



# Newborn Vitamin A Supplementation



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## **Concepts and Guidelines for Developing and Evaluating Implementation Models for Newborn Vitamin A Supplementation (NVAS) in South Asia**

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## Concepts and Guidelines for Developing and Evaluating Implementation Models for Newborn Vitamin A Supplementation (NVAS) in South Asia

### Background

Every year approximately 7 million infants die before reaching one year of age. The overwhelming majority of these deaths occur before six months of age. Forty-four percent of all infant deaths in the world occur in Southern Asia (1). The first months of infancy represent the highest risk period for infant death (2), and efforts to reduce early infant mortality remain a major public health challenge in many developing countries (3). This period also may represent the postnatal period of high risk with respect to vitamin A deficiency, in part, because infants tend to be born with low liver and total body stores of vitamin A (VA), yielding a reserve that is typically capable of supporting physiological needs for only a few weeks (4-8).

Long known to reduce child mortality of children over six months of age (9), a new role for newborn vitamin A supplementation (NVAS) is being examined as a means to reduce infant mortality. NVAS involves supplementing infants shortly after birth with a single, large oral dose of VA (50,000 IU). The intervention has been tested in three field trials in Southern Asia (Indonesia, India, and Bangladesh), each of which has reported significant reductions of •15% in infant mortality in the 1<sup>st</sup> six months of life (10-12). A meta-analysis based on these three trials suggests that the risk of death from all causes in the first half of infancy can be reduced by approximately 20% when newborns within the region are given a 50,000 IU oral dose of vitamin A (13).

Evidence from short- and long-term studies suggests that risk of acute side effects following oral receipt of vitamin A early in infancy is minimal in extent and severity. Slight increases in bulging fontanelle rates, ranging from <1% to 7%, have been reported among infants under six months of age dosed with vitamin A versus placebo (4, 14-18). In each study, however, bulging fontanelles subsided without treatment, usually within 48 hours. Based on thorough fontanelle evaluations among Indonesian newborns, bulging fontanelles were associated with normal intracranial pressure and no increased risk of hemorrhage based on resistive indices derived from Doppler ultrasonography(19). Further follow-up studies on these infants at three years of age indicate that a bulging fontanelle carries no apparent risk of mental, psychomotor, behavioral or growth abnormalities (20).

This document is currently guiding the work of key partners in Nepal and Bangladesh who are in the process of moving forward research evidence on NVAS into programs through the development, testing and evaluation of potential delivery models at country level. Key partners include USAID, Saving Newborn Lives (SNL)/Save the Children, UNICEF, Johns Hopkins University (JHU), the Canadian International Development Agency (CIDA), the Micronutrient Initiative (MI), and A2Z Project.

### Rationale

The potential of NVAS to reduce infant mortality in Southern Asia has clearly increased interest in how this intervention should be implemented and how it should fit into existing reproductive health, newborn care initiatives and policies. Key issues include:

1. **Finding feasible strategies to dose newborns with a single oral 50,000 IU dose of vitamin A within a day or two of life** in settings where a high proportion of infants are born at home, where a low proportion of births are attended by a skilled worker, and where health services for neonatal and post-neonatal care are marginal-to-non-existent.
2. **Identifying the type of worker(s) and their training and supervisory needs to deliver the vitamin A.** Some programs have trained community workers in early detection and treatment of diarrhea and pneumonia among neonates, although these workers are not usually trained for deliveries, and therefore not present at birth or within the first day or two of birth. Similarly, some programs are strengthening access to and the quality of facility-based delivery services, and moving away from training skilled attendants, who are more likely to present at home-based births. In some countries with very limited facility deliveries, mothers might be trained to dose their neonates, with the capsule included in a home delivery kit.
3. **Integrating newborn VA supplementation into an optimal reproductive health and newborn “package” of services.** Countries are at different stages in developing the content of and the delivery platform for packages of essential reproductive health and neonatal care services. A wide range of options include safe delivery kits, improved cord cleansing, management of neonatal sepsis, attention to birth asphyxia, among others. Consideration needs to be given to whether and

