Towards achieving optimal Vitamin A Nutrition in India

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Contributors

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Outline

• Introduction to Vitamin A
  – Historical Milestones
  – Functions, metabolism
  – Sources of Vitamin A
  – Recommended Dietary Allowances of Vitamin A
• Vitamin A Deficiency Disorders (VADD)
• Burden of Vitamin A Deficiency- Global and India
• Strategy for Prevention and Control of VADD
• Millennium Development Goals (MDGs), Copenhagen Consensus
• Vitamin A Supplementation Programme in India
• Way forward
Vitamin A

- Vitamin A is a micronutrient belonging to group of fat soluble vitamins
- Essential for growth and differentiation of following body cells
  - Retina (vision pigment)
  - Respiratory epithelium lining
  - Gastrointestinal tract
  - Immune system

Forms of Vitamin A

- Vitamin A is found in two principal forms:
  - Retinol
    - Found in animal food sources
    - Yellow, fat-soluble substance
    - Pure alcohol form is unstable, found in tissues in a retinyl ester form
    - Commercially produced as esters - retinyl acetate and palmitate
  - Carotenes
    - Alpha, beta, gamma-carotene; and xanthophyll beta-cryptoxanthin (all of which contain beta-ionone rings)
    - Pro-Vitamin A in herbivores and omnivore animals, enzyme 15-15'-dioxygenase cleaves beta-carotene in the intestinal mucosa and converts it to retinol
Chemical Structure of Vitamin A

Vitamin A alcohol

β - Carotene

Vitamin A: Historical milestones

<table>
<thead>
<tr>
<th>Year</th>
<th>Major milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913</td>
<td>Discovery of Vitamin A by Elmer McCollum, Marquette Davis</td>
</tr>
<tr>
<td></td>
<td>Fat soluble nutrient in butter fat, cod liver oil</td>
</tr>
<tr>
<td>1930</td>
<td>Discovery of beta carotene and Vitamin A structure by Paul Karrer</td>
</tr>
<tr>
<td>1947</td>
<td>Industrial Synthesis of Vitamin A</td>
</tr>
<tr>
<td>1964</td>
<td>First global survey of VADD</td>
</tr>
<tr>
<td>1980s</td>
<td>Vitamin A linked with child mortality</td>
</tr>
</tbody>
</table>
Vitamin A: Historical milestones

<table>
<thead>
<tr>
<th>Year</th>
<th>Major Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>WHO advocates Vitamin A with measles vaccine in Vitamin A deficient countries</td>
</tr>
<tr>
<td>1990s</td>
<td>Reduction of maternal mortality with retinol/beta-carotene supplements</td>
</tr>
<tr>
<td>1998</td>
<td>WHO launched the global Vitamin A initiative</td>
</tr>
<tr>
<td>2000</td>
<td>Millennium Development Goals (call for reduction of nutritional problems)</td>
</tr>
<tr>
<td>2008</td>
<td>Copenhagen challenges solution</td>
</tr>
</tbody>
</table>

Functions of Vitamin A in Human Body

<table>
<thead>
<tr>
<th>System</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vision</td>
<td>Light and Dark adaptation</td>
</tr>
<tr>
<td>Cellular differentiation morphogenesis</td>
<td>Gene transcription</td>
</tr>
<tr>
<td>Immune response</td>
<td>Non-specific, cell metabolism (anti infection vitamin and is vital for survival)</td>
</tr>
<tr>
<td>Hemopoeisis</td>
<td>Iron metabolism</td>
</tr>
<tr>
<td>Growth</td>
<td>Skeletal</td>
</tr>
<tr>
<td>Fertility</td>
<td>Male and Female</td>
</tr>
<tr>
<td>Thyroid metabolism</td>
<td>Regulation of Thyroid Stimulating Hormone(TSH) secretion</td>
</tr>
<tr>
<td>Anti-oxidant</td>
<td>Scavenger of free radicals</td>
</tr>
</tbody>
</table>
**Vitamin A Metabolism (simplified)**

90% of ingested retinol and 70% of carotenes are absorbed

Absorbed Vitamin A is stored in liver as retinyl palmitate

Zinc required for mobilization of retinyl palmitate to free retinol

Retinol transported in blood, bound to a retinol binding protein and travels to target tissue

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**Rhodopsin- Retinal visual cycle and role of Vitamin A**

- The pigment epithelium layer of the retina in the eye is storage site for Vitamin A.

  - Reconstituted Rhodopsin (Visual purple) → Light Exposure → Degraded Rhodopsin

- Diet deficient in Vitamin A leads to deficient rhodopsin reconstitution, interfering with vision especially in dim light.
Rhodopsin-retinal visual cycle and role of Vitamin A (contd.)

