VACCINE DELIVERY RESEARCH DIGEST

UNIVERSITY OF WASHINGTON GLOBAL HEALTH START PROGRAM
REPORT TO THE BILL AND MELINDA GATES FOUNDATION

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Yang W, Parisi M, Lahue B, Uddin J, Bishai D.

Vaccine. 2014 Oct 7. pii: S0264-410X(14)01335-8. [Epub ahead of print]

PMID: 25306911

ABSTRACT

INTRODUCTION: Open vial vaccine wastage in multi-dose vials is a major contributor to vaccine wastage. Although switching from 10-dose vials to 5-dose vials could reduce wastage, a higher total cost could be triggered because smaller vials cost more to purchase and store.

METHODS: This study drew field data of daily session sizes in local vaccination facilities from Bangladesh, India (Uttar Pradesh), Mozambique, and Uganda, and used Akaike Information Criteria to determine the best fit statistical distribution across various clinic types. These distributions were input to estimate the vaccine wastage using Lee's (2010) model. Inactivated polio vaccine (IPV) immunization was simulated to compare the costs over ten years with 10-dose vials versus 5-dose vials.

RESULTS: By switching from 10- to 5-dose vials, the observed open vial wastage rate due to vial size preference and session size for IPV was reduced from 0.25 to 0.11 in Bangladesh, 0.17 to 0.08 in India (Uttar Pradesh), 0.13 to 0.06 in Mozambique, and 0.09 to 0.04 in Uganda, respectively. The cost savings realized from lower IPV wastage did not offset the higher costs of procurement and storage costs associated with smaller dose presentation.

CONCLUSION: While our model showed that switching from 10-dose vials to 5-dose vials of IPV reduced open vial wastage, it was not cost-saving.

WEB: http://dx.doi.org/10.1016/j.vaccine.2014.09.057

IMPACT FACTOR: 3.49

CITED HALF-LIFE: 4.90

UW EDITORIAL COMMENT: Table 4 shows that lower wastage rates could be achieved in each country by switching from the 10-dose IPV vial to the 5-dose vial. However Figure 2 shows that the cost per dose, considering not only reduced wastage but also factors such as procurement costs and cold chain costs, is actually lower in the 10-dose IPV vial. A limitation of this study is that the model did not include some important factors that influence costs and wastage, such as storage capacity within clinics, wastage due to over procurement of vaccine, and closed vial wastage.

2. IMPACT OF ROTAVIRUS VACCINE ON PREMATURE INFANTS.

Roué JM, Nowak E, Le Gal G, Lemaitre T, Oger E, Poulhazan E, et al.

Clin Vaccine Immunol. 2014 Oct;21(10):1404-9. Epub 2014 Jul 30.

PMID: 25080553

ABSTRACT

Infants born preterm are at a higher risk of complications and hospitalization in cases of rotavirus diarrhea than children born at term. We evaluated the impact of a rotavirus vaccination campaign (May 2007 to May 2010) on hospitalizations for rotavirus gastroenteritis in a population of children under 3 years old born prematurely (before 37 weeks of gestation) in the Brest University Hospital birth zone. Active surveillance from 2002 to 2006 and a prospective collection of hospitalizations for rotavirus diarrhea were initiated in the pediatric units of Brest University Hospital until May 2010. Numbers of hospitalizations for rotavirus diarrhea among the population of children born prematurely, before and after the start of the vaccination program, were compared using a Poisson regression model controlling for epidemic-to-epidemic variation. A total of 217 premature infants were vaccinated from 2007 to 2010. Vaccine coverage for a complete course of three doses was 41.9%. The vaccine safety in premature infants was similar to that in term infants. The vaccination program led to a division by a factor of 2.6 (95% confidence interval [CI], 1.3 to 5.2) in the number of hospitalizations for rotavirus diarrhea during the first two epidemic seasons following vaccine introduction and by a factor of 11 (95% CI, 3.5 to 34.8) during the third season. We observed significant effectiveness of the pentavalent rotavirus vaccine on the number of hospitalizations in a population of prematurely born infants younger than 3 years of age. A multicenter national study would provide better assessment of this impact. (This study [Impact of Systematic Infants Vaccination Against Rotavirus on Gastroenteritis Hospitalization: a Prospective Study in Brest District, France (IVANHOE)] has been registered at ClinicalTrials.gov under registration no. NCT00740935.).