- how newborn vitamin A supplementation will fit into these packages, and whether or not postpartum supplementation is also part of these kits.
4. **Testing the feasibility of using active or passive pregnancy and/or birth detection systems.** Few, if any, formal community-based proactive detection systems exist for identifying pregnant woman or newborns in program settings. The need for delivering vitamin A to the newborn within the first days of life may provide an opportunity to stimulate birth registration systems, establish birth dates, and set the timing for the infant's six-month vitamin A dosing visit. However, such systems will require feasibility testing.
  5. **Identifying the social preparation and communication needs for introducing NVAS into the community.** New interventions, particularly those that target all neonates in a community, require thought and care with respect to how they are introduced and the messages that should accompany the intervention. Dosing of newborns with 50,000 IU vitamin A has been shown to be safe; however, it will not prevent many of the deaths that occur to neonates and young infants. Also, it is not intended to interfere with exclusive breastfeeding. These and other considerations require that appropriate messages accompany the introduction of NVAS.
  6. **Determining what coverage and timing can be achieved using different models (whether and how NVAS should be linked to immunizations that should be given at or near birth).** Some countries have reported high BCG and OPV coverage rates. These immunizations are recommended to be given at or near birth. Where coverage of these vaccinations is high and given within the first day or two of life, it will be important to consider linking NVAS with these immunization contacts. Similarly, high post-partum coverage rates, particularly if dosing is done early, may also offer an opportunity.
  7. **Obtaining an acceptable, safe, inexpensive and reliable supply of 50,000 IU vitamin A capsules.** Obviously, NVAS will require obtaining a product that optimizes the safety, dose, shelf-life, acceptability, and cost concerns. It will be important to investigate issues related to product storage, safety of use, ease of administration by health worker, consumer acceptability and packaging. It is likely that the usual soft gelatin capsule will be used, but this may not be the optimal product for neonates.

### Possible Delivery Strategies

Because of the newness of this intervention, it is important to assess the feasibility of various delivery strategies in different country contexts as a basis for identifying barriers to and enablers of implementation and for assessing timeliness of delivery, coverage and cost.

Several strategies for delivering a single oral-dose of vitamin A to newborns, and their respective advantages and disadvantages, are listed in **Table I**. The possible strategies include delivery through (1) the formal health system (via ANC visits, birth, post-partum, neonatal care, and/or immunization visits), (2) informal health systems linked with the formal health system (e.g. village-based volunteers under the supervision or guidance of formal health workers or skilled birth attendants), or (3) inclusion in safe delivery kits, with mothers dosing their neonates (which may include local purchase through the private sector as "stand-alone" newborn VA supplements or packaged in a commercially available "safe birthing kit").

The best strategy or combination of strategies is likely to vary between countries, depending on factors such as health infrastructure, utilization of antenatal services, proportion of facility-based births, timing and coverage of BCG/OPV vaccinations, reach and capability of health volunteers, and market penetration and access. However, common indicators as presented in Annex I will be used to assess their suitability regardless of the context in which they are being evaluated.

### Goals of the feasibility model development activities:

- To identify and test several feasible strategies for delivering a single oral 50,000 IU dose of vitamin A to newborn infants as soon as possible after birth in 2-3 South Asian countries
- To provide governments with models for neonatal dosing, along with expected coverage and timing, that can be scaled up to the national level.

### Overall plan for development of a feasibility model:

1. The research will be overseen by the host-country newborn technical working group.
2. Operation research will be conducted over an 18 month period in 2-3 countries.
3. In each country, 2-3 delivery mechanisms will be examined.
4. Ideally, each delivery mechanism will be tested at a scalable level (e.g. district level).
5. For each district, a comprehensive monitoring system will provide information on coverage, timing and aspects of NVAS delivery.
6. The effort for each country will be evaluated, with implementation processes and outcomes documented.

