Report of the One Day Symposium on “Vaccine Development in India and Other Developing Countries – Challenges and Opportunities”

5th December 2015

Organized by:

Supported by:

Rapporteur:

Sujaya Ingale and Mugdha Lele

Email: siip@venturecenter.co.in
A one day Symposium on “Vaccine Development in India and Other Developing Countries – Challenges and Opportunities” was jointly organized at Venture Center via the joint efforts of Bioincubator at Venture Center and Emmes Services on Saturday, 5th December 2015.

The workshop began with a brief welcome by Dr. Premnath introducing the various activities of Venture Center. He mentioned that Venture Center runs such events to facilitate useful collisions and discussions so that participants learn from people who have done it and this event would also catalyse fruitful outcomes like past events at Venture Center.

Ms Archana Sarda gave overview of Emmes. She mentioned that Emmes is committed to public health research and has more than 20 years experience in vaccine development and this symposium is to form an ongoing dialogue as to how Emmes can help in vaccine development scenario in India and developing world.

Session 1: Vaccine development landscape

Key note address titled Developing countries vaccine Industry and global vaccine needs was given by Dr Suresh Jadhav, Executive Director of Serum Institute of India Pvt. Ltd., Pune. Dr. Jadhav presented bird’s eye view on global vaccine scenario. He told the audience that Serum institute is the largest supplier of vaccine in terms of number of doses. Every 2 children born in the world out of three are getting vaccine manufactured by Serum. In his talk he put forth his concern about reduction in vaccine manufacturing companies in USA and Europe due to lack of political will. On the contrary in developing world the situation is totally different. In year 2000 with the help from Bill & Mellinda Gates Foundation, a Global Alliance for Vaccines and Immunizations (GAVI) was created to improve access to new and underused vaccines for children living in world’s poor countries. At the same time, Developing Countries Vaccine Manufacturing Network (DCVMN) was formed with the objective to provide consistent and sustainable supply of quality vaccines at an affordable price to developing countries. Today on one side companies are closing down in developed countries and more companies are formed in developing countries.
Talking about global immunization landscape he said, about 85% population is in developing countries whereas burden of disease is almost 93% in developing countries and vaccine sale is only 18% in terms of revenue is in developing countries. To look at global disease burden of vaccine preventable deaths in children below 5 years, estimated 1.5 million deaths are preventable through routine vaccination. About Indian scenario he said, India loses close to 2 million lives a year due to vaccine preventable diseases. Vaccine coverage is also lowest in India. Per capita vaccine expenditure is also lowest in India compared to China and USA. Govt of India’s recent initiative such as Indradhanush indicates political will for improving vaccination coverage in India and hence there is lot of scope for Vaccine Industry to perform. Quality vaccines at affordable prices will be the key to success. NCL Venture Center’s focus on Biotech hub is a welcome step for Industry.

He also spoke about challenges in meeting global needs which are - Limited resources, Competing health priorities, Poor management of health systems, inadequate monitoring and supervision, Political instability and lack of political will. Talking about Indian Vaccine Industry he said, Asia is emerging as the vaccine hub of the world and India is on the go to play a key role in vaccine market. The Global vaccine market is expected to reach to $40 billion by the year 2015.

The current revenue of the Indian vaccine market is estimated around US$ 500 million in 2012-13 and expected to grow at more than 20 % during 2014-15. Around 70% of the total volume manufactured is exported. India is the major supplier of Vaccines to UNICEF which in turn supplies 40 % of the total vaccine demand for childhood vaccination in more than 100 countries. Indian industry is an attractive target for take-overs / partnerships / collaborations. He also mentioned impact of MenAfricVac made by Serum Institute on public health concern in Africa which in 11 days completely immunized the population of 15 million.

After all this, the facts remain that:
- Vaccines prevent 2 to 3 million deaths annually around the world
- In $ 20 complete vaccination of a child against pneumonia, diarrhoea, polio and measles diseases can be achieved
- 1 in 5 children do not have access to life saving immunizations.
- Till today over 22 million infants remain unimmunized in the world each year

Summarising the talk he said, DCVMN have moved from dependency to self sufficiency and has finally emerged as global suppliers for affordable vaccines. DCVMN look forward to supplies and markets in developed world. But they will have to overcome challenges and would need partnerships/collaborations with scientific community and Big Pharma to address issues of access and IP. In addition to this they will need support from international agencies/foundations in terms of funding and advocacy.

