Biotechnology Industry Research Assistance Council (BIRAC)
(A Govt. of India Enterprise)

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birac | Innovation Profiles 2018

Vigyan se Vikas

Vigyan se Vikas

Contents

Foreword

The Indian biotechnology sector is one of the fastest growing knowledge-based sectors and is expected to make key contribution in India's rapidly developing economy. DBT & BIRAC have been making focused efforts to promote and support Biotech startup ecosystem. The aim to achieve $100 billion bio-economy by 2025 is also being supported at the policy level and in coordination with several initiatives of the Government.

Some of the recent policy level initiatives include operationalization of National Biopharma Mission for biopharmaceuticals/vaccines, setting up of incubators focused on agriculture/secondary agriculture, focused support schemes for women entrepreneurs etc. BIRAC has continued to forge relevant international partnership to ensure global competitiveness of the startups. To facilitate understanding of complex compliances and regulatory requirements to entrepreneurs, initiatives such as FIRST Hub bring together representation from NITI Aayog, CDSCO, ICMR, NIB and other govt. departments at a common platform accessible for personal consultation to the startups. BRBC – BIRAC's 3rd regional centre at Venture Center, Pune providing focused regulatory facilitation are certain examples.

We are now looking at supporting 2000 startups, 50 Bio-Incubators, 5 Regional centers and Bio clusters by 2020.

I am happy to note that despite the inherent challenges of biotech research (long gestation, intensive skill requirement, complex regulatory landscaped etc.), innovative efforts of our entrepreneurs, backed by BIRAC support have begun to bear fruits. This compendium is an excellent compilation of the innovative ideas being pursued by our innovators that are on the way to conversion into commercial products/ technologies soon.

There are still certain challenges such as larger investments for high risk product development and scale up, regulatory compliances, raw material availability and procurement, involvement of state governments etc. I would like to assure our readers that we would continue to bring in newer initiatives to overcome these challenges and enable Indian biotech community to create a global impact through affordable and accessible innovations.

Dr. Renu Swarup
Secretary, DBT & Chairperson, BIRAC

Preface

BIRAC since 2012 is actively nurturing and promoting the biotech innovation ecosystem in the country. BIRAC is committed to facilitate National Strategic Programs including 'Make in India', 'Startup India' and 'Swachh Bharat' mission. All our mandated activities are aligned to promote "Innovation Research for Affordable Product Development" in high unmet need areas. BIRAC partners with National and International organizations to facilitate a sustainable and scalable Innovation Ecosystem which is globally competitive.

Programs of BIRAC such as BIG, SBIRI, BIPP, PACE, SPARSH, IIPME, BioNEST, SEED Fund, AcE Fund, etc. are instrumental in channelizing the entrepreneurial energy within the country. BIRAC has supported more than 1000 startups, entrepreneurs & SMEs, an incubation space of 3,37,000 sq. ft. in 31 bio-incubators for capacity building throughout the country and >10,000 skilled manpower.

The latest edition of the BIRAC Compendium lists out the innovations supported by BIRAC reflecting high innovation quotient of the country through products and technologies that are either commercialized or under development.

I appreciate the publication team at BIRAC for their sincere effort in bringing out this useful book showcasing innovations along with a comprehensive analysis of the support provided by BIRAC across different sectors.

I extend my best wishes and congratulate the innovators for their excellent effort in transforming the Indian Biotech ecosystem.

We will continue to work with the entrepreneurs, make efforts to understand their needs and bridge the gaps in the ecosystem to stimulate technology driven products development.

Dr. Mohd. Aslam
Advisor (Scientist 'G'), DBT & MD, BIRAC

About BIRAC

Vision

"Stimulate, foster and enhance the strategic research and innovation capabilities of the Indian biotech industry, particularly startups and SMEs, for creation of affordable products addressing the needs of the largest section of society."

Mission

Facilitate and mentor the generation and translation of innovative ideas into biotech products and services by the industry, promote academia – industry collaboration, forge international linkages, encourage techno entrepreneurship and enable creation and sustainability of viable bio enterprises.

Focus

Empowering and Enabling the Biotech Innovation Ecosystem for affordable product development

Core Values

- Integrity
- Transparency
- Team work
- Excellence
- Commitment

Set-up in 2012 by Department of Biotechnology, Ministry of Science & Technology, Government of India, to serve as its interface agency to promote industry-academia interface, BIRAC is a Section 8 "Not-for-profit Company" under the Companies Act, 2013. The mandate of BIRAC is to nurture and empower the biotech innovation ecosystem and transform all elements of the nascent biotechnology industry systems. A Schedule 'B' Public Sector Undertaking, BIRAC is guided by an independent Board of Directors comprising of senior scientists, academicians and policy makers and industrialists.

To serve various dimensions of its mandate, BIRAC operates mainly in 3 verticals. Investment schemes provide funding support to academia, entrepreneurs, start-ups, SMEs and Biotech Companies for all stages of the product development value chain from discovery to proof of concept to early and late stage development to validation and scale up, right upto commercialization. There are also few special product development missions. The second vertical is Entrepreneurship Development which focuses not only on the funding support, but also on making available the right infrastructure, mentoring and other networks for technology transfer and licensing, IP and business mentoring including regulatory guidance. Lastly BIRAC's Strategic Partnership group works closely with all partners – national and international, which includes Government departments and Ministries both Central and State, industry organisations, international bilateral agencies, philanthropic organisations and corporate sector, to leverage the strength and expertise and mobilize resources and extend the outreach of its activities.