### Activities

1. **Planning and Strategy Review:**
  - a. **Review of existing strategies and data:** Before selecting, adapting or designing a delivery strategy for testing the feasibility of newborn VA supplementation in a country, there is a need to examine the strategies used by others to reach pregnant women and/or newborn infants to assess problems encountered, coverage, and timing of visits. If an essential newborn care program exists, it will be important to determine how newborns are identified, how soon after birth newborns are reached and by whom, what essential services are provided to them, problems encountered and perceptions of families about these services. Where other strategies exist, such as immunization contacts, home- or clinic-based childbirth services, and ante-natal care programs, similar information should be obtained and analyzed.
  - b. **Identify existing activities and gaps.** Where other organizations or programs are already addressing newborn care, contact these organizations to discuss what they have learned about reaching and providing services newborns, advice they may have for introducing newborn VA supplementation, existing gaps in information, and opportunities for cooperative ventures.
  - c. **Gather new information.** If there is not enough information already known about parental attitudes and perceptions towards newborn dosing or the perceptions, capabilities and attitudes of workers who would be involved with delivering the vitamin A to newborns, it will be important to gather information to fill these knowledge gaps and further inform the selection of common indicators for the communication strategy.
2. **Selection of the NVAS strategy.** Once the above activities have been completed, a consensus must be reached on the delivery mechanisms to study. This process will naturally determine the type of health worker or volunteer involved for those strategies involving such workers, as well as the appropriate supplement type, quantity and packaging requirements. For each strategy chosen for study, the approach needs to be mapped out, including district selection, institutional arrangements, and development of an action plan for working with district health staff.
3. **Selection of the intervention package.** Given the wide range of maternal and neonatal interventions currently being tested, there also needs to be consensus on the package of interventions to be included with NVAS.
4. **Development of a training package.** Some training will be required for each delivery strategy. For strategies involving delivery kits and self-dosing, a training package for mothers and those involved with distribution of kits is needed. For strategies involving dosing by health staff or informal workers, training needs to be designed for that level of worker. Some orientation is also needed for district staff at all levels, particularly on safety issues and anticipation of questions from clients.
5. **Development and pre-testing of training and communication materials.** Mothers must be fully aware of the benefits and potential adverse effects of neonatal dosing, and a communication plan is needed for this new intervention. Some care is needed in developing this plan so it doesn't affect existing child VAS programs.
6. **Conducting formative research to provide recommendations on safe, cost-effective, and appropriate product packaging, shape, color, and administration.** Neonatal dosing may involve different concerns than dosing older children and postpartum mothers, especially if the strategy is dosing by mothers. Formative research needs to contribute to the design and administration of the NVAS.

7. **Design the monitoring and evaluation plan.** It is important that a comprehensive monitoring system is included in the study. This system is designed as a supplement to the existing systems used to monitor health systems, since further information is needed to understand coverage, timing of dosing, adverse events, and programmatic factors that may affect coverage. Once the strategy is evaluated, much of this monitoring system will be unnecessary for scaling up.
8. **Implement the strategy.** Once the overall system has been designed, and materials are developed and tested, the strategies can be implemented.
9. **Monitor the implementation.** Monitoring will involve routine data collection from mothers (for self-dosing strategies) or from health workers. The monitoring system must be comparable across model development activities in each country, and should regularly assess the quality of inputs (i.e. training, communication materials, supplements) and services (newborn VA dosing), the timeliness of newborn VA delivery, the degree to which all newborns in the targeted communities are identified and reached, and the acceptability of NVAS and the cost involved in implementing the intervention. Data will be reviewed monthly, with brief quarterly reports developed to track progress. A summary report will be developed from programmatic and monitoring information.
10. **Evaluate the project.** The project will be evaluated through an independent review of existing monitoring data, including some data audit, and review of overall results. Some additional evaluation methods may be needed to assess maternal acceptance and other program elements.

### Questions to be addressed by the feasibility model development

1. What are adequate and feasible strategies to deliver NVAS shortly after birth in 2-3 South Asian settings?
2. What is the optimal package of interventions logically included with NVAS?
3. What kind of worker should deliver NVAS and what are their training and supervision needs?
4. What messages should accompany the introduction of NVAS in communities?
5. Is a soft-gelatin vitamin A capsule an appropriate dosing mechanism for the newborn dose? If so, what are the packaging, storage and capsule shape and color characteristics that will maximize safety, consumer acceptability and ease of administration of the supplement? If not, what alternatives should be explored?
6. What coverage can be achieved using different models, and what is the age distribution for dosing for each model?
7. Can NVAS strengthen pregnancy or birth registration systems?
8. Can NVAS impact breastfeeding initiation practices?