WEB: http://dx.doi.org/10.1128/CVI.00265-14

IMPACT FACTOR: 2.60

CITED HALF-LIFE: 2.40

UW EDITORIAL COMMENT: Figure 3 shows the observed vs. expected outcome for rotavirus hospitalizations over a series of epidemic season. While the observed number of hospitalizations in the 3-5 year group, who were not targeted for rotavirus vaccination, increased over time, the observed hospitalizations in premature infants, the vaccine target group, fell over time to well below the expected value. The relative reduction in hospitalizations can be seen in Table 3. The investigators found the vaccine to be safe in the premature group, with no increased incidence of serious adverse events (Figure 4).

3. A CLUSTER RANDOMIZED NON-INFERIORITY FIELD TRIAL ON THE IMMUNOGENICITY AND SAFETY OF TETANUS TOXOID VACCINE KEPT IN CONTROLLED TEMPERATURE CHAIN COMPARED TO COLD CHAIN.

Juan-Giner A, Domicent C, Langendorf C, Roper MH, Baoundoh P, Fermon F, et al.

Vaccine. 2014 Sep 25. pii: S0264-410X(14)01286-9. [Epub ahead of print]

PMID: 25261378

ABSTRACT

BACKGROUND: In resource-poor settings, cold chain requirements present barriers for vaccine delivery. We evaluated the immunogenicity and safety of tetanus toxoid (TT) vaccine in "Controlled Temperature Chain" (CTC; up to 40°C for <30 days before administration), compared to standard cold chain (SCC; 2-8°C). Prior to the study, stability parameters of TT-CTC were shown to meet international requirements.

METHODS: A cluster randomized, non-inferiority trial was conducted in Moïssala district, Chad, December 2012-March 2013. Thirty-four included clusters were randomized to CTC or SCC. Women aged 14-49 years, eligible for TT vaccination and with a history of ≤1 TT dose, received two TT doses 4 weeks apart. Participants were blinded to allocation strategy. Tetanus antibody titers were measured using standard ELISA at inclusion and 4 weeks post-TT2. Primary outcome measures were post-vaccination seroconversion and fold-increase in geometric mean concentrations (GMC). Non-inferiority was by seroconversion difference (TTSCC-TTCTC) <5% and ratio of GMCs (TTSCC/TTCTC) <1.5. Adverse events were monitored at health centers and at next contact with participants.

RESULTS: A total of 2128 women (CTC=1068; SCC=1060) were recruited. Primary intention to vaccinate analysis included 1830 participants; 272 of these were included in the seroconversion analysis. Seroconversion was reached by >95% of participants; upper 95%CI of the difference was 5.6%. Increases in GMC were over 4-fold; upper 95%CI of GMC ratio was 1.36 in the adjusted analysis. Few adverse events were recorded.

CONCLUSIONS: This study demonstrates the immunogenicity and safety of TT in CTC at <40°C for <30 days. The high proportion of participants protected at baseline results in a reduction of power to detect a 5% non-inferiority margin. However, results at a 10% non-inferiority margin, the comparable GMC increases and vaccine's stability demonstrated in the preliminary phase indicate that CTC can be an alternative strategy for TT delivery in situations where cold chain cannot be maintained.

WEB: http://dx.doi.org/10.1016/j.vaccine.2014.09.027

IMPACT FACTOR: 3.49

CITED HALF-LIFE: 4.90

UW EDITORIAL COMMENT: Table 4 shows that seroprotection was not significantly different in the CTC and SCC group. The main limitation of this study was the inability to detect a 5% non-inferiority margin, however the authors state that the 10% inferiority margin that they achieved has been used in previous CTC research.

4. THE IMPACT OF INTRODUCING NEW VACCINES ON THE HEALTH SYSTEM: CASE STUDIES FROM SIX LOW- AND MIDDLE-INCOME COUNTRIES.

Burchett HE, Mounier-Jack S, Torres-Rueda S, Griffiths UK, Ongolo-Zogo P, Rulisa S, et al.