Vigyan Se Vikas

Science and Technology (S&T) are key drivers to the development of a society leading to its economic advances, improvement in health systems, education and infrastructure. Products and technologies from different sectors of S&T are transforming business practices across the Indian economy, as well as the lives of those that it is meant for. The Indian government is continuously framing and improving policies that are specifically aimed at projecting India as S&T powerhouse. Initiatives such as the Science, Technology, Innovation and Creation of Knowledge (STICK) framework is a proof of Indian government's support for innovation.

The Indian biotechnology sector is one of the fastest growing knowledge-based sector, rather the sunrise sector, in India and is expected to play a key role in shaping India's rapidly developing economy. DBT and BIRAC are constantly making efforts to improve the Indian Bio-Innovation ecosystem. The Government aims to scale-up the number of start-ups in biotechnology sector to 2,000 over next three years. 4 new bio-clusters and 31 bio-incubators have also been set up across India enabling the development in innovation landscape of the country.

BIRAC's mandate of building the Indian Biotech Ecosystem is grounded in enabling and empowering innovators through inculcating the culture of nurturing and openness. The success of biotech product innovation needs targeted support. Nurturing risky projects and handholding them through the uncertain phase, are crucial for moving innovation forward.

Technological convergence should be of utmost priority for bringing the most remarkable breakthroughs in this sector. Doing business in India has never been as easy as it is today with continuous improvement being made in both policy and ecosystem. With numerous comparative advantages in terms of R&D facilities, knowledge, skills, and cost effectiveness, the biotechnology industry in India has immense potential to emerge as a global key player and contribute to the development of society as a whole.

We are today poised to bring about a truly transformational revolution of "Vigyan Se Vikas".

BIRAC Innovations: Vigyan Se Vikas

The budding and escalating Indian biotechnology sector is one of the fastest developing knowledge-based sectors, considered as the sunrise sector and is expected to play a pivotal role in shaping India's rapidly developing economy. The Government has setup 4 new bio-clusters and 31 bio-incubators across India and aims to scale up the number of start-ups in biotechnology sector to 2,000 over next two years to enable the development in innovation landscape of the country. India is on operation mode to achieve $100 billion Bio-economy target by 2025. India's bio-economy is concentrated on the following sectors, Bio-Pharma and Healthcare, Bio-services, Bio-Agri, Bio-Industrial and Bioinformatics and System Biology. There is serious demand to bring about a truly practical and realistic transformational revolution of "Vigyan Se Vikas". BIRAC is constantly putting efforts to improve this Bio-innovation ecosystem.

India is full of talented innovative minds, manpower and resources which can soup up the Bioeconomy with cutting-edge research for developing new technologies and exploring start-up ecosystem. Academia-Industry collaborations is likely to play a key role in this Strategic partnerships to ensure the growth of Indian economy. BIRAC with its vision to stimulate, foster and enhance the strategic research and innovation capabilities of the Indian biotech industry, particularly start-ups and SME's, has been playing an enabling role in this mission.

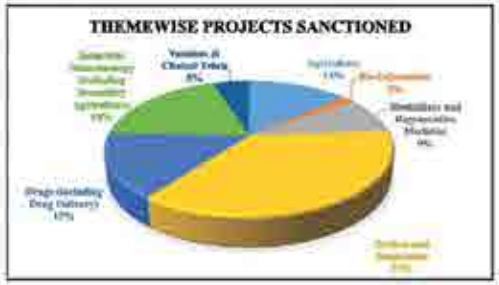
The mandate of BIRAC is to nurture and empower the biotech innovation ecosystem. To serve its mandate, BIRAC operates mainly in 3 verticals, Investment schemes, Entrepreneurship Development and Strategic Partnerships. BIRAC provides support at all levels of the product development chain through its various funding schemes.

- Proof-of-concept studies are supported under Biotechnology Ignition Grant (BIG), Social Innovation programme for Products Affordable & Relevant to Societal Health (SPARSH), Industry Innovation Programme on Medical Electronics (IIPME) and Academic Innovation Research (AIR),
- Validation studies are supported under Small Business Innovation Research Initiative (SBIRI), Biotechnology Industry Partnership Programme (BIPP) and Contract Research Scheme (CRS)
- Scale-up of the technology is supported under BIPP

In order to empower and support entrepreneurs and start-ups, BIRAC has supported 31 Bio-incubators under which 3,37,000 sq. ft. incubation space has been created. In addition to this, 3 Regional Entrepreneurship Development Centres at Venture Centre (Pune), C-CAMP (Bangalore) and IKP (Hyderabad) have been set up. BIRAC is facilitating access to research resources by establishing infrastructure, providing IP and Technology Management services and mentoring support through its panel of subject matter experts and workshops. Recently, Regulatory facilitation cell (FIRST HUB) has also been set up at BIRAC whose mandate is to provide guidance to innovators in regulatory aspects.

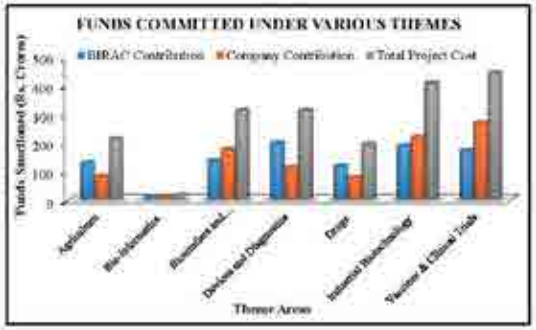
The impact that BIRAC has created in the past 6 years has been remarkable. A total of 650 beneficiaries have been supported by BIRAC through more than Rs. 900 crores worth of funding. This has resulted in the development of 130 products and technologies and 165 new IPs. BIRAC funded projects have generated employment for more than 2000 people and 163 Women entrepreneurs have been supported. The list of ongoing projects is available at **http://birac.nic.in/projects.php**.