**Sources of Vitamin A**

- **Animal Sources (retinol)**
  - Milk
  - Liver
  - Egg

- **Plant sources (beta carotene)**
  - Green leafy vegetables (carrots)
  - Yellow fruits
Breast milk- important source of Vitamin A for neonates

• Colostrum 3 times richer in Vitamin A and ten times richer in beta-carotene
• Transitional breast milk contains double the vitamin A as compared to mature milk
• Mature breast milk also rich source of Vitamin A

Recommended Dietary Allowance (RDA) of Vitamin A for Indians

<table>
<thead>
<tr>
<th>Group</th>
<th>Particulars</th>
<th>Vitamin A (microgram/day)</th>
<th>Retinol</th>
<th>Beta-carotene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman</td>
<td>Pregnant</td>
<td>800</td>
<td></td>
<td>6400</td>
</tr>
<tr>
<td></td>
<td>Lactation</td>
<td>950</td>
<td></td>
<td>7600</td>
</tr>
<tr>
<td>Infants</td>
<td>0 -12 months</td>
<td>350</td>
<td></td>
<td>2800</td>
</tr>
<tr>
<td>Children</td>
<td>1-6 years</td>
<td>400</td>
<td></td>
<td>3200</td>
</tr>
<tr>
<td>Adults</td>
<td>&gt; 7 years</td>
<td>600</td>
<td></td>
<td>4800</td>
</tr>
</tbody>
</table>

Outline

• Introduction to Vitamin A
• Vitamin A Deficiency Disorders (VADD)
  – Causes
  – Infection and VADD- Cycle
  – Xerophthalmia and its spectrum
  – Vitamin A and Anaemia
  – Vitamin A and Child Survival
• Burden of Vitamin A Deficiency- Globally and India
• Strategy for Prevention and Control of VADD
• MDGs, Copenhagen consensus
• Vitamin A Supplementation Programme in India
• Way forward

Causes of Vitamin A Deficiency-1

Lack of Vitamin A in the diet
• Vitamin A rich foods seasonal/ expensive
• Vitamin A rich foods not given to young children
• Infants not breast fed, or weaned before 4-6 months of age

Poor Diet
Diets low in fat, protein, zinc or essential nutrients necessary for absorption and utilization of Vitamin A
Causes of Vitamin A Deficiency-2

Illness
(Mal-absorption of Vitamin A and fat)
• Prolonged diarrhea
• Severe Protein Energy Malnutrition
• Measles
• Acute lower respiratory tract infections
• Roundworm and other parasitic infections

Vitamin A Deficiency: Conceptual Framework
Cycle of Infection and Vitamin A Deficiency Disorders

INFECTION

REDUCED RESISTANCE TO INFECTION

• INCREASED METABOLIC DEMANDS
• DECREASED APPETITE
• DECREASED ABSORPTION

VITAMIN A Deficiency

Vitamin A Deficiency Disorders (VADD) Cycle

Adults
• Low preformed Vitamin A
• Low fat
• Low Vitamin E
• Parasites
LOW VITAMIN A STATUS

Pregnancy
• Increased needs
• Food taboos
LOW FETAL STORES

Young Child
• Increased needs for growth
• Malnutrition
• Infections
• Parasites
• Poor intake

VADD
**Xerophthalmia**

- Signifies dry eye
- All the clinical signs and symptoms that affect the eye in Vitamin A Deficiency
- Parts that are affected in the eye are
  - **Conjunctiva (Bulbar)**
  - **Cornea**
  - **Retina**

**WHO Classification of Xerophthalmia**

<table>
<thead>
<tr>
<th>Clinical finding</th>
<th>WHO Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night Blindness</td>
<td>XN</td>
</tr>
<tr>
<td>Conjunctival Xerosis</td>
<td>X1 A</td>
</tr>
<tr>
<td>Bitot’s spot</td>
<td>X1 B</td>
</tr>
<tr>
<td>Corneal Xerosis</td>
<td>X 2</td>
</tr>
<tr>
<td>Corneal ulceration/ Keratomalacia</td>
<td>&lt; 1/3 of corneal surface</td>
</tr>
<tr>
<td></td>
<td>&gt;= 1/3 of corneal surface</td>
</tr>
<tr>
<td>Corneal Scar</td>
<td>CS</td>
</tr>
<tr>
<td>Xerophthalmic fundus</td>
<td>XF</td>
</tr>
</tbody>
</table>
Night Blindness (XN)

- Often the first symptom
  - indicative of retinal dysfunction
- Leads to subjective impairment of vision in night

Conjunctival Xerosis (X1 A)

- Range of dryness to keratinization of conjunctiva in form of thickening, wrinkling and pigmentation
- Changes in the proteins and secretory cells
- Can lead to infections in the eye
**Bitot’s Spots and Corneal Xerosis (X2)**