**Table 1. Potential Advantages and Disadvantages of Different Delivery Strategies for Newborn VA Supplementation**

<b>Delivery Options</b>	<b>Description</b>	<b>Possible Advantages</b>	<b>Possible Disadvantages</b>
<b>1) Clinic-based birth</b>	Newborn VA administered by clinic staff shortly after birth of infant and before discharge	Newborn VA administered by clinic-based staff immediately after birth	High utilization rates of clinic-based birth required for high newborn VA coverage; Requires training of health workers
<b>2) Home-based birth visit</b>	A small supply of newborn VA provided to community contact (e.g. TBA, SBA, FCHV, others) who visits the household to provide assistance during child birth	VA supplement can be given by a trained worker within hours of child birth along with other essential newborn care interventions, including post-partum VAS ; Credibility of health worker may make intervention more acceptable; Intervention may enhance health workers credibility; Can be included in a safe birthing kit; May be combined with birth registration	High coverage of assisted deliveries required for high VA coverage; Requires pregnancy surveillance and/or a community-based birth notification system to ensure timely visit; Requires training of health worker
<b>3) Post-partum and neonatal care home visit</b>	A small supply of newborn VA provided to community contact (e.g. TBA, SBA, FCHV, others) who visits the household shortly after child birth to provide post-partum and/or neonatal health services	VA supplement can be given by a trained worker within days of child birth along with other essential newborn care interventions, including post-partum VAS ; Credibility of health worker may make intervention more acceptable; Intervention may enhance health workers credibility; May be combined with birth registration, identification of low birth weight infants, and other interventions	High coverage post-partum/neonatal care home visit required for high VA coverage; Requires a community-based birth notification system to ensure timely visit; Requires training of health worker
<b>4) Clinic-based immunization visit</b>	Newborn VA administered by clinic staff when newborn is brought to clinic for BCG and/or OPV vaccination	Newborn VA administered by clinic-based staff during immunization visit; No home visit necessary; Can also increase coverage of postpartum supplementation; Provides opportunity for newborn dose to be recorded on the child health card along with immunizations; Success depends on how soon after birth neonates are brought to the clinic for BCG and/or OPV and the BCG/OPV coverage rates	Mothers may not bring neonates to clinics until weeks after birth.

<b>Delivery Options</b>	<b>Description</b>	<b>Possible Advantages</b>	<b>Possible Disadvantages</b>
<b>5) Home or community-based (extended outreach) immunization visit</b>	A small supply of newborn VA provided to health workers who administer BCG and/or OPV to infants at or near birth	No extra home visit necessary if VA given during immunization visit; Can also increase coverage of postpartum supplementation; Provides opportunity for newborn dose to be recorded on the child health card along with immunizations; Credibility of health worker may make intervention more acceptable	Newborn VA coverage depends on coverage and timing of BCG/OPV vaccination visits; Requires extra time and training of health worker
<b>6) ANC Visit</b>	Newborn VA given to pregnant woman at time of 3rd TM ANC visit. Mother or family member administers newborn VA to infant at birth	VA supplement available in the home for immediate administration after birth; No extra home visit necessary.	Requires high utilization of ANC services to achieve high coverage; Orientation of mother on how to administer the VA dose to the newborn required; VA supplement will need to be packaged as a single dose so the capsule does not degrade or get damaged due to moisture, or compression; VA supplement may get lost or mother may forget to give the supplement to her newborn; potential for choking is very high; may not have scissors available to snip off capsule
<b>7) Household purchase from local shop</b>	Newborn VA would be purchased by families from local shops and administered to the newborn after birth by a family member	Demand driven; Family-financed; May be incorporated in a commercial "safe birthing kit"; Does not require a separate home visit by health worker	Families that cannot afford or do not value the product will not benefit from the newborn VA supplementation intervention; Requires broad-based and intensive social marketing effort; Requires widespread availability of capsules or other appropriate dose delivery mechanism in the private sector; No quality control of the vitamin A supplement; Requires "buy-in" from the commercial sector.