Proposals funded by BIRAC are categorized under 7 broad thematic areas which include Agriculture (including Aquaculture & Veterinary Sciences), Bioinformatics, Biosimilars & Regenerative Medicine, Devices & Diagnostics, Drugs (including Drug Delivery), Industrial Biotechnology (including secondary agriculture) and Vaccines & Clinical Trials. Considering the theme-wise distribution of the sanctioned projects, it is observed that the majority of the projects (37%) falls under the theme Devices & Diagnostics followed by Industrial Biotechnology (19%), Drugs (15%) and Agriculture (13%). Other thematic areas like Biosimilars and Regenerative Medicine, Vaccines & Clinical Trials and Bioinformatics account for 16% of the total sanctioned projects.



However, a different trend is observed while comparing the funds sanctioned to different thematic areas by BIRAC till date. The projects under "Vaccines and Clinical Trials" have taken maximum share followed by "Industrial Biotechnology", "Devices & Diagnostics" and "Biosimilars & Regenerative Medicine". It is also important to note here that thematic areas "Devices & Diagnostics" and "Industrial Biotechnology" also have larger number of projects that have been sanctioned by BIRAC.

Another important observation is made when the trend in intellectual property (filed/generated) is compared in different thematic areas. The trend conforms to the number of projects sanctioned under the theme area. The highest number of IP has been filed under Devices & Diagnostics (46%) followed by Industrial Biotechnology (21%) and Drugs (17%). The IP filed/ generated is a good measure of the success of the project and is an important factor that should be considered while assessing the market potential of the product/ technology that have been developed. Accordingly, the number of IP generated confirms the success of BIRAC funded projects in the area of "Devices & Diagnostics".



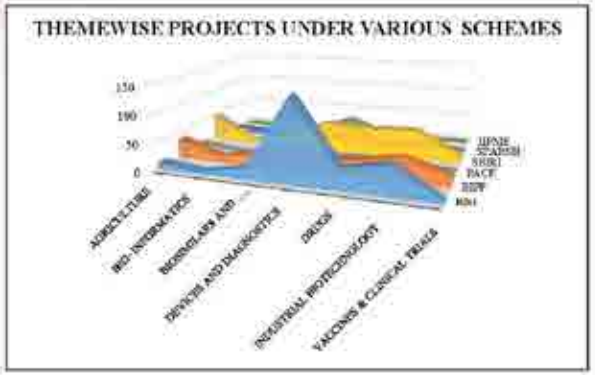
BIRAC has been supporting the entire life cycle of the product/technology development right from the ideation stage till pre-commercialization and has played an instrumental role in shaping the biotechnology ecosystem. This has been achieved through various investment schemes which are designed to specifically fit the product/ technology life cycle.

Various schemes like BIG (ideation stage), SBIRI (early-stage validation), BIPP (late stage validation), PACE (translational research), SPARSH (social innovation) and IIPME (in collaboration with MIETY specifically for medical electronics) have been introduced to cater the dynamics of biotechnology sector.

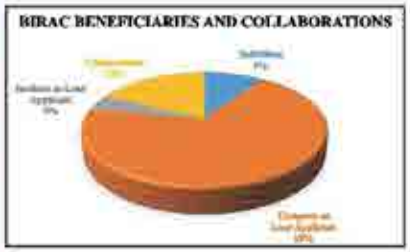
Comparing the distribution of various themes under each scheme, it is observed that BIG scheme which supports the ideation stage and is open for individuals and start-ups, have large number of projects from Devices and Diagnostics. Similarly, SPARSH scheme has the highest representation of this theme.

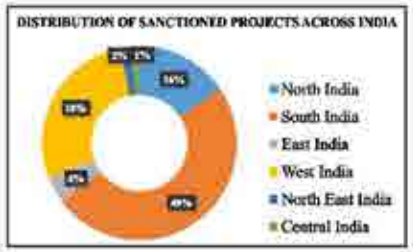
PPP investment schemes SBIRI and BIPP attracts small and medium enterprises and industries and have uniform distribution of these thematic areas. For instance "Agriculture" based projects are best represented by these two schemes. BIPP caters to the high risk projects and thus have good number of projects from "Biosimilars & Regenerative Medicine" and "Vaccines & Clinical Trials".

Lower capital cost, defined regulatory requirements and short gestation period can be the reasons attributed for larger preference of young entrepreneurs for "Devices & Diagnostics" thematic area.



BIRAC through its large array of schemes have encouraged a lot of industries to get actively involved in biotechnological research that can be observed while studying the composition of different BIRAC beneficiaries. Academic institutes have gained momentum in showing an increasing trend of involvement towards translational research by forming collaborations with industries.