<table>
<thead>
<tr>
<th>Bitot’s spots</th>
<th>Corneal Xerosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryness and foamy/ Cheesy accumulations on the inner eyelids</td>
<td>Dullness or cloudy cornea Texture of the cornea dry and rough</td>
</tr>
</tbody>
</table>

**Keratomalacia**

- Softening, ulceration on the cornea
- Perforation of the cornea
- A medical emergency
- Leads to blindness
Corneal Scar (CS)

- Healed sequelae of prior corneal disease related to Vitamin A Deficiency
  - Opacities or scars of varying density (nebula, macula, leukoma)
  - Weakening and out pouching of the remaining corneal layers (staphyloma and descemetocele)
  - Phthisis bulbi
- Not specific for xerophthalmia, also caused by trauma and infection

Xeropthalmic Fundus (XF)

- Small white retinal lesions
- Described in some cases of VADD
- May be accompanied by constriction of the visual fields
- Largely disappear within 2-4 months in response to Vitamin A therapy
Night Blindness Screening Questionnaire (WHO)

Does your child have any problem seeing during night time?

- Yes
- No

Is this problem different from other children in your community? (appropriate where VADD is not prevalent)

Does your child have night blindness? (use local term- Rathondi in Hindi/ Recheekati/ night eyes/ chicken eyes)

Criteria for assessing the public health significance of Xerophthalmia and Vitamin A Deficiency

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Minimum prevalence among children &lt; 6yrs in the community</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical (primary)</strong></td>
<td></td>
</tr>
<tr>
<td>Night Blindness (XN)</td>
<td>1.0%</td>
</tr>
<tr>
<td>Bitot’s spot (X1B)</td>
<td>0.5%</td>
</tr>
<tr>
<td>Corneal Xerosis and/or ulceration/ keratomalacia (X2+ X3A+ X3B)</td>
<td>0.01%</td>
</tr>
<tr>
<td>Xerophthalmia related corneal scars (XS)</td>
<td>0.05%</td>
</tr>
<tr>
<td><strong>Biochemical (supportive)</strong></td>
<td></td>
</tr>
<tr>
<td>Serum retinol (Vitamin A ) less than 0.35 micromol/ L (10 microgm/dl)</td>
<td>5.0%</td>
</tr>
</tbody>
</table>
Vitamin A and Anaemia

- Multiple apparent roles of Vitamin A
  
  - Iron mobilization and transport
  
  - Formation of blood cells: haematopoiesis (enhancement of growth and differentiation of erythrocyte progenitor cells)
  
  - Potentiation of immunity to infection and reduction of the Anaemia of infection
  
  - Mobilization of iron stores from tissues

Vitamin A and Anaemia

- Epidemiological surveys show that the prevalence of anaemia is high in populations affected by VADD in developing countries

- Improvement of Vitamin A status has generally been shown to reduce anaemia
Vitamin A and Child Survival

• Vitamin A supplementation leads to reduction in child mortality

  – 24% reduction in all cause mortality (RR 0.76, 95% CI 0.69 to 0.83)
  – 28% reduction in diarrhea related mortality (RR 0.72, 95% CI 0.57 to 0.91)


Vitamin A supplementation and reduction of child mortality

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Relative Risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Cause mortality</td>
<td>RR 0.76 (0.69-0.83)</td>
</tr>
<tr>
<td>Follow up: 12-96 weeks</td>
<td></td>
</tr>
<tr>
<td>All Cause mortality (HIV + Children)</td>
<td>RR 0.55 (0.37-0.82)</td>
</tr>
<tr>
<td>Follow up: 6-24 months</td>
<td></td>
</tr>
<tr>
<td>Diarrhea related mortality</td>
<td>RR 0.72 (0.51-1.24)</td>
</tr>
<tr>
<td>Follow up: 48-104 weeks</td>
<td></td>
</tr>
<tr>
<td>Measles related mortality</td>
<td>RR 0.80 (0.51-1.24)</td>
</tr>
<tr>
<td>Follow up: 52-104 weeks</td>
<td></td>
</tr>
<tr>
<td>Lower respiratory tract infection-related mortality</td>
<td>RR 0.78 (0.54-1.14)</td>
</tr>
<tr>
<td>Follow up: 48-104 weeks</td>
<td></td>
</tr>
</tbody>
</table>
Vitamin A supplementation and reduction of child morbidity

<table>
<thead>
<tr>
<th>S. No</th>
<th>Reduction in Child Morbidity</th>
<th>Statistical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reduced incidence of diarrhea</td>
<td>RR 0.85, 95% CI 0.82 to 0.87</td>
</tr>
<tr>
<td>2</td>
<td>Reduced incidence of measles</td>
<td>RR 0.50, 95% CI 0.37 to 0.67</td>
</tr>
<tr>
<td>3</td>
<td>Reduced prevalence of vision problems including:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Night blindness</td>
<td>RR 0.32, 95% CI 0.21 to 0.50</td>
</tr>
<tr>
<td></td>
<td>b. Xerophthalmia</td>
<td>RR 0.31, 95% CI 0.22 to 0.45</td>
</tr>
</tbody>
</table>

