15th DCVMN International AGM
Vaccines, Our Shared Responsibility
(October 27-29, 2014)

"Partnerships for Vaccine Development"

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Ministry of Science & Technology
Government of India, New Delhi
“Attaining new heights in biotechnology research, shaping biotechnology into a premier precision tool of the future for creation of wealth and ensuring social justice – specially for the welfare of the poor”.

OUR VISION
Advances in Vaccinology

- Vaccines are the fastest growing biotech area with the entire pharma/biological sector and India is considered a global hub in this sector.

- To design better and more effective vaccines.

Need Newer Techniques to design novel vaccines

- Genomics, proteomics, bioinformatics, computational tools, reverse vaccinology, microarray technology, signature tagged mutagenesis and \textit{Invivo} expression technology
Vaccine Development and Demand

• Till 1980 vaccine requirements for immunization programme has been made through the public sector vaccine manufacturers.

• Due to increase in demand of vaccines, the private sector entered in the vaccine manufacturing business to produce new and improved vaccines.

- High Demand - GAVI supported by multiple donor, purchase through UNICEF for the entire developing world.

- India itself is a large consumer for its immunization programme.

- The global vaccine market expected to reach about $1 billion by 2015.

- Expected product innovations and global recognition of the benefits of immunization with new and improved prophylactic, therapeutic and adult vaccines.
Major vaccines produced in India

- DPT,
- DT,
- Tetanus Toxoid,
- BCG,
- Oral Polio (formulation)
- MMR
- Penta
- Rubella,
- Hepatitis-B,
- Rabies
- Typhoid etc.

Now Rotaviral Diarrhoea Vaccine : **ROTAVAC** - **BBIL**

SII & others
The VISION 2025 of Department of Biotechnology, Govt. of India envisages

No one should suffer from Vaccine Preventable Diseases

- To make available of affordable, safe & effective vaccines for Children, Adolescent, Adults and Geriatric population.

- To accomplish the strategy comprises of strengthening:
  - Fundamental tools for vaccine development (Basic and applied R & D)
  - Product Development, Manufacturing, Regulation & Marketing capabilities
  - Human Resource
  - Effective partnerships with National/International Scientists and Organizations.
Collaborative Vaccine Development

- Vaccine development, clinical trial and commercialization is very complex and requires many steps with involvement of multi-partners.
- The partners will bring prospective, resources and unique skills
- Academic institutions will develop candidate vaccines and conduct clinical trials.
- Industry provides expertise in product development, manufacturing and commercial launching.
- The Government will facilitate through financial support and regulatory clearances.
- Most currently available as well as those in the developmental stage resulted from successful collaborations between partners from academic institutions, government, private sector including support from global organizations and non-governmental organizations.
The Department is implementing the programme since 1987-88 through:

- Technology Mission on Immunization – Development of new and improved vaccines and production of some of the EPI vaccines (polio, measles etc.)
  - BIBCOL (IPV, Moscow)
  - IVCOL (PMSV, France)

- Indo – US Vaccine Action Programme – a model bilateral programme under implementation for the past 27 years - “Value Added Programme”

- Medical Biotechnology Task Force

- National Jai Vigyan Mission programme for S&T on generation of new and improved Vaccines

- Vaccine Grand Challenge Programme – A new governance model

The VGCP is being implemented with an overall objective to accelerate development of candidate vaccines for which earlier leads are available and to take them through pre-clinical and clinical development and commercialization.