Region wise distribution of sanctioned projects under various schemes shows that the majority of the companies/entrepreneurs (49%) are from South Indian states namely Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana and the union territory of Puducherry with Karnataka and Andhra Pradesh being the major hubs. Western Indian states (Goa, Maharashtra, and Rajasthan) have 28% of the total projects sanctioned by BIRAC which is same as that of last year. However, compared to the last year's figures projects sanctioned to North Indian states namely Delhi, Haryana, Punjab, Himachal Pradesh, Uttar Pradesh have shown an increasing trend representing about 16 % of the total projects sanctioned. East and North-Eastern states represent 6% of the share of total projects sanctioned by BIRAC and is expected to increase further owing to increased outreach activities being conducted by BIRAC.

In a nutshell:

Recognition for BIRAC Startups & SMEs

Several BIRAC supported startups and SMEs have received recognition from other national and international agencies for their products and technologies.

1. **Windmill Health Technologies Pvt. Ltd., New Delhi** won the BIRAC National Award for Indigenous Product Commercialization on the occasion of Technology Day event on May 11th 2017 at New Delhi.
2. **Pandorum Technologies Pvt. Ltd, Bengaluru** received the innovator award at the ET start-up award 2017.
3. **Bugworks Research India Pvt. Ltd., Bengaluru** featured in the list of top 30 start-ups for 2017 in Indsight India and won a global grant from CARB-X.
4. **Module Innovations and Embryyo Technologies** won the discovery award round 2 of Longitude Prize funded by Merck
5. **String Bio Pvt. Ltd, Bengaluru** bagged a US$ 100,000 grant at the inaugural Future Food Asia Award
6. **Achira Labs Pvt. Ltd, Bengaluru** raised investments from Catamran Ventures.
7. **Amrita Vishwa Vidyapeetham** and **Wipro** jointly won the Aegis Graham Bell award 2017 for "Innovation in mHealth" category for first of its kind and cost effective Diabetes management solution.
8. Dr Vanita Prasad, Founder & Director **REVY Environmental Solutions Pvt. Ltd** has won the following awards:
   - Adjudged a winning solution under the category of 'Low energy and cost effective sustainable solutions for wastewater treatment' in the recently held India-Israel Innovation Challenge 2017 and the felicitation was held at iCreate, Dev Dholera on 17th Jan'18 with PM India and PM Israel in attendance.
   - REVY Environmental Solutions Pvt. Ltd has received "Smart Fifty Award" conferred by Department of Science and Technology, Government of India and IIM Calcutta Innovation Park for the development of innovative solution in waste water treatment space.
   - An award for "Iconic Women Creating A Better World Award" Conferred to Dr. Vanita Prasad during Annual International Women Economic Forum 2018 held from April 26th to 1st May, 2018 at New Delhi on the theme of "The Economics of Goodness: Empowering Potential, Engineering Change".
9. **Kornerstone Devices** won the Gold Award in the Medicall Innovation Awards 2017
10. **Oraxion Therapeutics**, a spin-off from BIRAC supported Aten Porus Lifesciences has entered into an "option to license" agreement for US $125 million with a US-based biopharma company to licence its drug ORX-301 for the treatment of rare diseases.
11. **Aindra Systems** won the RICH Cancer Innovation Challenge conducted by the Telangana Government in August 2018.
12. **Cutting Edge Medical Devices Pvt Ltd.** received following awards:

- "Most Promising Start-up of Madhya Pradesh (Technology Sector) 2016" on 12th August 2017 by FMPCCI award conferred by the Honourable Chief Minister of Madhya Pradesh.
- Second Prize in National Startup Summit in India International Science F Organised by Department of Science and Technology, Govt of India, AICTE, NIOT and Vigyan Bharti.
- Winners of innovation and Entrepreneurship based reality show on CNN News 18 called PULSE THE VENTURE, Winner gets a trophy and Rs. 1,00,00,000/- as an investment the program was aired on CNN News18 on 23rd December 2017.
- Among TOP 50 in the SMARTFIFTY Program by DST and IIM Calcutta Innovation Park
- MILLENNIUM ALLIANCE GRANT of Rs. 30,00,000/- for the product development and community based clinical trials. Grant given by Millennium Alliance an Alliance between Department of Science and Technology, USAID, DFID-UK Government, World Bank Group and Facebook

