average. Barcodes with up to 50% fading had a 100% success rate, but success rate deteriorated beyond 60% fading. Curved barcodes took longer to scan compared with flat, but success rate deterioration was only observed at a vial diameter of 10 mm. Light conditions did not affect success rate or scan time between 500 lux and 20 lux. Conditions below 20 lux impeded the device's ability to scan successfully. Variability in scan time was observed across devices in all trials performed.

CONCLUSIONS: 2D vaccine barcoding is possible using mobile devices and is successful under the majority of conditions examined. Manufacturers utilizing 2D barcodes should take into consideration the impact of factors that limit scan success rates. Future studies should evaluate the effect of mobile barcoding on workflow and vaccine administrator acceptance.

WEB: http://dx.doi.org/10.2196/jmir.5591

IMPACT FACTOR: 5.82

CITED HALF-LIFE: 3.80

UW EDITORIAL COMMENT: TAble 2 shows the total number and percent of successful scans for each variable condition of size, fading %, curvature, and illumination, by mobile device. Tests that combined different variable conditions (eg. high fading and low light) weren't conducted, thus whether there are additive or multiplicative implications of these factors isn't clear. These tests were conducted assuming barcodes were printed "ideally" and mobile phones were "modern," but it would be important to assess how older/less modern devices perform and the influence of a less-than-perfectly-printed barcode on accuracy, so that the constraints under which these applications perform are well-informed. Authors note that barcodes are increasingly used for medication and medical devices already, though not necessarily in low-resource settings. Another potential use of barcodes is for easily tracking expiration dates. They also point out that applications that allow barcodes to be read could be used not only by health care providers, but by patients themselves.

Authors recommend a usability study to evaluate the training requirements, as to evaluate how best to integrate scanning into provider workflow.

9. THE ECONOMIC VALUE OF INCREASING GEOSPATIAL ACCESS TO TETANUS TOXOID IMMUNIZATION IN MOZAMBIQUE.

Haidari LA, Brown ST, Constenla D, Zenkov E, Ferguson M, et al.

Vaccine. 2016 Jul 29;34(35):4161-5. Epub 2016 Jun 29.

PMID:27340098

ABSTRACT

BACKGROUND: With tetanus being a leading cause of maternal and neonatal morbidity and mortality in low and middle income countries, ensuring that pregnant women have geographic access to tetanus toxoid (TT) immunization can be important. However, immunization locations in many systems may not be placed to optimize access across the population. Issues of access must be addressed for vaccines such as TT to reach their full potential.

METHODS: To assess how TT immunization locations meet population demand in Mozambique, our team developed and utilized SIGMA (Strategic Integrated Geo-temporal Mapping Application) to quantify how many pregnant women are reachable by existing TT immunization locations, how many cannot access these locations, and the potential costs and disease burden of not covering geographically harder-to-reach populations. Sensitivity analyses covered a range of catchment area sizes to include realistic travel distances and to determine the area some locations would need to cover in order for the existing system to reach at least 99% of the target population.

RESULTS: For 99% of the population to reach health centers, people would be required to travel up to 35km. Limiting this distance to 15km would result in 5450 (3033-7108) annual cases of neonatal tetanus that could be prevented by TT, 144,240 (79,878-192,866) DALYs, and $110,691,979 ($56,180,326-$159,516,629) in treatment costs and productivity losses. A catchment area radius of 5km would lead to 17,841 (9929-23,271) annual cases of neonatal tetanus that could be prevented by TT, resulting in 472,234 (261,517-631,432) DALYs and $362,399,320 ($183,931,229-$522,248,480) in treatment costs and productivity losses.

CONCLUSION: TT immunization locations are not geographically accessible by a significant proportion of pregnant women, resulting in substantial healthcare and productivity costs that could potentially be averted by adding or reconfiguring TT immunization locations. The resulting cost savings of covering these harder to reach populations could help pay for establishing additional immunization locations.