Vaccine. 2014 Sep 26. pii: S0264-410X(14)01290-0. [Epub ahead of print]

PMID: 25261379

ABSTRACT

OBJECTIVE: We aimed to explore the impacts of new vaccine introductions on immunization programmes and health systems in low- and middle-income countries

METHODS: We conducted case studies of seven vaccine introductions in six countries (Cameroon, PCV; Ethiopia, PCV; Guatemala, rotavirus; Kenya, PCV; Mali, Meningitis A; Mali, PCV; Rwanda, HPV). Interviews were conducted with 261 national, regional and district key informants and questionnaires were completed with staff from 196 health facilities. Routine data from districts and health facilities were gathered on vaccination and antenatal service use. Data collection and analysis were structured around the World Health Organisation health system building blocks.

FINDINGS: The new vaccines were viewed positively and seemed to integrate well into existing health systems. The introductions were found to have had no impact on many elements within the building blocks framework. Despite many key informants and facility respondents perceiving that the new vaccine introductions had increased coverage of other vaccines, the routine data showed no change. Positive effects perceived included enhanced credibility of the immunisation programme and strengthened health workers' skills through training. Negative effects reported included an increase in workload and stock outs of the new vaccine, which created a perception in the community that all vaccines were out of stock in a facility. Most effects were found within the vaccination programmes; very few were reported on the broader health systems. Effects were primarily reported to be temporary, around the time of introduction only.

CONCLUSION: Although the new vaccine introductions were viewed as intrinsically positive, on the whole there was no evidence that they had any major impact, positive or negative, on the broader health systems.

WEB: http://dx.doi.org/10.1016/j.vaccine.2014.09.031

IMPACT FACTOR: 3.49

CITED HALF-LIFE: 4.90

UW EDITORIAL COMMENT: Table 5 summarizes the identified components of new vaccine introduction and the positive and negative effects it can have on the existing health system. Figure 1 counters the belief held by key informants that introduction of a new vaccine increases coverage of other vaccinations; 4 of the 5 campaigns analyzed showed no increase trend, and the 5th only showed evidence of a short-term increase.

5. BURDEN OF TYPHOID FEVER IN LOW-INCOME AND MIDDLE-INCOME COUNTRIES: A SYSTEMATIC, LITERATURE-BASED UPDATE WITH RISK-FACTOR ADJUSTMENT.

Mogasale V, Maskery B, Ochiai RL, Lee JS, Mogasale VV, Ramani E, et al.

Lancet Glob Health. 2014 Oct;2(10):e570-80.

PMID: 25304633

ABSTRACT

BACKGROUND: No access to safe water is an important risk factor for typhoid fever, yet risk-level heterogeneity is unaccounted for in previous global burden estimates. Since WHO has recommended risk-based use of typhoid polysaccharide vaccine, we revisited the burden of typhoid fever in low-income and middle-income countries (LMICs) after adjusting for water-related risk.

METHODS: We estimated the typhoid disease burden from studies done in LMICs based on blood-culture-confirmed incidence rates applied to the 2010 population, after correcting for operational issues related to surveillance, limitations of diagnostic tests, and water-related risk. We derived incidence estimates, correction factors, and mortality estimates from systematic literature reviews. We did scenario analyses for risk factors, diagnostic sensitivity, and case fatality rates, accounting for the uncertainty in these estimates and we compared them with previous disease burden estimates.

FINDINGS: The estimated number of typhoid fever cases in LMICs in 2010 after adjusting for water-related risk was 11·9 million (95% CI 9·9-14·7) cases with 129 000 (75 000-208 000) deaths. By comparison, the estimated risk-unadjusted burden was 20·6 million (17·5-24·2) cases and 223 000 (131 000-344 000) deaths. Scenario analyses indicated that the risk-factor adjustment and updated diagnostic test correction factor derived from systematic literature reviews were the drivers of differences between the current estimate and past estimates.

INTERPRETATION: The risk-adjusted typhoid fever burden estimate was more conservative than previous estimates. However, by distinguishing the risk differences, it will allow assessment of the effect at the population level and will facilitate cost-effectiveness calculations for risk-based vaccination strategies for future typhoid conjugate vaccine.