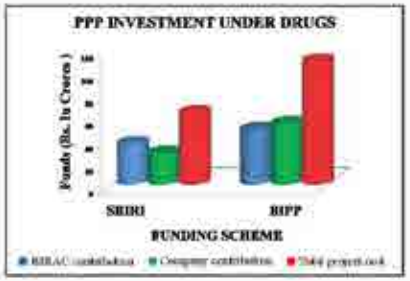
13. **Janitri Innovations Pvt. Ltd.** has received following awards and recognitions:
    - Supported by Bill and Melinda Gates Foundation (GCE) (100,000 USD)
    - Got selected for Qualcomm Design India Challenge 2018 (Total 15 Startups)
    - Got selected for Techemerge Brazil (total 30 healthcare companies from across the globe), An Initiative by IFC (World Bank Group)
    - The 10 Most Admired Medical Device Companies in 2017
    - Top 8 innovators of ASME iShow 2017 India
    - Published on yourstory and factordaily
14. Prof. M. Manivannan **(Merkel Haptic Systems Pvt Ltd)** was awarded "Fellow of IMSA" by the International Medical Sciences Academy at the Royal College of Physicians and Surgeons, Glasgow, UK on 25th Aug 2018, for developing affordable next generation Medical Training systems using Virtual Reality and Haptic technologies.
15. **Periwinkle Technologies Pvt. Ltd.** received following awards and recognition:
    - Winner of the Capital First social impact award - Dec 2017
    - Finalist at the TISSI'preneur competition - Dec 2017
    - Winner of the Villgro iPitch national competition - Feb 2018
    - One of the winners of the global business development support by Xir8AP and IC2 Institute, UT Austin - Feb 2018
    - Invited by the Duke of York to represent India at the Pitch@Palace Commonwealth - Apr 2018
    - Recognition in media - several newspapers, social media (YourStory, VCCircle etc) and TV channels such as CNBC, eTV
16. **Sensivision Health Technologies Pvt. Ltd.** was among the top 50 finalists of India Innovation Growth Program (IIGP) 2.0 conducted by DST, Lockeed Martin and Tata Trusts.
17. **Jeevtronics Pvt Ltd.** was among the finalists at Pune International Center's NSCI conference
18. **Aarna Biomedical Products Ltd** (Product: Poorti) won the India Innovation Growth Programme (IIGP 2.0) – 2018 in social innovations category.
19. **Dr. Shalini Gupta (NanoDx)** won the Nesta Longitude prize UK with an award money of 25000 GBP.
20. **Prantae Solutions** (Dr. Sumona Karjee) - Received award as 40 under40 from The New Indian Express Group
21. **CyCa Oncosolutions Pvt. Ltd.** (Dr. Nusrat) - Won the National Award for development of Technology having Commercialization Potential Winner of Best innovative product - Rubicon's Award, Ireland
22. Milind Chaudhari, **Wainnovate Biosolutions Pvt. Ltd.** won AABI torch award for Internationalizationfrom Asian association of Business Incubators, Shanghai, China.
23. Sachin Dubey, **Module Innovations Pvt. Ltd.** won "Design: Impact Awards for Social Change" in collaboration with Tata Trusts
24. **Innaumation Medical Devices LLP** AUM voice prosthesis. Dr. Vishal Rao featured in Harvard Business Review as 3 Entrepreneurs Who Made It Their Mission to Lower Health Care Costs

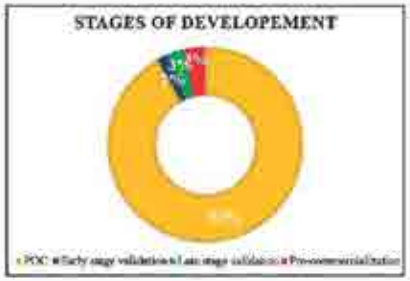
Theme Wise Assessment

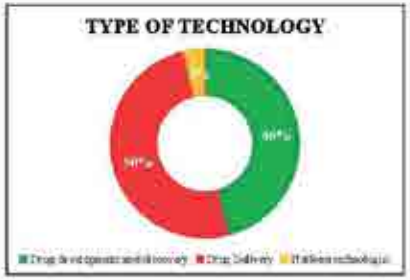
Drugs (Including Drug Delivery)

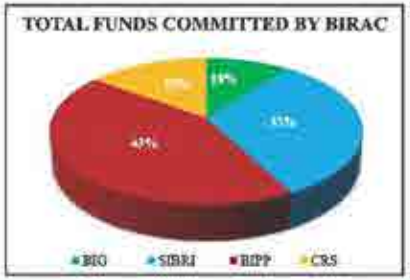
The contribution of BIRAC in drug development, drug delivery and platform technologies is associated with funding 109 projects. The funding to drugs sector focuses on development and validation of affordable technologies and products with a view to reduce their cost, increase their availability and accessibility to the society. The projects supported under drugs mainly deals with the indications such as Cancer, metabolic disorders, wound management, infectious diseases, inflammation and Neurological disorders etc. Maximum number of projects supported under drug delivery are for generating proof of concept. The platform technologies have been developed for drug screening, validation and target based assays. Few successful outcomes during last few years are Fibro gel, c-Met kinase inhibitors, clinical investigation of Galnobex® for the treatment of diabetic foot ulcer, novel inhibitors of fatty acid biosynthesis for the treatment of drug resistant S. aureus bacterial infections and technology for synthesizing drug glucuronides and their deuterium labelled analogs. Other successful projects from last year include identification of preliminary hits of DNA gyrase inhibitors which showed potent activity against E.coli & Acinobactorare and ORX-301 for Niemann-Pick Type C disorder. A Facility is developed in which 214 phyto chemical reference substances (PRS) from Indian medicinal plants have been isolated & characterized with 95% purity and commercialized nationally and globally. Another technology is developed for targeted insertion of a foreign gene at safe/ neutral genomic locus and has been validated in 6 cell lines, including primary cells.

Total PPP investment under this area amounts to Rs. 186 crores wherein BIRAC has invested Rs.114 crores for supporting 118 innovative projects. These 118 projects engaged 61 companies, 21 start-ups, 10 entrepreneurs and 29 academic institutes. Till date, a total of 9 products/technologies/PoC and 28 Intellectual property have been generated from this sector.



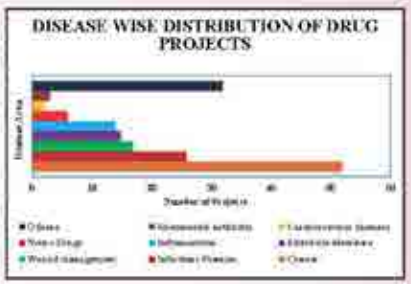






Analysis:

- BIRAC contribution is slightly more in BIPP compared to SBIRI as well as company contribution is more in BIPP indicating enabling role of BIRAC in catalyzing large scale innovation and company interest in this area.
- Many of the projects are for developing proof of concept.
- Collaborations are not that evident and may be encouraged for successful outcomes in this area
- Maximum number of projects have been supported in the area of cancer followed by infectious diseases, wound management, metabolic disorders, inflammation, neurological diseases, cardiovascular diseases, RA and other drug delivery.