Potential candidate vaccines developed
- Rotavirus, Cholera, Typhoid, Rabies (DNA based), Malaria, Dengue, Tuberculosis, Japanese Encephalitis, HIV, chickenguniya etc.
Key features envisaged under VGCP for granting mechanisms:

- Preliminary grant for nascent ideas followed by full grants for those that show promise.
- Planning grant for proposal writing as a team with consultant support.
- Centre of Excellence and programme support as per existing DBT schemes but through the vaccine grand challenge apex committee.
- Research strengthening grants for retaining key team members on contract hiring basis, extendable every 5 years.
- Engagement of consultants for problem solving as per Government of India norms.
- Public Private Partnership projects strictly according to SBIRI and BIPP and pharma fund rules.
- Cooperate grants, where R&D is jointly managed by investigators and by a professional team engaged by the programme on a part time basis.
- Subcontracting of work to not for profit organization, public institutes and industry through an open, competitive process.
- Consortium projects with other ministries or agencies in the country and internationally.
Current Status of DBT Vaccine Projects

- **Rotaviral vaccine development (116E)**
  - Developed first indigenous rotavirus vaccine called ROTAVAC® - $1 per dose.
  - Under a unique social innovation public private partnership model.
  - Recently approved to pilot introduction of the vaccine in EPI programme of Govt. of India.

- **Malaria vaccine development**
  - Phase-I completed
  - Established MVDP (DBT, EMVI, MVI, Bill & Melinda Gates Foundation)

- **Dengue vaccine development**
  - Tetravalent vaccine against DENV-1 to 4] - ICGEB, New Delhi
  - International Vaccine Agency - GlobeVac
  - Technical Consultation – NIH
- **Cholera vaccine development**
  - Phase III

- **JE vaccine development**
  - Transferred to Panacea Biotech- due to various reasons not progressed further.

- **Typhoid vaccine development**
  - Transferred to USV Ltd.
  - Efforts made to make $V_i$ polysaccharide vaccine (THSTI-BBIL)

- **Rabies vaccine development**
  - Animal studies completed
  - Human studies not pursued

- **Chickengunya -**
  
  Immunological studies
  - ICGEB, AIIMS, New Delhi
  - Emory Vaccine Centre
Effective Global Partnership
Rotaviral Diarrhoea Vaccine Development

Rotaviral Diarrhoea Vaccine Candidates
[116E and I321]

Academic Institutions
AIIMS, New Delhi-CDC, Atlanta
IISc., Bangalore-Stanford University

Indian Federal Government
DBT / ICMR

US Federal Government
NIH / NIAID

Global Organizations
PATH

NGO
SAS, New Delhi

Industry
BBIL, Hyderabad

Global Organizations
PATH
Low-Cost Rotavirus Vaccine

Developed in partnership between

- Department of Biotechnology
  Govt. of India
- Bharat Biotech
  Lead Innovation
- CDC
  Centers for Disease Control and Prevention
- NIH
  National Institute of Health (NIH)
- PATH
  International Health Organization
- Stanford University
- Indian Institute of Science (IISc)
- All India Institute of Medical Sciences (AIIMS)

The vaccine was first identified by researchers at the All India Institute of Medical Science (AIIMS) in New Delhi in 1985.

- Initiation
- Funding
  $100 million in funding including that from the Indian government and the Bill & Melinda Gates Foundation
- Partnership
  Rotavac developed through unique collaborative efforts of a group committed to social innovation
- 2013 Announcement
  Scientists announced the new low-cost oral vaccine against rotavirus

Bharat Biotech puts the cost as under Rs. 54 a dose for children.
Affordable health care at its best!
Example of effective global partnership
Case Study-II: Malaria Vaccine Development

- **Indian Federal Government**
  - DBT, ICMR

- **MVDP**
  - Independent Society

- **Academic Institutions**
  - ICGEB and MRC, New Delhi

- **US Federal Government**
  - NIH, NIAID

- **Global Organizations**
  - PATH, MVI, EMVI, Bill & Melinda Gates

- **Industry**
  - BBIL, Hyderabad

**Malaria Vaccine Candidate**

- [MSP1\textsubscript{19} and P. vivax Duffy binding]
Dengue Vaccine Development

Government Support
DBT

Academic Institution
ICGEB, New Delhi

Dengue Vaccine
[ED-III]
[Tetravalent vaccine against DENV-1 to 4]

Technical Consultation
NIAID, NIH

Industry
To be identified

International Vaccine Agency
GlobeVac
National immunization programme of Government is the best example of policy makers regulating the prices directly, so that the vaccines should reach the masses at affordable cost.