NCL Venture can be an important partner to Indian Vaccine Industry in reaching above goals. He concluded his talk with a word of caution to entrepreneurs that vaccine manufacturing is game of numbers. If you are looking for international market you have to look for a product that you can make at affordable price. Today there is tremendous pressure on the manufacturers by the Gates Foundation, GAVI and UNICEF to reduce prices.
Dr. Prasad Kulkarni, Medical Director from Serum Institute of India Pvt Ltd., Pune, shared his views on the Unique challenges in Vaccine development. He started his talk with importance of vaccines, a brief history of vaccines and vaccines of today. He explained typical phases of clinical trials. He also explained how vaccine development is unique and different than a chemical drug product and need special considerations. Clinical trials of vaccines have unique challenges which include safety, efficacy or immunogenicity, decisions like phase II and/or III and operational challenges.

Challenges during preclinical development include:

- Access to technology especially in developing countries
- Numerous circulating strains –multivalent vaccines; geographical difference in them; annual updates
- Certain vaccines cannot be made in low endemic countries e.g. polio
- Large commercial scale batches needed for Phase III trials; most of it needs destruction
- Toxicity studies in India need similar design as other drugs unlike Europe Middle East and Africa (EMEA) or World Health Organization (WHO)

As far as safety in vaccine clinical trials is concerned, following are the challenges

- Used in healthy population, most often children
- Tolerance for vaccine Adverse Effects is very low; makes it a very sensitive issue
- Even a slight increase in mild reactions could make vaccine unacceptable

He gave HPV trial as a classic example of the sensitive nature of safety issues in vaccine trial. An ideal vaccine should be effective as well as safe. Ethically & scientifically acceptable potential risks are to be defined early. Background disease rate is important and should be taken into consideration. In infant trials multiple simultaneous vaccinations may make causality assessment difficult. Congenital anomalies may get detected during trial; issue of whether to pay for its treatment should be addressed.

A very rare side effect may be missed during trials and may be detected after it comes to market. For example Rotashield which was eventually withdrawn within a year of licensure. Medical and social activism may hinder introduction and development of new vaccines and should be kept in mind.

To demonstrate vaccine efficacy is a challenge because measurable efficacy endpoints are difficult for vaccines. Two common approaches for vaccine efficacy are Clinical endpoint and Immune response endpoints. In clinical endpoint efficacy studies, number of cases will
typically be the primary endpoint. It is usually necessary in situations when vaccine is novel, first of its kind administered to target population and no accepted immune response correlate of protection E.g. Rotavirus vaccine, varicella.

Challenges in clinical endpoint efficacy studies are

- Long follow up of multiple years, hence higher dropout rates
- Large sample size in thousands leading to increased budget & time
- Operational challenges at all critical steps from preparation to monitoring to data analysis
- Difficult to find resources (sites, CRAs) with experience of such trials

The second approach is immunological endpoint studies where the endpoint is an immunological response most often a biomarker like antibody. It is used when clinical efficacy study is impossible, burden of disease is too low, and well established correlate is available. E.g. Use of Anti-HBsAg for Hepatitis B Vaccine

Challenges in immunological end point studies are

- Selection of the type of assay; assays must be accurate, reliable & valid
- Biological samples to be tested; their storage & transport
- Choice of laboratories to perform assay; Certain assays are highly specialized; few labs are only capable
- Interpretation of results must be objective & unambiguous

Regulatory challenges

- No distinct guidelines for vaccine trials; Schedule Y the definite law in India
- In addition, approval to recombinant vaccines by DBT and its advisory committees like Institutional Biosafety Committee (IBSC), Review Committee on Genetic Manipulation (RCGM) and Genetic Engineering Approval Committee (GEAC)
- Approval of Health Ministry Screening Committee (HMSC) if foreign funding; vaccine trials due to large scale set up often need foreign funding
- Some agencies also need lot to lot consistency of vaccine
- Non-interference with other simultaneous vaccines – needs bigger blood sample especially in children
- Persistence of response? Booster response? May need additional trials
- Audio-Video consenting especially in large clinical trials
- Vaccines risk losing their price appeal due to such regulatory challenges

Lack of awareness among scientific community about Vaccines in general & vaccine trial in particular is another challenge to overcome. Use of placebo poses ethical dilemma and could kill a promising vaccine at early stage.