### Draft Monitoring Framework

PROVISION OF SERVICE	Type of Information Needed	Illustrative indicator(s)	Potential source
		<ul style="list-style-type: none"> <li># of health facility/community staff trained (or mothers, depending on the strategy selected)</li> </ul>	<ul style="list-style-type: none"> <li>Health worker interviews</li> <li>Record from training providers</li> </ul>
<b>Supervision</b>		<ul style="list-style-type: none"> <li># supervisors trained</li> <li>Ratio of supervisors to involved health workers</li> <li>% of supervisory reports missing or with errors</li> </ul>	<ul style="list-style-type: none"> <li>Project reports</li> <li>Supervisory reports</li> <li>Record from training providers</li> </ul>
<b>Quality of care</b>	<ul style="list-style-type: none"> <li>Ability of health workers to dose appropriately</li> <li>Follow-up of dosed neonates</li> </ul>	<ul style="list-style-type: none"> <li>% of health facility/community staff knowing neonatal dose and timing</li> <li>% of neonates seen within 10 days of dosing</li> </ul>	<ul style="list-style-type: none"> <li>Supervisory visit reports</li> <li>Health worker register</li> </ul>
<b>Communication</b>	<ul style="list-style-type: none"> <li>Quality (acceptance) and geographic scope of communication messages</li> </ul>	<ul style="list-style-type: none"> <li># of communications messages developed</li> <li># of communication methods/means used to disseminate consistent key messages</li> <li>% of mothers understanding importance of NVAS</li> <li>% of mothers understanding the benign nature of bulging fontanel</li> </ul>	<ul style="list-style-type: none"> <li>Mothers' interviews</li> <li>Exit interviews</li> </ul>
<b>Logistics supply</b>	<ul style="list-style-type: none"> <li>Timely receipt of required supplies at each key distribution point</li> <li>Ease of dosing</li> <li>Appropriate packaging</li> </ul>	<ul style="list-style-type: none"> <li>% of health workers reporting lack of supplies at any point in given month</li> <li>% of safe delivery kits with NVAC</li> <li># NVAC distributed / total expected births</li> <li># NVAC provided/ # of doses delivered</li> <li>% of health workers reporting problems with capsule use</li> </ul>	<ul style="list-style-type: none"> <li>Project logistics report</li> <li>Health worker register</li> <li>Supervisory reports</li> </ul>

<b>UTILIZATION OF SERVICES PROVIDED</b>	<b>Type of Information Needed</b>	<b>Illustrative indicator(s)</b>	<b>Potential source</b>
<b>Mothers' awareness</b>	<ul style="list-style-type: none"> <li>• Level of understanding of the importance of NVAS</li> <li>• Mothers' attitude toward neonatal dosing</li> </ul>	<ul style="list-style-type: none"> <li>• % of mothers interviewed aware of the importance of vitamin A</li> <li>• % of mothers' interviewed stating that they are happy that their neonate was dosed</li> </ul>	<ul style="list-style-type: none"> <li>• Mothers' interview</li> <li>• Periodic mini survey</li> <li>• Exit interviews</li> </ul>
<b>Health worker awareness (including supervisors)</b>	<ul style="list-style-type: none"> <li>• Ability of health worker to convey their awareness of the importance and safety of NVAS</li> </ul>	<ul style="list-style-type: none"> <li>• % of health workers and volunteers interviewed aware of the importance of vitamin A</li> <li>• % of health workers and volunteers adequately presenting NVAS to mothers</li> </ul>	<ul style="list-style-type: none"> <li>• Health worker interviews</li> <li>• Supervisory reports (observation)</li> </ul>