Government has to look at various options to make the vaccines affordable.

For example **Polio Vaccine** was made available to masses at negligible price through the public programme.

Without compromising the quality of vaccine, we have to work towards achieving the affordability, healthy competition is a necessity for the companies and at the same time the Government too has social responsibility.
INDUSTRIAL PROMOTION AND DEVELOPMENT

• Major policy goal to promote R&D in SME’s and to provide enabling mechanism to build in-house company technology capabilities

• Continuation and expansion of Small Business Innovation Research Initiative - SBIRI

• Public partnership with large scale companies encouraged and supported in areas vital to the national development from scientific, economic or social perspective and development of technologies and products.

• Establishment of incubators by consortia of small and medium enterprises : Biotechnology Industry Research Assistance Council (BIRAC) for monitoring, supporting and nurturing R&D in small and medium biotechnology companies.

• Biotech clusters : Institutions, parks, incubators with large space for new start-ups – NCR, Bangaluru, Mohali, Kolkata, Pune.
Challenges

- New and improved vaccines need to be developed for a variety of infections of public health importance against which no effective preventive intervention measures are available or practical.

- A new paradigm needs to be established among all stakeholders of immunization—this includes research institutions, industrial partners, funding agencies in public-private partnership mode including global partners.

- Since vaccine R&D is an expensive and high-risk enterprise. Normally it takes more than 10-15 years to bring a vaccine from research to commercialization with an approximate cost of US$200-500 million per vaccine.

- The uncertainty of research outcomes makes the pipeline necessity with a portfolio of vaccine candidates for each of the targeted diseases.

- The prospects of new formulation technologies, especially for new conjugate vaccines and production under GMP conditions, revolutionized production of international standard quality vaccines.

- **Not having effective vaccine adjuvants** – Need to establish Vaccine Adjuvant Centre for new and novel adjuvants.
Major hurdles faced by vaccine industry

- Technological capacity and access to know-how
- Lack of generic pathway for vaccines
- High capital investment in manufacturing infrastructure with lack of demand
- Gap in the need and accessibility of vaccines
- Need to add new vaccines in expanded program in immunization (EPI)
- High cost of R&D, long and complex clinical trials result in longer time to licensure
- Entry barriers to emerging suppliers in competition
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<td>Global</td>
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(source: ClinicalTrials.gov)

(Published in: Biospectrum – Volume 12)
Opportunities and Challenges of International Cooperation in S&T with development of Vaccines and Pharmaceuticals: The DBT Experience

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Challenges</th>
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<tr>
<td>• Model for national programmes</td>
<td>• Harmonization with national/regional priority areas – avoiding duplication of work</td>
</tr>
<tr>
<td>• Institutional strengthening &amp; Capacity building</td>
<td>• Clinical trial issues (SC order) &amp; adoption of global best practices</td>
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<td>• Access to international networks</td>
<td>• Increased administrative time &amp; effort – review, IP, agreements etc</td>
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<tr>
<td>• Frontier research in areas of mutual interest</td>
<td>• Collaboration in strength to strength; not just transfer of biological material</td>
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<td>• PPP with international partners</td>
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<td>• Develop products/processes: global standards</td>
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Translational Health Science & Technology Institute (THSTI)

Intramural Centers

Vaccine & Infectious Disease Research Centre
Pediatric Biology Centre
Centre for Biodesign & Diagnostics
Centre for Human Microbial Ecology
Policy Centre for Biomedical Research
Drug Discovery Research Centre

Partnership Centers

Population Science Partnership Centre

Extramural Centers

Clinical Development Services Agency

Intl.Centres (USA)

IAVI — HIV
Pre Term Birth
Based on the experiences so far, we in the Department re-defining the Vaccine Research and Development Mission to translate the product development process upto commercialization in accelerated mode.

The same is under consideration by the Government of India.
How do we deal with this exciting but uncertain future with Courage, Core Values, Innovativeness, and Togetherness.
Thanks