WEB: http://dx.doi.org/10.1016/S2214-109X(14)70301-8

IMPACT FACTOR: 39.21

CITED HALF-LIFE: 9.10

UW EDITORIAL COMMENT: This analysis shows the importance of considering risk factors when assessing global burden of disease, and the impact this can have on vaccination programs. Table 1 shows the percent of the population that fall under high risk categories in areas where typhoid is endemic. The adjusted analysis shows lower number of cases and deaths than previous burden of disease studies (see Figure 2). The results of this study are limited because the only risk factor analyzed was safe water access, while other risks such as sanitation and food contamination could have a large effect on the incidence of typhoid.

6. POTENTIAL IMPACT OF A 9-VALENT HPV VACCINE IN HPV-RELATED CERVICAL DISEASE IN 4 EMERGING COUNTRIES (BRAZIL, MEXICO, INDIA AND CHINA).

Serrano B, Alemany L, Ruiz PA, Tous S, Lima MA, Bruni L, et al.

Cancer Epidemiol. 2014 Oct 7. pii: S1877-7821(14)00153-2. [Epub ahead of print]

PMID: 25305098

ABSTRACT

BACKGROUND: We estimated the potential impact of an investigational 9-valent human papillomavirus (HPV) vaccine (HPVs 6/11/16/18/31/33/45/52/58) in HPV-related cervical disease in Brazil, Mexico, India and China, to help to formulate recommendations on cervical cancer prevention and control.

METHODS: Estimations for invasive cervical cancer (ICC) were based on an international study including 1356 HPV-positive cases for the four countries altogether, and estimations for precancerous cervical lesions were extracted from a published meta-analysis including 6 025 HPV-positive women from the four mentioned countries. Globocan 2012 and 2012 World Population Prospects were used to estimate current and future projections of new ICC cases.

RESULTS: Combined proportions of the 9 HPV types in ICC were 88.6% (95%CI: 85.2-91.3) in Brazil, 85.7% (82.3-88.8) in Mexico, 92.2% (87.9-95.3) in India and 97.3% (93.9-99.1) in China. The additional HPV 31/33/45/52/58 proportions were 18.8% (15.3-22.7) in Brazil, 17.6% (14.2-21.2) in Mexico, 11.3% (7.5-16.1) in India and 11.9% (7.5-17.2) in China. HPV6 and 11 single types were not identified in any of the samples. Proportion of the individual 7 high risk HPV types included in the vaccine varied by cytological and histological grades of HPV-positive precancerous cervical lesions. HPV 16 was the dominant type in all lesions, with contributions in low grade lesions ranging from 16.6%(14.3-19.2) in Mexico to 39.8% (30.0-50.2) in India, and contributions in high grade lesions ranging from 43.8% (36.3-51.4) in Mexico to 64.1% (60.6-67.5) in Brazil. After HPV 16, variations in other majors HPV types were observed by country, with an under representation of HPV 18 and 45 compared to ICC.

CONCLUSIONS: The addition of HPVs 31/33/45/52/58 to HPV types included in current vaccines could increase the ICC preventable fraction in a range of 12 to 19% across the four countries, accounting the 9-types altogether 90% of ICC cases. Assuming the same degree of efficacy of current vaccines, the implementation of the 9-valent HPV vaccine in Brazil, Mexico, India and China would substantially impact on the reduction of the world cervical cancer burden.

WEB: http://dx.doi.org/10.1016/j.canep.2014.09.003

IMPACT FACTOR: 4.33

CITED HALF-LIFE: 2.40

UW EDITORIAL COMMENT: The contribution of each HPV subtype to cases of invasive cervical cancer, stratified by country, can be seen in Figure 2 and Table 3. Table 4 shows a comparison of the cancer burden attributable to subtypes 16/18 (targeted by current vaccination) to the additional 5 subtypes that are included in the 9-valent vaccine, showing a significant contribution of these additional subtypes.

7. MAPPING VACCINE HESITANCY-COUNTRY-SPECIFIC CHARACTERISTICS OF A GLOBAL PHENOMENON.

Dubé E, Gagnon D, Nickels E, Jeram S, Schuster M.