<b>COVERAGE</b>	<b>Type of Information Needed</b>	<b>Illustrative indicator(s)</b>	<b>Potential source</b>
<b>Birth registration</b>	<ul style="list-style-type: none"> <li>• Estimate of the proportion of expected births captured</li> </ul>	<ul style="list-style-type: none"> <li>• # of pregnancies identified</li> <li>• # births registered</li> <li>• % of expected births registered</li> </ul>	<ul style="list-style-type: none"> <li>• Health worker registers</li> <li>• Calculated expected births from population data</li> </ul>
<b>NVAS coverage</b>	<ul style="list-style-type: none"> <li>• Reliable estimates of actual coverage</li> <li>• Timing of NVAS dosing</li> <li>• Degree to which most vulnerable are reached</li> </ul>	<ul style="list-style-type: none"> <li>• % of identified neonates (0-28 days old) receiving NVAS</li> <li>• % of identified neonates (0-28 days old) receiving any of the other interventions delivered if part of a package</li> <li>• Age distribution of NVAS receipt</li> <li>• Socio-economic, geographic and ethnic distribution among neonates dosed compared to district as whole</li> </ul>	<ul style="list-style-type: none"> <li>• Health worker registers</li> <li>• District demographic records</li> </ul>
<b>Adverse events</b>	<ul style="list-style-type: none"> <li>• Prevalence and severity of adverse events</li> <li>• Effect of adverse event on mothers' attitudes</li> </ul>	<ul style="list-style-type: none"> <li>• % of neonates dosed experiencing adverse event within specified time of dosing (bulging fontanel, vomiting, choking, other)</li> <li>• % of mothers with child with adverse event expressing concern about event</li> </ul>	<ul style="list-style-type: none"> <li>• Health worker registers</li> <li>• Mothers' interviews</li> </ul>

EVALUATION	Type of Information Needed	Illustrative indicator(s)	Potential source
<b>Ability of NVAS approach to provide adequate service</b>	<ul style="list-style-type: none"> <li>• Coverage, program reach, quality of care, secondary effect of improving birth registration rates and postpartum supplementation</li> <li>• Influence on breastfeeding practices</li> </ul>	<ul style="list-style-type: none"> <li>• Indicators as noted above on coverage, reach to most vulnerable, and quality of care</li> <li>• % of postpartum supplementation pre and post</li> <li>• % of births registered pre and post</li> <li>• Exclusive breastfeeding rates pre and post</li> </ul>	<ul style="list-style-type: none"> <li>• Project records</li> <li>• Survey (if done)</li> </ul>
<b>Ability of NVAS approach to dose with optimal timing</b>	<ul style="list-style-type: none"> <li>• Timing of NVAS dosing</li> </ul>	<ul style="list-style-type: none"> <li>• % of identified neonates receiving NVAS within 5 days of delivery</li> </ul>	<ul style="list-style-type: none"> <li>• Project records</li> <li>• Possible sub-sample checking (based on health worker register and identification of a selection of neonates)</li> </ul>
<b>Safety</b>	<ul style="list-style-type: none"> <li>• Rate for adverse events, and the impact on project</li> <li>• Possible impact of other interventions delivered at the same time</li> </ul>	<ul style="list-style-type: none"> <li>• % of dosed neonates with adverse event</li> <li>• Degree of severity of adverse event</li> <li>• Prevalence of adverse event by cause</li> <li>• Degree of dissatisfaction of mothers with neonate with adverse event</li> </ul>	<ul style="list-style-type: none"> <li>• Project records</li> <li>• Independent mothers' interviews</li> </ul>
<b>Costs</b>	<ul style="list-style-type: none"> <li>• Overall costs for project, and estimated costs for scaling up, per district</li> </ul>	<ul style="list-style-type: none"> <li>• Average cost per neonate dosed</li> </ul>	<ul style="list-style-type: none"> <li>• Cost analysis developed from project budget and dosing data</li> </ul>