Increased risk of vomiting in first 48 hrs (RR 2.75, 0.81 to 4.19)

Reduction of child mortality and morbidity

19
Outline

- Introduction to Vitamin A
- Vitamin A Deficiency Disorders (VADD)
- **Burden of Vitamin A Deficiency - Global, India**
- Strategy for Prevention and Control of VADD
- MDGs, Copenhagen Consensus
- Vitamin A Supplementation Programme in India
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Global Burden
Global Burden of Vitamin A Deficiency in children

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Numbers affected</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Vitamin A status (Serum Retinol &lt;0.70 micromole/L)</td>
<td>190 million</td>
<td>WHO 2009</td>
</tr>
<tr>
<td>Night Blindness</td>
<td>5.7 million</td>
<td>WHO 2009</td>
</tr>
<tr>
<td>Clinical Xerophthalmia</td>
<td>4.4 million</td>
<td>West Darnton-Hill 2008</td>
</tr>
<tr>
<td>Blindness due to VADD</td>
<td>0.4 million</td>
<td>Sight and Life 2012</td>
</tr>
</tbody>
</table>

- Vitamin A Deficiency in newborn, infants and children responsible for
  - 6% of under-5 deaths
  - 5% of under-5 DALYs
  - 1.7% of total DALYs lost

- Vitamin A Deficiency alone is responsible for almost 8% of child deaths in South East Asia and 6% in Africa (WHO)

DALY- Disability Adjusted Life Years
Global Burden of VADD in Pregnancy

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Numbers affected</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Vitamin A Status (Serum Retinol &lt;0.70 micromole/L)</td>
<td>19.1 million</td>
<td>WHO 2009</td>
</tr>
<tr>
<td>Night Blindness</td>
<td>9.75 million</td>
<td>WHO 2009</td>
</tr>
</tbody>
</table>

Subclinical Vitamin A Deficiency prevalence world wide (1995-2005)

Source: WHO 2009

Burden in India
National Institute of Nutrition Survey 2002-05

- Eight states
- 71,591 pre-school children examined
- National prevalence of VADD - 2.3%
- Highest in Madhya Pradesh (6.6%), West Bengal (3.8%)
- Prevalence of sub-clinical VAD 62%
  (serum retinol <20 microgm/dl)

Prevalence of Clinical VAD (Bitot’s Spot) among 1–5 year Children by States in India

NNMB Technical Report No: 23, 2005
### Prevalence of clinical and subclinical VAD and low intake of Vitamin A by states

<table>
<thead>
<tr>
<th>State</th>
<th>Bitot’s Spot</th>
<th>Conjunctival Xerosis</th>
<th>Serum Retinol &lt;0.7 micromole/l</th>
<th>Vitamin A intake &lt;50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>0.2</td>
<td>0.2</td>
<td>61.5</td>
<td>85.7</td>
</tr>
<tr>
<td>Gujarat</td>
<td>0.0</td>
<td>0.0</td>
<td>-</td>
<td>94.6</td>
</tr>
<tr>
<td>Karnataka</td>
<td>0.0</td>
<td>0.0</td>
<td>52.1</td>
<td>86.1</td>
</tr>
<tr>
<td>Kerala</td>
<td>0.5</td>
<td>0.5</td>
<td>79.4</td>
<td>82.1</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>0.0</td>
<td>0.0</td>
<td>88.0</td>
<td>89.0</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>0.0</td>
<td>0.0</td>
<td>54.7</td>
<td>86.4</td>
</tr>
<tr>
<td>Odisha</td>
<td>0.0</td>
<td>0.0</td>
<td>57.7</td>
<td>74.4</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>0.0</td>
<td>0.0</td>
<td>48.8</td>
<td>63.6</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>0.5</td>
<td>0.5</td>
<td>-</td>
<td>80.2</td>
</tr>
<tr>
<td>West Bengal</td>
<td>0.3</td>
<td>3.1</td>
<td>61.2</td>
<td>65.0</td>
</tr>
</tbody>
</table>

### Determinants of VADD

- The odds of bitot’s spots higher among children
  - With family size of more than four
  - Illiterate mothers
  - Households without a sanitary latrine
  - Not received even one dose of Vitamin A supplementation
  - Belonging to backward communities

The Central India Children Eye Study-2011

- 11,829 school children from Nagpur
- Xerophthalmia (conjunctival xerosis, bitot’s spot, corneal xerosis) and/or night blindness seen in 13.4% children


Night Blindness in pregnancy-
Coverage Evaluation survey 2002

- Reported in 12% of females during pregnancy
- Higher proportion in rural areas and among illiterate women
- Proportion was high (upto 20%) in Bihar, Jharkhand, Uttarakhand and Madhya Pradesh