- Drug delivery and development of platform technologies are also taking some share in addition to drug development.

Biosimilars & Regenerative Medicine:

India, being one of the fastest growing economies, (with a current growth rate of ~ 7.5% in 2017-18), is likely to reclaim the position in 2018, with growth expected to accelerate to 7.3% in the year, according to the World Bank's Global Economic Prospects report. The Indian healthcare industry has become one of India's largest sectors both in terms of revenue and employment and the market is expected to record a CAGR of 16.28 per cent by 2022. It is expected that the healthcare market can increase three fold to Rs 8.6 trillion (US$ 133.44 billion) by 2022. To provide a safe and cost effective drugs for its huge, non-insured population remains the main goal to be achieved.

The launch of different biosimilars in the country serves the primary motive of making the critical drugs affordable to the people, as in most cases the innovator biological drugs were beyond reach. Biosimilars are the biological medicinal products that comes into the picture, once the patent for an existing biological originator product has expired. Under the area of regenerative medicine, several national and transnational linkages have emerged to develop innovative capacity, most prominently in stem cells and cord blood banking, as well as in gene therapy, tissue engineering, biomaterials and 3D printing. However, challenges remain of achieving regulatory oversight, viable outputs and equitable impacts. Governance of private cord blood banking, nanomaterials and 3D bio-printing requires more attention.

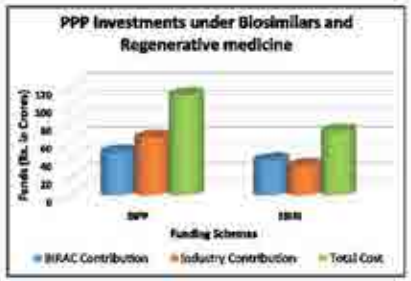
The global biosimilars market was estimated to be valued at USD 3,474.01 million in 2017, and is expected to register a CAGR of 43.85% during the forecast period of 2018-2023. Currently Indian Biosimilar market is 2-3% of Global. There is a huge opportunity to Capture Global market of Biosimilars. Similarly the worldwide regenerative medicine market was estimated at USD 13.41 billion in 2016, and is forecast to be worth reach USD 38.70 billion by 2021, expanding at a CAGR of 23.6% from 2016 to 2021. In India it has grown exponentially as the country has invested in advancing research and commercialisation of regenerative medicines through several initiatives.

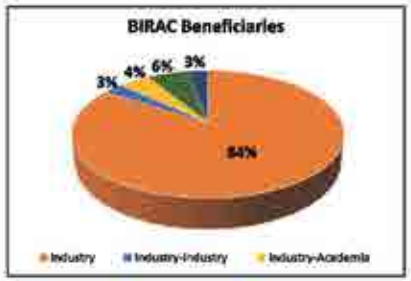
Keeping in view, the importance of the area of Biosimilars and Regenerative Medicine, BIRAC has supported a total of 69 projects till date. The supported projects along with the development of biosimilars, stem cells for different indications scaffolds also include the process development of existing products in this area with a scope of increasing the present market share/output in the country. The projects address diseases like Cancer, Diabetes, Inflammatory diseases, Alzheimer's and platform technologies for producing monoclonal antibodies. In the field of regenerative therapy the projects that have been considered for funding include the process development for isolation and expansion of different types of stem cells and establishing their efficacy in different disease conditions like osteoarthritis, diabetic foot ulcer and urethral stricture.

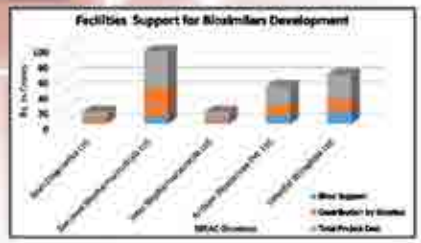
Total investment under this area, amounts to Rs. 193.53 crores wherein BIRAC alone has invested Rs. 97.11 crores for supporting 69 innovative projects. These supported projects engaged 60 companies including Start-ups, 4 individuals and 7 academic institutes (alone as well as in partnership with industries).

Till date, a total of 12 products/technologies/PoC have been developed and five intellectual properties have been generated in this sector.

Follignf for reproductive technology is the first recombinant FSH product developed, manufactured and sold by an Indian Company (BHART SERUM & VACCINES). Rasburicase to control Hyperuricemia under trade name TULY is a recombinant Uricase to control hyperuricemia in cancer patients undergoing chemotherapy developed by VIRCHOW BIOTECH and with number of units sold 27,570. The company is also being funded for clinical grade plasma purified Alpha-1 Antitrypsin and C1- esterase Inhibitor. Affigenix Biosolutions Pvt. Ltd. has developed an immunoassay which enabled drug companies to monitor the clearance of trypsin used in the downstream processing of Biologics and Biosimilars. The kit has been commercially launched as "Trypsin clearance assay kit" and more than 200 kits already sold. In the field of regenerative medicine, a multi-centric clinical trial for evaluation of safety and efficacy of UregrowTM (Autologous Adult Live Cultured Buccal Epithelial Cells) implantation for the treatment of urethral strictures has been successfully conducted.