## References

1. The United Nations Children's Fund. State of the world's children 2007. New York, NY: UNICEF; 2006.
2. Lawn JE, Cousens S, Zupan J, Lancet Neonatal Survival Steering Team. 4 million neonatal deaths: When? where? why? *Lancet*. 2005;365(9462):891-900.
3. Martines J, Paul VK, Bhutta ZA, Koblinsky M, Soucat A, Walker N, et al. Neonatal survival: A call for action. *Lancet*. 2005;365(9465):1189-97.
4. West KP,Jr. Public health impact of preventing vitamin A deficiency in the first six months of life. In: Delange FM, West KP,Jr, editors. *Micronutrient Deficiencies in the First Months of Life*. Vevey, Switzerland: Karger; 2003. p. 103-28.
5. Shah RS, Rajalakshmi R, Bhatt RV, Hazra MN, Patel BC, Swamy NB, et al. Liver stores of vitamin A in human fetuses in relation to gestational age, fetal size and maternal nutritional status. *Br J Nutr*. 1987;58(2):181-9.
6. Montreewasuwat N, Olson JA. Serum and liver concentrations of vitamin A in thai fetuses as a function of gestational age. *Am J Clin Nutr*. 1979;32(3):601-6.
7. Gebre-Medhin M, Vahlquist A. Vitamin A nutrition in the human foetus. A comparison of sweden and ethiopia. *Acta Paediatr Scand*. 1984;73(3):333-40.
8. Ganguly C, Mukherjee KL. Relationship between maternal serum vitamin A and vitamin A status of the corresponding fetuses. *J Trop Pediatr*. 1988;34(6):313-5.
9. Sommer A, West KP. *Vitamin A deficiency : Health, survival, and vision*. New York: Oxford University Press; 1996.
10. Rahmathullah L, Tielsch JM, Thulasiraj RD, Katz J, Coles C, Devi S, et al. Impact of supplementing newborn infants with vitamin A on early infant mortality: Community based randomised trial in southern india. *BMJ*. 2003;327(7409):254.
11. Humphrey JH, Agoestina T, Wu L, Usman A, Nurachim M, Subardja D, et al. Impact of neonatal vitamin A supplementation on infant morbidity and mortality. *J Pediatr*. 1996;128(4):489-96.
12. Klemm RD, Labrique A, Christian P, Rashid R, Shamim AA, Katz J. Efficacy of newborn vitamin A supplementation in reducing infant mortality in rural bangladesh: The JiVitA-2 trial. *Micronutrient Forum Abstracts, Istanbul, Turkey, 16-18 April 2007*. 2007.
13. West KP,Jr. Newborn vitamin A dosing: Policy implications for asia and africa. *Micronutrient Forum Abstracts, Istanbul, Turkey, 16-18 April 2007*. 2007.
14. de Francisco A, Chakraborty J, Chowdhury HR, Yunus M, Baqui AH, Siddique AK, et al. Acute toxicity of vitamin A given with vaccines in infancy. *Lancet*. 1993;342(8870):526-7.
15. Iliff P, Humphrey JH, Mahomva AI. Tolerance of large doses of vitamin A given to mothers and their babies shortly after delivery. *Nutr Res*. 1999;19:1437-46.
16. Baqui AH, de Francisco A, Arifeen SE, Siddique AK, Sack RB. Bulging fontanelle after supplementation with 25,000 IU of vitamin A in infancy using immunization contacts. *Acta Paediatr*. 1995;84(8):863-6.
17. Randomised trial to assess benefits and safety of vitamin A supplementation linked to immunisation in early infancy. WHO/CHD immunisation-linked vitamin A supplementation study group. *Lancet*. 1998;352(9136):1257-63.

18. West KP, Jr, Katz J, Shrestha SR, LeClerq SC, Khatri SK, Pradhan EK, et al. Mortality of infants < 6 mo of age supplemented with vitamin A: A randomized, double-masked trial in nepal. *Am J Clin Nutr.* 1995;62(1):143-8.
19. Agoestina T, Humphrey JH, Taylor GA, Usman A, Subardja D, Hidayat S, et al. Safety of one 52-mumol (50,000 IU) oral dose of vitamin A administered to neonates. *Bull World Health Organ.* 1994;72(6):859-68.
20. Humphrey JH, Agoestina T, Juliana A, Septiana S, Widjaja H, Cerreto MC, et al. Neonatal vitamin A supplementation: Effect on development and growth at 3 y of age. *Am J Clin Nutr.* 1998;68(1):109-17.