Source: Coverage Evaluation Survey (CES) 2002
High risk population and vulnerable groups

- Infants and children
  - Increased Vitamin A requirement to support rapid growth and
  - To assist in fighting against infections
- Pregnant and lactating women
- Persons affected with drought and other disasters

Outline

- Introduction to Vitamin A
- Vitamin A Deficiency Disorders (VADD)
- Burden of Vitamin A Deficiency- Global and India
- Strategy for Prevention and Control of VADD
  - Vitamin A Supplementation
  - Fortification
  - Long term dietary approaches
- MDGs, Copenhagen Consensus
- Vitamin A Supplementation Programme in India
- Way forward
Vitamin A supplementation as public health intervention - Short term solution

- Vitamin A supplementation is
  - Cost-effective
  - Safe
  - Sustainable
  - Easily implemented on a national scale

- Over 6,00,000 lives can be saved each year

- 20 million disability adjusted life years can be gained

Availability of Vitamin A for supplementation

- Syrup
- Capsules
- Tablets
- Injectables
**Vitamin A Syrup- Important Points**

- Available in concentration of 1,00,000 or 2,00,000 IU
- Should be administered using 2ml spoon/dispenser
- Must be kept away from direct sunlight
- Stored in cold dark room temperature and is stable for minimum one year
- Bottle once opened must be utilized within 6-8 weeks

**Vitamin A Supplementation Schedule for Indian Children**

<table>
<thead>
<tr>
<th>Age</th>
<th>Dose</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months to 11 months</td>
<td>1,00,000 IU</td>
<td>Once</td>
</tr>
<tr>
<td>12 months to 5 years</td>
<td>2,00,000 IU</td>
<td>Every 6 months</td>
</tr>
</tbody>
</table>

Why every 6 months supplementation is required?

- Body cannot make Vitamin A on its own
  - Vitamin A is stored in the liver
- Illness, if occurs, depletes stored Vitamin A
- Vitamin A stores lasts for 4-6 months only

Food fortification with Vitamin A

- Fortification of staple foods such as
  - Wheat and rice and other grains
  - Vegetable oil
  - Dairy foods
  - Margarine
  - Sugar
Sugar Fortification—Guatemala case study

- Sugar identified as the best vehicle for fortification
- A special form of water soluble Vitamin A developed
- No negative taste, texture, color or flavor changes in the final product
- Critical requirement was new sugar production factories to install customized equipment to mix the Vitamin A into the sugar

Home fortification

- Uses products such as micronutrient powders and lipid based nutrient supplements
- Given to mother to add to the food traditionally eaten by the child in the home
- Available as powders/ sachets/ sprinkles
Improvements in Dietary intake  
Long term solution

<table>
<thead>
<tr>
<th>Dietary improvement</th>
<th>Aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition education/communication</td>
<td>Change the behaviour of the people</td>
</tr>
<tr>
<td>Horticultural interventions (home food</td>
<td>Increase availability of Vitamin A rich foods</td>
</tr>
<tr>
<td>provision/ home gardening)</td>
<td></td>
</tr>
<tr>
<td>Economic/ food policies</td>
<td>Affecting availability, price and effective demand of</td>
</tr>
<tr>
<td></td>
<td>Vitamin A rich foods</td>
</tr>
<tr>
<td>Technological advances</td>
<td>To promote plant breeding and genetic modification (eg.</td>
</tr>
<tr>
<td></td>
<td>Genetically Modified rice)</td>
</tr>
</tbody>
</table>

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- MDGs, Copenhagen Consensus
  - Links to MDGs and Copenhagen consensus
  - Economics of Vitamin A supplementation
  - Progress with Vitamin A supplementation
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- Way forward
Millennium Development Goals and Vitamin A

<table>
<thead>
<tr>
<th>MDG</th>
<th>Goal</th>
<th>Role of Vitamin A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal 4</td>
<td>Reduce Child Mortality</td>
<td>Vitamin A reduces child mortality</td>
</tr>
<tr>
<td>Goal 2</td>
<td>Achieve universal primary education</td>
<td>Vitamin A prevents childhood blindness</td>
</tr>
</tbody>
</table>

Copenhagen Consensus (2008)- Ten challenges

4 out of 10 solutions were related to Vitamin A
Copenhagen Consensus (2008) - >40 Solutions considered

1. Micronutrient supplements for children (Vitamin A and Zinc)

Four solutions related to malnutrition

Vitamin A supplementation tops the development priority solution

3. Micronutrient fortification (iron and salt)

5. Bio-fortification

9. Community based nutrition promotion

Copenhagen Consensus (2012): Hunger and Malnutrition

• For about $100 per child, bundle of interventions could reduce chronic undernutrition by 36% in developing countries
  – Micronutrient provision
  – Complementary foods
  – Treatments for worms and diarrheal diseases
  – Behaviour change programs