Operational challenges

- Sites having unique needs such as community presence
- Experience, Expertise of vaccine trial
- Long term follow up - bigger setup & more resources
- Infrastructure – cold chain maintenance
- Laboratories may test for a wrong strain and give false negatives – killing the vaccine
- Biological samples, especially blood in children
- Import/Export of biological samples as well as vaccines
- Unforeseen situations like natural calamities may jeopardize the specimens/IPs

He concluded his talk with take home message that vaccines are unique, hence trials have different needs. Trial designs must ensure robust reporting of safety. There has to be a choice between efficacy & immune response and successful clinical plan hinges on syncing of multiple factors.

Dr. Rajat Goyal, Country Director, International AIDS Vaccine Initiative, discussed about Emerging trends in Vaccine R&D. Dr Goyal started his talk with overview of biotechnology and vaccine development in past and future. He said centers like Venture Center is the solution for tomorrow.

He further said, large volume efficacy trials will not be possible in future. World is trying to apply reverse methodology and new generation technologies as a platform. He explained concept of reverse engineering of vaccines with examples. Good knowledge of human immunology and immune system is becoming more and more important in discovery and development of vaccines. The antigen discovery platforms like reverse vaccinology, genome based target discovery, whole cell mapping, T cell antigen discovery are getting more and more solid and the question is how do you apply these platforms towards antigens, adjuvants and use of them to better understand human immune system.

Recent advances in vaccine discovery like antigen discovery, novel vector platforms and adjuvant technologies and recent advances in immune monitoring like novel assays, high throughput and multiplexed platforms are leading to experimental vaccine clinical research trials which ultimately lead to improved success rates in vaccine development.

He gave examples of consortia to link siloed expert domains for common goal. These examples included proposed Human Vaccines Project, European Advanced Immunization Technologies Project, Translational Vaccinology Consortium – Proposed PDP – Oxford Collaboration, TB Vaccine Accelerator and The Translational Research Cancer Centers Consortium.

He mentioned BIRAC’s Mission Biopharmaceutical Accelerator Program which involves integrated network of academicians, SME’s, industry, CRO, CMO, institutes and collaborations harnessing individual strengths.

He also mentioned Network model of BIRAC Consortium of Partners and India – East Africa partnership model.
Dr. Tushar Tewari, Team leader at PATH, India spoke about Conducting large community based vaccine clinical trials in India. He talked about his experience of current project he is working on Rotavirus vaccine. It began with what a study should have. It should have multiple sites for diversity, availability of leadership and key study personnel, access to community, accredited IRB’s/IEC’s and ability to generate timely and high quality data.

Community engaged research is the one in which community input is integrated in the development of the research question, implementation of the research project, analysis of the results and/or dissemination of the findings to community stakeholders. He emphasized that being the subject of research is different from being a participant in research. So involvement of community is very important. He pointed out difference between traditional research process and community engaged research process and also difference between hospital based trials and community based trials.

He explained steps in community engaged trials, community interaction and sensitization, recruitment strategies, study clinics and dissemination of results. The talk ended with a note - Invest in community, build a positive and lasting relationship with the community for a win-win situation.

Session 2: Vaccine trials case studies

Dr. Robert Lindblad, the Chief Medical Officer at Emmes elaborated on his experiences of launching an Ebola vaccine study in a research naive country like Sierra Leone. Dr Lindblad gave brief background of Ebola epidemic, time course of Ebola infection and presented current status of Ebola epidemic. He talked about clinical research setting in Sierra Leone. There were only a couple of physicians with any research experience. No research coordinators or research associates. No familiarity with ICH, GCP or HSP. No established research centers. Limited laboratory support was available. No trust in the research process. An ongoing epidemic was further exacerbating trust. So the task was to establish the purpose of the research, to provide vaccinations during an epidemic, to conduct clinical trial research, to determine efficacy and safety. Challenges in general were government oversight, sponsors/coordination, funding, launching a clinical trial. Several specific challenges were faced in building infrastructure which include physical locations, identify staff, training, SOPs/processes, consent, document production and storage, internet access, computers, printers, file cabinets, web based data systems, monitoring.

He mentioned six points to consider to mitigate risk – Politics, Planning, People, Patience, Problem solving, Perseverance. He concluded his talk with lessons learned during these trials. Those lessons are, you need to have good leadership and vision, need to invest in infrastructure; you have to be on site hands on training, supervising and mentoring and balance public need and quality research. These factors led to the success of Ebola vaccine trials in Sierra Leone.