With an intention to offer a full range of GMP and bioanalytical lab and other development services, which support a seamless approach to biosimilar drug development by different start-ups, companies, and institutions, BIRAC has also supported facility development which includes bioprocess facility for large-scale production of microbial antigens and monoclonal antibodies, facility for high end structural and functional characterization of protein therapeutics and Scale-up facility for plasma fractionation for high value products. Total project cost under facilities development amounts to Rs. 119.314 crores wherein BIRAC has invested Rs. 40.211 crores.

Analysis:

- BIRAC and Industries both are contributing almost equivalent funds for the projects under Biosimilars & Regenerative Medicine.
- Industries including Start-ups alone are pursuing maximum number of projects in this area without any collaboration with Academia or other Firms. Collaborations (either Industry-Industry or Industry -academia) may be encouraged for successful and timely outputs and to involve more expertise in the respective projects.
- Maximum number of projects funded are at Proof of Concept stage followed by early stage validation, late stage validation and Pre-commercialization.
- BIRAC is implementing a Mission Program for Accelerating Discovery Research to Early Development for Biopharmaceuticals (National Biopharma Mission).

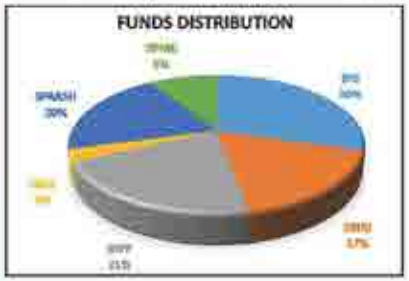
Devices & Diagnostics

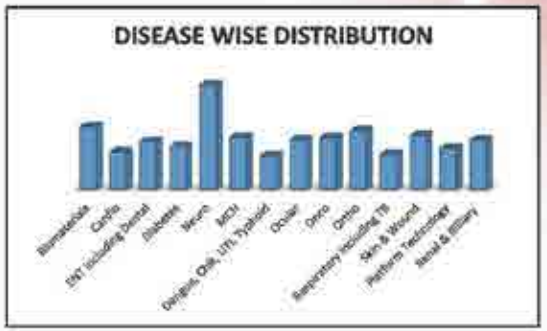
The Medical Devices industry in India is presently valued at USD 5.2 billion and contributes 4-5% to the USD 96.7 billion indian health care industry. Currently, India has about 750–800 medical device manufacturers in the country, with an average investment of Rs 170–200 million and an average turnover of Rs 450–500 million.

The industry has steadily grown and witnessed a surge from USD 2.02 billion in 2009 to USD 3.9 billion in 2015 at a Compound Annual Growth Rate (CAGR) of 15.8%. As per industry estimates, the Indian medical devices market will grow to USD 50 billion by 2025.

In the last two decades, the Medical Devices Industry has undergone a transformation - from being a non-regulated sector, prior to 2006, to regulation of 15 notified devices as per the new Medical Device Rules announced in 2017.

Indian government is making serious efforts to boost domestic manufacturing of medical devices and there are a range of Medical Device Clusters that have emerged due to supportive state-level policies as well as the availability of skilled labour. There are a few Medical Device Parks planned across India, including Andhra Pradesh MedTech Zone Limited (AMTZ), a park in Sultanpur Village (Telangana) and HLL Lifecare Mediparks in Tamil Nadu, Maharashtra and Gujarat. (Source: Sector Survey: Medical Devices. Make in India)





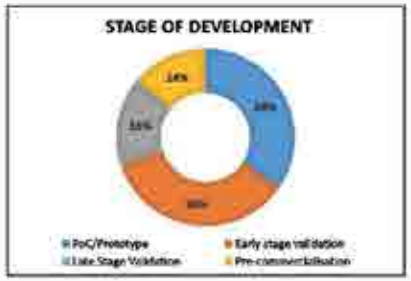
BIRAC along with Country has witnessed a positive wave of developments in the devices and diagnostics sector over the year. Lot of young individuals have ventured into the sector and started their entrepreneurship journey. BIRAC also promoted the "Make in India" "Start Up India" and Invested around INR 235 Cr in Devices and Diagnostics through its flagship schemes.

345 Individuals, Entrepreneurs, Startups, SMEs and Companies are supported for development of Innovative Products/Technologies by BIRAC through its various programs. Out of these 238 projects are submitted solely by Companies or Individuals and 107 as collaborative projects. The collaborative projects account for 40 % of the total projects supported.

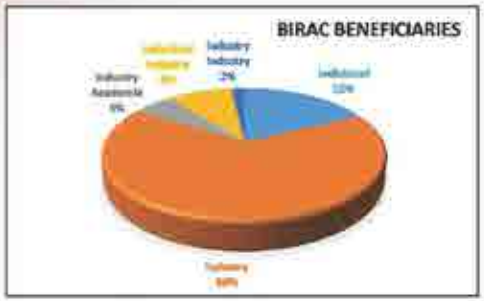
As per the analysis of BIRAC funded projects, maximum interest is observed in the area of neurological disorders. The projects supported range from diagnostic instruments for Parkinson's, kits including imaging devices and prognostic biomarker based assays, radiology based detection to surgical therapeutic equipment. The latest trend this year is for personal wearable customized IoT based devices. The interoperability of the devices is the hottest trend amongst the young entrepreneurs. The devices and diagnostics sector has seen maximum number of patent filing. 76 patents are filed by various companies for innovative technologies.