• Merged the intervention of Research and Development to increase yield enhancements
## Economics of Vitamin A Supplementation

<table>
<thead>
<tr>
<th>Region (s)</th>
<th>Total cost of supplementation per child per year if Vitamin A coverage 20-80%</th>
<th>Total cost of supplementation per child per year if Vitamin A coverage 80-90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Asia, Sub-Saharan Africa, East Asia</td>
<td>$1.20</td>
<td>$2.40</td>
</tr>
<tr>
<td>Central Asia</td>
<td>$1.60</td>
<td>$3.20</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>$2.60</td>
<td>$5.20</td>
</tr>
</tbody>
</table>

* Cost of programs involving outreach, assuming that 20% of coverage can be done with routine health services

## Cost benefit ratios and regional variations

<table>
<thead>
<tr>
<th>Region (s)</th>
<th>Vitamin A coverage 20-80%</th>
<th>Vitamin A coverage 80-90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Asia, Sub-Saharan Africa, East Asia</td>
<td>17:1</td>
<td>9:1</td>
</tr>
<tr>
<td>Central Asia</td>
<td>&lt;13:1</td>
<td>&lt;6:1</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>&lt;8:1</td>
<td>&lt;5:1</td>
</tr>
</tbody>
</table>

DALY value of $1000 is used throughout
Progress with Vitamin A Supplementation for children aged 6-59 months

Still almost one third of children don’t receive two doses of Vitamin A

Outline

- Introduction to Vitamin A
- Vitamin A Deficiency (VADD)
- Burden of Vitamin A Deficiency - Global and India
- Approaches to Prevention and Control of VADD
- MDGs, Copenhagen Consensus and Vitamin A
- Vitamin A Supplementation Programs in India
  - History and strategy
  - Coverage
  - Lessons learned
- Way forward
National Vitamin A Supplementation Programme

- Launched by Government of India in 1970
- To prevent nutritional VADD blindness
- National Programme for the Prevention of Nutritional Blindness
- Included short term and long term strategies

Short Term Strategy Supplementation with Vitamin A

- Every infant 6-11 months and child 1-5 years administered Vitamin A every 6 months
- A child to receive a total of nine oral doses of Vitamin A by its fifth birthday
Treatment of Vitamin A Deficiency in Children

- All children with clinical signs of Vitamin A Deficiency must be treated as early as possible

- Administer 2,00,000 IU of Vitamin A to child > 1 year of age immediately after diagnosis

- To be followed by 2,00,000 IU of Vitamin A 1-4 weeks later

Vitamin A and Measles

- All children suffering with measles should receive two doses of Vitamin A
- One dose (50 000 IU for infants aged less than six months, 100 000 IU for infants aged 6-11 months, and 200 000 IU for children aged ≥ 12 months)
- On the day of measles diagnosis, and one dose on the following day

Partnerships in implementation of Vitamin A program in India

- Health system
- Nutrition- Integrated Child Development Services (ICDS)
- Education
- Civil Society
- Non Governmental Organizations (NGOs)
- International partner agencies
- Industry
- Agriculture
- Media
## Low Coverage of Vitamin A in India

<table>
<thead>
<tr>
<th>Age group</th>
<th>Dose of Vitamin A</th>
<th>Place</th>
<th>Year and Author</th>
<th>Sample size</th>
<th>Coverage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-school children</td>
<td>One dose in preceding year</td>
<td>8 states</td>
<td>2002-05</td>
<td>2681</td>
<td>58%</td>
</tr>
<tr>
<td>12-23 months</td>
<td>First</td>
<td>Delhi</td>
<td>2005</td>
<td>210</td>
<td>37.6%</td>
</tr>
<tr>
<td>9-23 months</td>
<td>Dose in last 6 months</td>
<td>Maharashtra</td>
<td>2012</td>
<td>2809</td>
<td>48.4%</td>
</tr>
</tbody>
</table>

## Vitamin A Coverage Trends in India

<table>
<thead>
<tr>
<th>Survey Coverage Evaluation Survey (CES)</th>
<th>Ever received Vitamin A (%) Children age 12-23 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>CES 2002</td>
<td>40</td>
</tr>
<tr>
<td>CES 2005</td>
<td>54</td>
</tr>
<tr>
<td>CES 2006</td>
<td>58</td>
</tr>
<tr>
<td>CES 2009</td>
<td>65</td>
</tr>
</tbody>
</table>
# Determinants of Vitamin A coverage

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of Mother</td>
<td>Mothers age’s &gt; 35 years (&lt;50% Vitamin A coverage) compared to mothers &lt; 35 years (&gt;60% coverage)</td>
</tr>
<tr>
<td>Sex of child</td>
<td>No gender differential in coverage</td>
</tr>
<tr>
<td>Birth order</td>
<td>As the birth order increased the chances of the child receiving Vitamin A decreased</td>
</tr>
<tr>
<td>Place of Residence</td>
<td>Rural areas lagged behind the urban area by nearly 3%</td>
</tr>
<tr>
<td>Mother’s education</td>
<td>Vitamin A coverage improved with increase in mothers education</td>
</tr>
</tbody>
</table>

* CES 2009

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# Determinants of Vitamin A coverage (cont.)