During the question answer session that followed the talks, Dr. Rajat Goyal compared and contrasted the two Ebola and Rotavirus clinical vaccine trials and asked about the stakeholders and what was their role. Dr. Tewari responded by saying that Gates
Foundation had funded the study. The funding was provided through PATH. PATH was providing all the technical support for the study, while manufacturer was Serum Institute of India. A CRO was involved in monitoring of study and data management. There were two labs involved: CMC Vellore and Retro viral research lab in Pune.

Rajat Goyal was interested to understand the role adopted by each of the stakeholders, viz., manufacturer, funding agency, clinical team, CRO, government and principal investigator. Prasad Kulkarni responded to this question acknowledging that there were indeed a lot of complexities and different stakeholders. Many things were going in parallel and different people were taking responsibility of different things. CRO was monitoring clinical operations and data.

A further question to understand the community involvement in all this was posed which was answered by Dr. Bavdekar, consultant at KEM. The community where these studies were done, KEM hospital has been working for many years. So the trust developed through medical care slowly went on to clinical trials. Before the trials, lot of training and teaching was already done in the community.

Dr Rajat Goyal summarized the points discussed as in case of Ebola epidemic the 6 Ps which Dr. Lindblad mentioned in his talk, they had to establish within the structure and get it going. In the Rotavirus vaccine clinical trials there was groundwork done in the community and communication further enhanced trust factor by engaging local community. Dr. Paranjpe and Dr Sahay shared their experience of HIV vaccine trials, where community sensitization was the key for the success. Dr Goyal closed the session with positive note that involve people, it can be done! Whenever you do community study, nobody tells what to do, community tells you what you can do for them.

Session 3: Trial designs, regulatory approvals and incorporation in national programs

Mr. Anil Kumar (Biostatistician, Emmes Services) and Dr. Ravinder Anand (Vice President and Senior Statistician, Emmes Services) took the session on Case Studies of Stepped-Wedge Cluster Randomized Trial Design.

Mr Anil Kumar talked about Cluster Randomized Trials (CRT) in which clusters of individuals rather than independent individuals are randomly allocated to intervention groups

Reasons for Adopting Cluster Randomization are

- Administrative/logistical convenience
- Ethical considerations
- Better subject compliance
- To avoid treatment group contamination
- Intervention is naturally applied at the cluster level

There are three types of CRT Designs –Parallel, Crossover and Stepped Wedge (SW)

He gave example of cluster randomized trial design Ebola Ring Vaccination Study in Guinea to assess the efficacy of the rVSV-ZEBOV candidate. This Phase 3 study used “Ring
“Vaccination” approach, a novel cluster-randomized trial design to assess vaccine efficacy and effectiveness during outbreaks.

Coming to the Stepped Wedge Design, he gave brief Background and talked about characteristics of Stepped Wedge Design. He showed the Design Matrix and also showed comparison of stepped wedge CRT with the standard CRT. He explained further with example of the Gambia Hepatitis Intervention Study which is a large-scale vaccination project to introduce the national hepatitis B (HBV) vaccination to young infants progressively over a 4-year period, started in July 1986 and gave the status of the study as of now.

A case study of when a SWCRT design may not be appropriate - Ebola Vaccine Trial in Sierra Leone

Dr. Ravinder Anand presented another example of this design - Ebola Vaccine Trial in Sierra Leone. He started with the background that in October 2014 CDC planned to use SWCRT design as Ebola incidence was still on the rise, study population included high risk caregivers and Ebola treatment unit workers, risk of Ebola virus infection was expected to decline during trial duration and current risk and rate of decline varied by region. Study investigators concern was that given heterogeneity in risk between clusters (regions), vaccinating clusters in a random order is likely to be less effective than prioritizing vaccination of high risk clusters. So a simulation study was planned to compare the statistical validity (false-positive rate) and power of SWCRT and RCT designs. The results showed that the false positive rates were high in stepped wedge model and the power is low compared to risk prioritized vaccination. He summarized his talk with strengths and weakness of SWCRT design.