Vaccine. 2014 Sep 30. pii: S0264-410X(14)01307-3. [Epub ahead of print]

PMID: 25280436

ABSTRACT

The term vaccine hesitancy refers to delay in acceptance or refusal of vaccines despite the availability of vaccination services. Different factors influence vaccine hesitancy and these are context-specific, varying across time and place and with different vaccines. Factors such as complacency, convenience and confidence are involved. Acceptance of vaccines may be decreasing and several explanations for this trend have been proposed. The WHO Strategic Advisory Group of Experts (SAGE) on Immunization has recognized the global importance of vaccine hesitancy and recommended an interview study with immunization managers (IMs) to better understand the range of vaccine hesitancy determinants that are encountered in different settings. Interviews with IMs in 13 selected countries were conducted between September and December 2013 and various factors that discourage vaccine acceptance were identified. Vaccine hesitancy was not defined consistently by the IMs and most interpreted the term as meaning vaccine refusal. Although vaccine hesitancy existed in all 13 countries, some IMs considered its impact on immunization programmes to be a minor problem. The causes of vaccine hesitancy varied in the different countries and were context-specific, indicating a need to strengthen the capacity of national programmes to identify the locally relevant causal factors and to develop adapted strategies to address them.

WEB: http://dx.doi.org/10.1016/j.vaccine.2014.09.039

IMPACT FACTOR: 3.49

CITED HALF-LIFE: 4.90

UW EDITORIAL COMMENT: Table 2 provides a summary of the IM's assessment of vaccine hesitancy in each country, with more detailed information provided in Table 1. Figure 1 provides the SAGE Working Group Hesitancy Model, which includes the main issues mentioned by the IMs as well as additional influences identified by the SAGE group. The results presented in this paper are limited in application because the researchers did not provide information on which countries were represented in the analysis. Therefore this analysis cannot be used to identify country specific influences, but rather as an overview of the global problem.

8. COVERAGE AND ACCEPTABILITY OF CHOLERA VACCINE AMONG HIGH-RISK POPULATION OF URBAN DHAKA, BANGLADESH.

Uddin MJ, Wahed T, Saha NC, Kaukab SS, Khan IA, Khan A, et al.

Vaccine. 2014 Sep 29;32(43):5690-5. doi:. Epub 2014 Aug 20.

PMID: 25149429

ABSTRACT

The oral cholera vaccine (Shanchol), along with other interventions, is a potential new measure to prevent or control cholera. A mass cholera-vaccination programme was launched in urban Dhaka, Bangladesh, during February-April 2011 targeting about 173,041 people who are at high risk of cholera. This cross-sectional, descriptive study assessed the coverage and acceptability of the vaccine. The study used a quantitative household survey and qualitative data-collection techniques comprising focus-group discussions, in-depth interviews, and observations for assessment. The findings revealed that 88% of the target population received the first dose of the vaccine, and 79% received the second dose. Absence of persons at home was a prominent cause of not administering the first (71%) and the second dose (67%). Thirty-three percent of the respondents (n=9308) did not like the taste of the vaccine. Only 1.3% and 3% recipients of the first dose and the second dose of the vaccine respectively reported adverse effects within 28 days of vaccination, and the adverse effects included vomiting or vomiting tendency and diarrhoea. To improve the coverage of the cholera vaccine, exploration of effective solutions to reach the unvaccinated population is required. The vaccine may be more acceptable to the community through changing its taste.

WEB: http://dx.doi.org/10.1016/j.vaccine.2014.08.021

IMPACT FACTOR: 3.49

CITED HALF-LIFE: 4.90

UW EDITORIAL COMMENT: This descriptive study found that acceptability of the oral cholera vaccine was fairly high in their target population. The reasons for not completing a dose are shown in Figure 1. Some limitations of the study include that, although the study team interviewed 39,910 eligible people, this represented only 61% of the population of interest, and vaccination history was assessed without a vaccination card in 39% of those they did reach.

9. EVALUATION OF TARGETED MASS CHOLERA VACCINATION STRATEGIES IN BANGLADESH: A DEMONSTRATION OF A NEW COST-EFFECTIVENESS CALCULATOR.

Troeger C, Sack DA, Chao DL.