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Religious groups</td>
<td>Islam&lt;Christianity&lt;Hindus&lt;Sikhs&lt;Other Religious groups</td>
</tr>
<tr>
<td>Social groups</td>
<td>SC&lt;OBC&lt;ST&lt;Others</td>
</tr>
<tr>
<td>BPL cards</td>
<td>Families having BPL cards faired better by 2 to 3% over those who didn't have it</td>
</tr>
<tr>
<td>Wealth Index</td>
<td>Families on higher wealth index had greater coverage</td>
</tr>
</tbody>
</table>
### State-wise Vitamin A Coverage

<table>
<thead>
<tr>
<th>Good performing states (&gt;80%)</th>
<th>Poor performing states (&lt;60%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Andhra Pradesh</td>
<td>1. Arunachal Pradesh</td>
</tr>
<tr>
<td>2. Goa</td>
<td>2. Nagaland</td>
</tr>
<tr>
<td>5. Himachal Pradesh</td>
<td>5. Uttar Pradesh</td>
</tr>
<tr>
<td></td>
<td>7. Madhya Pradesh</td>
</tr>
<tr>
<td></td>
<td>8. Rajasthan</td>
</tr>
<tr>
<td></td>
<td>9. Haryana</td>
</tr>
<tr>
<td></td>
<td>10. Tamil Nadu</td>
</tr>
<tr>
<td></td>
<td>11. Jammu Kashmir</td>
</tr>
</tbody>
</table>

### Coverage with Vitamin A: First Dose

Source: Coverage Evaluation Survey 2009 UNICEF
Coverage Evaluation Survey 2009

Vitamin A Supplementation in Children 12-23 months

- Received at least one dose of Vitamin A: 65.4%
- Received one dose of Vitamin A during past six months: 59.4%
- Vitamin A 1st Dose: 64%
- Vitamin A 2nd dose (18-23 months): 36.8%

Availability of Vitamin A in public health facilities of India

- A survey in 2010 of 129 health facilities
- 102 (79.1%) facilities had liquid Vitamin A at the time of visit

Ensuring availability of supply of Vitamin A is still a concern in Indian public health facilities

### Vitamin A Supplementation (VAS) programme coverage (%) [UNICEF]

<table>
<thead>
<tr>
<th>State</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>29</td>
<td>20</td>
<td>11</td>
<td>21</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>Gujarat</td>
<td>37</td>
<td>76</td>
<td>70</td>
<td>63</td>
<td>74</td>
<td>82</td>
</tr>
<tr>
<td>Karnataka</td>
<td>37</td>
<td>83</td>
<td>86</td>
<td>76</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>Kerala</td>
<td>-</td>
<td>-</td>
<td>11</td>
<td>08</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>62</td>
<td>0</td>
<td>54</td>
<td>83</td>
<td>96</td>
<td>92</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>53</td>
<td>63</td>
<td>70</td>
<td>75</td>
<td>78</td>
<td>75</td>
</tr>
<tr>
<td>Odisha</td>
<td>95</td>
<td>83</td>
<td>85</td>
<td>83</td>
<td>97</td>
<td>92</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>57</td>
<td>11</td>
<td>0</td>
<td>76</td>
<td>96</td>
<td>111</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>14</td>
<td>16</td>
<td>52</td>
<td>0</td>
<td>49</td>
<td>38</td>
</tr>
<tr>
<td>West Bengal</td>
<td>64</td>
<td>64</td>
<td>67</td>
<td>22</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>National</td>
<td>33</td>
<td>57</td>
<td>66</td>
<td>34</td>
<td>67</td>
<td>63</td>
</tr>
</tbody>
</table>