Mr. Jan S. Peterson, Senior Regulatory Scientist, Emmes Services, discussed the Regulatory Landscape for Vaccine Trials in India - Observations on Public Health and Registration Trials. Beginning his talk with history of vaccine trials in India Mr. Peterson told the young entrepreneurs and students that regulated trials are usually not the same as academic, scientifically oriented trials. Because regulators need to assure that adequate evidence supports registration of reasonably safe & effective products. He also pointed out that government policies and regulations are reactionary. These are developed in response to events for which the public and government representatives demand formal controls to avoid additional public harms. The need continues for vigilance and compliance monitoring, as pressures to bypass recognized ethical responsibilities still exist. And that the community perceptions often drive legal responses.
Talking about adapting research for regulatory needs he said, trust needs to be developed between sponsors, researchers and regulatory authority. If regulators are viewed as impediments, risks increase. Risks to sponsors and governments include delay or failure to register useful products, risks to population are delay/failure to register useful products or registration of useless or dangerous products.

Dr. Jyoti Joshi, Deputy Director, Immunization Technical Support Unit (ITSU), Public Health Foundation of India, discussed about how an approved vaccine becomes a part of the national vaccine program and helps address public health issues. Dr. Joshi talked about public health related topics and covered the parts after the vaccine is commercialized and available in the market it is still not available to larger population because it is in the private market and when it becomes part of a government program in country like India specifically, it becomes accessible to the larger community and how the process is achieved.

The decision regarding making for new vaccine introduction into national immunization program has two key components – prioritizing investments and to provide best available services in an appropriate, affordable and cost effective manner. Key issues to consider while considering new vaccine introduction are public health priorities, burden of disease and status of other disease prevention and control measures. Also need to have information about vaccine in terms of performance, characteristics, economic and financial issues and availability of vaccine supply.

She presented a case study of Pentavalent vaccine introduction, brief history and evolution of India’s Universal Immunization Program and major program milestones. She also talked about the current and proposed immunization schedule. Talking about steps for introduction of new vaccine, she said, after licensure, there has to be felt public need for vaccine introduction. After this there is detailed technical review and finally recommendation is reviewed by larger National Technical Advisory Group on Immunization (NTAGI). NTAGI recommendation means the country has given a commitment and it is followed by making commitment for finances by Empowered Program Committee which goes to Mission Steering Group for recommendation. Vaccine expert committee advises and plans introduction and vaccine introduction working group to ensure preparedness and successful implementation in country.

Dr. Joshi also presented impact of introduction in national immunization programmes on reducing childhood deaths and diseases and challenges like gaps in availability of reliable, context specific evidence on disease burden. Lastly she mentioned national flagship program Mission Indradhanush – to reach the unreached.

In the question answers session Dr. Goyal asked that at the policy level decisions are made but finally when it moves to the state level, what is the influence people at state government have on this? Dr. Joshi answered by saying that health is a state subject but immunization program is centrally sponsored scheme, States have the choice of adding vaccine. Usually it is done with consultation with immunization department.
Session 4: New technology showcase followed comments by experts

Dr. Vishwas Joshi, Founding Director, Seagull Biosolutions Pvt. Ltd. presented on active virosome technology for development of vaccines. Dr. Joshi talked about measles vaccine as an effective vector for vaccine development. He showed comparison of the traditional method for producing recombinant viruses and eSAME technology, they have developed which is simple and efficient, easy to scale up, and in which replication deficient viruses can be produced. So far they have produced two virosomes GFP virosome and Dengue virosomes. GFP virosome can be used as vaccine for measles. He told that Seagull plans to commercialise this platform as vaccine development platform.

Dr. M V Krishnasastry, Scientist, National Centre for Cell Science (NCCS), Pune, started his talk with an interesting video to explain that in an entire population some are co-operators those who incur cost and some are defectors those who do not incur cost. So in any population, some cells adopt different strategy than others and if they get better pay off, they will prevail. This is the way how population evolves. During evolution some phenotypes are dropped because of the cost involved in expression of that phenotype. So if we are constantly attacking one cell, there is possibility that another cell will come up with another strategy and we should be ready to know what that strategy is if we are doing vaccination.

Dr. A H Bandivdekar Consultant from National Institute for Research In Reproductive Health (NIRRH), Mumbai, presented Development of Recombinant Vaccine by Individually Cloning HIV1 C gag, env and polRT Genes using SFV Vector. Dr. Bandivdekar explained the development of recombinant vaccine by individually cloning HIV1 C gag, env and polRT genes and use of Semliki Forest virus (SFV) Vector. He explained advantages of SFV system. He presented SFV gene expression protocol. He also presented data showing immunization with rSFV2gen VRP constructs and cell mediated and humoral response caused by it.