WEB: http://dx.doi.org/10.1016/j.vaccine.2016.06.065

IMPACT FACTOR: 3.62

CITED HALF-LIFE: 5.50

UW EDITORIAL COMMENT: The relationship between the size of the catchment area radius for a health center and the rate of increase in the size of population covered was non-linear; the size of the additional population covered increased at an increasing rate for larger coverage radiuses up to 4 km, but after that the size of the additional population coverage gained for larger radius catchment areas declines (Figure 1). Authors suggest that the substantial rate of change in coverage for slightly larger radii is due to reaching additional people in urban centers with only slightly larger catchment areas, and explain that at a certain distance, less additional people are reached with larger catchment areas because the areas will include less densely populated rural areas, where coverage is less efficiently gained. Authors note that even using larger catchment areas, rural populations are more difficult to reach and less efficiently accessed, which is displayed visually in Figure 2. Likewise, there are "diminishing return" in terms of the economic impact of covering these "hard to reach" populations at larger geographic radii, in that differences in cases, case-related costs and DALYS lost are less pronounced as the size of radius increases at larger radii. Authors recommend that conducting outreach from existing fixed centers, providing transportation or reimbursement for travel may effective methods to increase reach and coverage, in addition to adding additional sites or changing locations of sites to reach a larger population.

10. INTERVENTIONS TO IMPROVE HPV VACCINE UPTAKE: A SYSTEMATIC REVIEW.

Walling EB, Benzoni N, Dornfeld J, Bhandari R, Sisk BA, et al.

Pediatrics. 2016 Jul;138(1). Epub 2016 Jun 13.

PMID:27296865

ABSTRACT

CONTEXT: The human papillomavirus (HPV) vaccine is a safe, effective cancer prevention method that is underutilized in the United States. Despite increased understanding of barriers to vaccination, rates remain low. Globally, developed and developing nations have achieved high rates of vaccination.

OBJECTIVE: Identification of effective strategies is necessary to optimize uptake of the HPV vaccine. We systematically reviewed the literature for national and international interventions that have successfully increased HPV vaccine uptake.

DATA SOURCES: We used a standardized protocol to search for articles published between January 1, 2006, and April 30, 2015, in 3 electronic databases: PubMed, Scopus, and Embase.

STUDY SELECTION: We identified interventions designed to increase HPV vaccine uptake among adolescents and young adults aged 11 to 26 years. All study designs were acceptable. Only articles that included post intervention vaccination rates were included.

DATA EXTRACTION: Two authors independently reviewed each article for data extraction and quality assessment. Interventions were classified according to the Community Preventive Service Task Force guide.

RESULTS: Results were reported according to the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework. Fifty-one articles met eligibility criteria: 2 informational interventions, 18 behavioral interventions, and 31 environmental interventions. Factors associated with HPV vaccine uptake were increased vaccine availability, decreased financial barriers, and interventions targeting both providers and patients.

LIMITATIONS: Lack of consistent RE-AIM metric reporting, limiting our ability to assess intervention validity and quality.

CONCLUSIONS: Population-based vaccination strategies that increased vaccine availability reached the greatest number of adolescents and were most successful in achieving high rates of vaccination.

WEB: http://dx.doi.org/10.1542/peds.2015-3863

IMPACT FACTOR: 5.80

CITED HALF-LIFE: 8.30

UW EDITORIAL COMMENT: The RE-AIM evaluation criteria against which interventions were assessed is explained in Table 4.. Studies assessing informational and behavioral interventions were exclusively conducted in the US or other high-income countries.

Environmental interventions aimed to “change the social environment to facilitate vaccination, eg. decreased financial barriers, novel vaccination locations” and included interventions at the “small (organizational guidelines, no government involvement)”, and “large policy levels (formal laws, rules or regulations, national or local government involvement).” Environment interventions were conducted in both high- and low-resource settings. School and clinic-based vaccination programs were the primary intervention approaches used in low-resource settings. Authors point out that the ability to reach large, diverse populations regardless of the health access of the individuals, and the increased access to the HPV vaccine were important contributing factors to success of these programs. Authors note that school-based programs were widely accepted by key stake-holders. One limitation was that school-based programs primarily targeted young adolescents, and vaccination coverage was impeded by poor school attendance.

APPENDIX: PUBMED SEARCH TERMS

(((((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]) AND ("2016/6/15"[PDAT] : "2016/07/14"[PDAT]))

* On July 28, 2016, this search of English language articles published between June 15, 2016 and July 14, 2016 and indexed by the US National Library of Medicine resulted in 207 unique manuscripts.