### Full VAS coverage by poverty concentration quintile, 2006-11 (%) [UNICEF]

<table>
<thead>
<tr>
<th>Year</th>
<th>Lowest</th>
<th>Lower</th>
<th>Middle</th>
<th>Higher</th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>50.0</td>
<td>41.3</td>
<td>47.2</td>
<td>47.5</td>
<td>37.7</td>
</tr>
<tr>
<td>2007</td>
<td>43.5</td>
<td>34.6</td>
<td>42.9</td>
<td>46.0</td>
<td>41.2</td>
</tr>
<tr>
<td>2008</td>
<td>72.1</td>
<td>59.9</td>
<td>62.8</td>
<td>64.4</td>
<td>47.3</td>
</tr>
<tr>
<td>2009</td>
<td>68.8</td>
<td>74.8</td>
<td>81.2</td>
<td>80.4</td>
<td>76.2</td>
</tr>
<tr>
<td>2010</td>
<td>52.2</td>
<td>26.5</td>
<td>39.4</td>
<td>52.1</td>
<td>52.1</td>
</tr>
<tr>
<td>2011</td>
<td>57.7</td>
<td>59.9</td>
<td>71.2</td>
<td>73.4</td>
<td>72.4</td>
</tr>
<tr>
<td>2006-2011</td>
<td>57.3</td>
<td>49.4</td>
<td>57.4</td>
<td>60.6</td>
<td>54.4</td>
</tr>
</tbody>
</table>
**Vitamin A supplementation program evaluation- IPEN/ AIIMS key findings**

- Lack of conceptual clarity amongst providers about dosing, schedule and clients
- Complacency of the providers that they have achieved adequate coverage and no problems in implementation
- Irregular/ short/ surplus supplies
- Problems with spoon- same usage by multiple children, clients preferred dispensers

**Outline**

- Introduction to Vitamin A
- Vitamin A Deficiency Disorders (VADD)
- Burden of Vitamin A deficiency- Global and India
- Approaches to Prevention and Control of VADD
- MDGs, Copenhagen Consensus and Vitamin A
- Vitamin A Supplementation Programme in India
- Way forward
Universal reach remains a challenge -
Need for extra mile to bridge inequity

Way forward

• Delivering Vitamin A supplementation (VAS):
  – Along with routine immunization
  – Special campaigns similar to Pulse Polio
  – At point of contact with health system during routine check ups for growth monitoring etc.
  – ASHA/ AWW should be utilised to provide door to door service

• Strengthening logistics
Accelerated Vitamin A and integrated outreach

- Organizing child health days and weeks as a strategy for integrating Vitamin A delivery with other interventions

- Packaging and inclusion in Integrated management of newborn and childhood illnesses (IMNCI)

Accelerated Vitamin A and integrated outreach (contd.)

Vitamin A delivery can be combined with:

- De-worming
- Immunization
- Treatment of anemia
- Malnutrition management
- Insecticide treated bed net distribution
- Promotion of health practices at community level
**Benefits of child health week/ days as delivery for Vitamin A supplementation**

- High achievement of Vitamin A coverage
- Focused-effective use of resources
- Increases coverage with other services
- Costs shared with other programs

**Focus on strengthening delivery of additional doses with immunization after 9 months of age**

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**Critical factors for high coverage with Vitamin A Supplementation Programme**

- Political Commitment
- Coordination between Health and Women child development departments
- District level micro-planning
- Procurement, supply and distribution of Vitamin A supplements
- Flexible dosing mechanisms
- Social mobilization and communication
- Training, supervision and monitoring

Source: UNICEF
Political Commitment

- Local leadership and ownership at state level
- Adequate funding to the programme
- Formulation of guidelines and standard operating guidelines
- Active participation of concerned stakeholders

Strong Coordination

- Health Family Welfare and Women Child Development - two critical departments to work in close synergy
- Joint coordination committees formulation
- Joint guidelines, planning and capacity building of frontline workers
- Team work between Auxiliary Nurse Midwives (ANMs) and Anganwadi Workers (AWWs) for Vitamin A delivery
District Level Micro-planning

- Bottom up approach
- Creating list of eligible children in the village
- Defining logistical needs
- Planning for covering all sites in the district
- Devising supportive supervisory plans

Procurement, supply and distribution of Vitamin A supplements

- Efficient and stable procurement system for uninterrupted Vitamin A supply is critical
- Well laid out mechanisms for distribution from district to block to village levels
- Need for well designed programme implementation plans for Vitamin A supplementation programmes
Flexible dosing for enhancing coverage for hard to reach areas

- Mostly, dosing is done in many places through biannual rounds
- Map out all geographic areas
- Special efforts needed for reaching out to disadvantaged children
- Plans for hard to reach areas involving local community volunteers may be designed and executed
- Involvement of Non Governmental organizations and partnerships may prove successful in enhancing coverage

Social mobilization and communication

- Communities need to be informed about purpose of VAS programmes adequately.
- Media to be engaged positively
- In rural areas-drum beating, mobile public address systems, local community meetings, village rallies, home visits may be used to raise awareness.
Training, supervision and monitoring

- All staff involved in delivery of VAS should be trained - *induction and refresher meetings*
- Monitoring and supervisory teams should be constituted
- Poor performing areas to be provided support for ensuring high coverage
- Medical colleges may be engaged in this role apart from programmatic staff

In long run…..

- Increase production and consumption of
  - Green leafy vegetables
  - Other Plant foods rich in carotenoids
- Improve overall nutritional status of children