Am J Trop Med Hyg. 2014 Oct 6. pii: 14-0159. [Epub ahead of print]

PMID: 25294614

ABSTRACT

Growing interest in mass vaccination with oral cholera vaccine in endemic and epidemic settings will require policymakers to evaluate how to allocate these vaccines in the most efficient manner. Because cholera, when treated properly, has a low case fatality rate, it may not be economically feasible to vaccinate an entire population. Using a new publicly available calculator for estimating the cost-effectiveness of mass vaccination, we show how targeting high-risk subpopulations for vaccination could be cost-effective in Bangladesh. The approach described here is general enough to adapt to different settings or to other vaccine-preventable diseases.

WEB: http://dx.doi.org/10.4269/ajtmh.14-0159

IMPACT FACTOR: 2.53

CITED HALF-LIFE: 9.20

UW EDITORIAL COMMENT: The Vaccine Introduction Cost-Effectiveness (VICE) calculator was developed by the investigators to compute cost-effectiveness outcomes for cholera vaccine using direct and indirect costs. The investigators used the calculator tool to determine the cost-effectiveness of an oral cholera vaccine in Bangladesh. Figure 1 shows under what conditions a vaccine in Bangladesh would be cost-effective, showing a general non-selective vaccination campaign to be out of range. Figure 2 shows how these calculations depend on incidence, case-fatality rate, and efficacy. The researchers found that vaccinating children would be much more cost-effective than vaccinating the entire population (Figure 3). The influence of overall protection vs. direct protection on cost effectiveness is shown in Figure 4b. The calculator developed by the research team is available at https://www.stopcholera.org/.

10. IMPACT AND COST-EFFECTIVENESS OF NEW TUBERCULOSIS VACCINES IN LOW- AND MIDDLE-INCOME COUNTRIES.

Knight GM, Griffiths UK, Sumner T, Laurence YV, Gheorghe A, Vassall A, et al.

Proc Natl Acad Sci U S A. 2014 Oct 6. pii: 201404386. [Epub ahead of print]

PMID: 5288770

ABSTRACT

To help reach the target of tuberculosis (TB) disease elimination by 2050, vaccine development needs to occur now. We estimated the impact and cost-effectiveness of potential TB vaccines in low- and middle-income countries using an age-structured transmission model. New vaccines were assumed to be available in 2024, to prevent active TB in all individuals, to have a 5-y to lifetime duration of protection, to have 40-80% efficacy, and to be targeted at "infants" or "adolescents/adults." Vaccine prices were tiered by income group (US $1.50-$10 per dose), and cost-effectiveness was assessed using incremental cost per disability adjusted life year (DALY) averted compared against gross national income per capita. Our results suggest that over 2024-2050, a vaccine targeted to adolescents/adults could have a greater impact than one targeted at infants. In low-income countries, a vaccine with a 10-y duration and 60% efficacy targeted at adolescents/adults could prevent 17 (95% range: 11-24) million TB cases by 2050 and could be considered cost-effective at $149 (cost saving to $387) per DALY averted. If targeted at infants, 0.89 (0.42-1.58) million TB cases could be prevented at $1,692 ($634-$4,603) per DALY averted. This profile targeted at adolescents/adults could be cost-effective at $4, $9, and $20 per dose in low-, lower-middle-, and upper-middle-income countries, respectively. Increased investments in adult-targeted TB vaccines may be warranted, even if only short duration and low efficacy vaccines are likely to be feasible, and trials among adults should be powered to detect low efficacies.

WEB: http://dx.doi.org/10.1073/pnas.1404386111

IMPACT FACTOR: 9.81

CITED HALF-LIFE: 8.00

UW EDITORIAL COMMENT: Figure 1 parts D and E show the impact of a future vaccine on children and adults, respectively, showing a larger impact when the vaccine is targeted at adult populations in LICs. Figure 2 provides contour plots of cost-effectiveness, showing the cost per dose to be cost-effective at various levels of vaccine duration and efficacy, with a line denoting the values below which no price would be cost-effective. The plots show that adult vaccines are more expensive than infant vaccines but also more likely to be cost-effective.

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 ("2014/09/15"[PDAT] : "2014/10/14"[PDAT]))

*On October 19, 2014, this search of English language articles published between September 15, 2014 and October 14, 2014 and indexed by the US National Library of Medicine resulted in 152 unique manuscripts.