Dr. Ranjana Deshmukh, Former Director & Visiting Research Scientist, Haffkine Institute for Training, Research & Testing, Parel, Mumbai presented the Recent developments in dengue vaccine. She presented dengue epidemiology and pathogenicity, explained the hurdles in dengue vaccine development and lack of appropriate animal model system to evaluate experimental dengue vaccines.

Talking about dengue vaccine development she said, Systematic research on dengue vaccine development began in the 1920s. There is currently no licensed vaccine available in market for Dengue. However, many ongoing vaccine development programs are awaiting their results A number of other vaccine candidates are entering phase I or II testing. She mentioned that Haffkine institute has developed a novel tetravalent recombinant DNA vaccine candidate comprising EDIII.

Dr Subhash Kapre, Ex-Executive Director of Serum Institute of India, Ltd, gave his comments on vaccine development, clinical trials and various issues discussed during the symposium. Dr Kapre said he would speak more on some of the challenges that come up in vaccine development. Every vaccine poses its own challenges in last stage of getting approval. So the message to young entrepreneurs is making of vaccine in India demands quality, clinical
trials to match up to international standard and on other side the vaccine is expected to be cheap.

He also cautioned about issues which are not known as scientific entrepreneur. So apart from the science part, the managing of science in financial terms is equally important. He also cautioned the budding entrepreneurs about once you have an idea, how to match it up with the established companies. He emphasised the importance of the common platforms like this today are very useful in bringing together the people who have the ideas and those who are interested in these ideas and take it further.

Dr Sambuddha Ghosh, Director, AbGenics LifeSciences Private Ltd, shared his experience as an entrepreneur. He said there are many challenges and we should be prepared at research level, manufacturing level and regulatory level. He emphasised the need of consortia of academicians, industry and all the stake holders including community so that multidisciplinary approach can be taken.

He emphasised potential of lot many disruptive technologies and India as very big player for the future. He also mentioned that innovations with small start-ups have to be encouraged and that’s going to be future trend. Finally he requested Venture Center to continue this effort and try to help each other.

Dr Paranjape, Ex-Director at National AIDS Research Institute, Pune and the Symposium director, summarized the symposium and thanked the speakers and participants.
<table>
<thead>
<tr>
<th>Time (hrs)</th>
<th>TOPIC</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900-0930</td>
<td>Registration and tea</td>
<td></td>
</tr>
<tr>
<td>0930-0945</td>
<td>Introductions</td>
<td>Premnath V; Archana Sarda</td>
</tr>
</tbody>
</table>
| 0945-1100 | Session 1: Vaccine development landscape  
• Key note address  
• Opportunities and challenges in vaccine development  
• Emerging trends in vaccine R&D | **Key note Speaker:** Suresh Jadhav  
**Speakers:** Prasad Kulkarni, Rajat Goyal  
**Coordinator:** Ravinder Anand |
| 1100-1115 | Networking tea | |
| 1115-1230 | Session 2: Vaccine trials case studies  
• Conducting large community based vaccine clinical trials in India  
• Challenges in conducting large vaccine trials with minimum infrastructure: Ebola trial in Sierra Leone. | **Speakers:** Tushar Tewari, Robert Lindblad  
**Coordinator:** Rajat Goyal |
| 1230-1330 | Lunch | |
| 1330-1530 | Session 3: Trial designs, regulatory approvals and incorporation in national programs  
• Statistical design and analyses issues in vaccine trials  
• Indian Regulatory landscape  
• How an approved vaccine becomes a part of the national vaccine program and eventually help address public health issues | **Speakers:** Ravinder Anand; Anil Kumar, Jan Peterson, Jyoti Joshi  
**Coordinator:** Tushar Tewari |
| 1530-1600 | Networking tea | |
| 1600-1730 | Session 4: New technology showcase followed by comments by experts  
• Short presentations by selected technology developers from R&D organizations and start-ups | **Speakers:** Vishwas Joshi, M V Krishnasastry, A H Bandivdekar, Ranjana Deshmukh  
**Experts:** Subhash Kapre, Sambuddha Ghosh  
**Coordinator:** Ramesh Paranjape |