BIRAC supported technologies range from handheld PoC devices to high end Diagnostic Imaging devices and surgical Instruments. Neurology, Biomaterials, Skin & wounds, Ortho, Oncology, ophthalmology and Maternal and Child Health has witnessed maximum number of projects. Orthopedics, Biomaterials, Implants and hospital consumables are few latest attractions which are high on market demand.

BIRAC is successful in supporting around 40 start-ups and individuals and helping them to achieve TRL – 9 i.e 40 products are commercialized till date with the help of BIRAC support. 47 technologies are currently under late stage validation and have achieved TRL 7 through BIRAC support, guidance and networking connections.



BIRAC has organized various hands on training events, Ideathon, hackathon to support pipeline generation for the BIRAC flagship programs. Currently, most of the projects are under prototype development phase and going through initial stages of product development cycle. The area witnessed maximum number of successful projects as compared to other areas. This could be because of low gestational period, high market demand and recent initiatives and policies of Government.



Some of the challenges associated with this sector include need of Designing, fabrication, prototyping and validation facilities. Identification of clinical partners and connecting with right hospital network. BIRAC is also trying to build the ecosystem of partnerships and collaborations through various schemes. It is encouraging to see that the academia and industry are collaborating in many disciplines and complimenting each other for the success of project. The collaborations are helping all the stakeholders to cross the "Valley of Death". It is observed through various projects that Collaborations are key to Success.

Analysis:

- The new Medical Device Rule 2017 is implemented from 1st Jan 2018. The new set of regulatory practices aims to remove regulatory hurdles so as to prepare India to meet the Medical devices sector requirements.
- Some of the challenges associated with this sector include need of Designing, fabrication, prototyping and validation facilities. Identification of clinical partners and connecting with right PI and hospitals.
- BIRAC is successful in facilitating 40 start-ups to achieve TRL – 9.
- Neurology, Biomaterials, Skin & wounds, Ortho, Oncology, ophthalmology and Maternal and Child Health has witnessed maximum number of projects.
- The latest trend this year is for personal wearable customized IoT based devices.
- Maximum number of projects are supported for the development of instrument and equipment.
- More projects are for early stage validation followed by proof of concept development.

Vaccines & Clinical Trials:

Vaccines

Immunization is the process of one's immune system fortifying itself against attacks by foreign antibodies. When we sniff dust, we sneeze. It is with the way the immune system functions. When the body senses any agents of a foreign nature, it responds with a solution to get rid of the agents. When it finds the right formula, it stores that information for 'when there is a need to find a solution again', but this time much quicker than the earlier. This is called immunological memory. Thus, when you expose one to a strand of virus or foreign agent in controlled conditions, the body quickly learns to adapt and defend itself from future attacks. This is called active immunization.

Because of advances in medical science, your child can be protected against more diseases than ever before. Some diseases that once killed thousands of children, have been eradicated completely and others are close to extinction–primarily due to safe and effective vaccines. Eradication of Polio is one example of the great impact that vaccines have shown in India.

Parents want to do everything possible to make sure their children are healthy and protected from preventable diseases. Vaccination is the best way to do that.

Investing in disease prevention today reaps health, economic, and societal benefits in the future. As a nation, it is critical that we continue to invest in programs that support our children's wellbeing, like nutrition, handwashing, sanitation, and immunization. Vaccines are a smart investment, as vaccine-preventable diseases impact so many parts of our lives. Not only does immunization save lives, but it also prevents the devastating costs of hospitalization that may throw families into poverty or exacerbate inequalities.

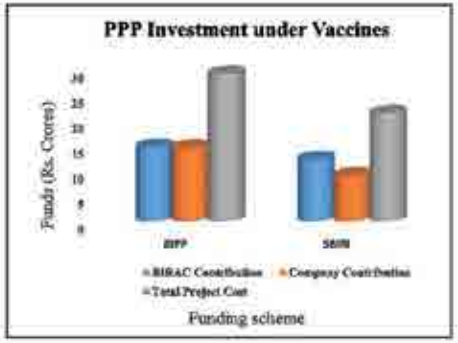
Having realized this, BIRAC supported a total of 21 projects for Vaccine development till date and the number is increasing continuously as well as investment. National Biopharma Mission launched by BIRAC is an example of investment towards the vaccine development. BIRAC Vaccine development efforts touches many life threatning diseases like Diarrhoea (Rotavirus), Cervical Cancer (HPV), Pneumonia, Influenza, Rabies, Meningitis, Parasitic diseases like Malaria and Leishmaniasis. BIRAC also supports vaccine development for Animals: supporting Marek's Disease Vaccine, PPR vaccine, Brucellosis and vaccines again fatal virus Paro virus in Dogs. Few of them are already in clinical trials and few are in their early stages of development. Rotavirus vaccine (ROTAVAC) is an excellent example of BIRAC support which started its journey right from the establishment of proof of concept to clinical trials and it has now been included by Government of India in National Immunization program.

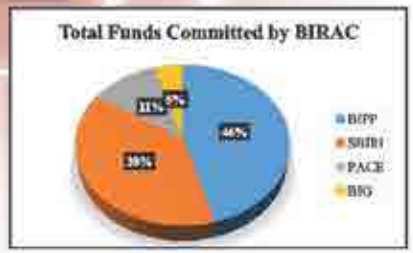
Total PPP investment under this area amounts to Rs. 56.17 crores wherein BIRAC has invested Rs. 32.41 crores by supporting 21 innovative projects. These 21 projects engaged 14 companies, 1 individual, 2 start-up, and 4 academic institutes.

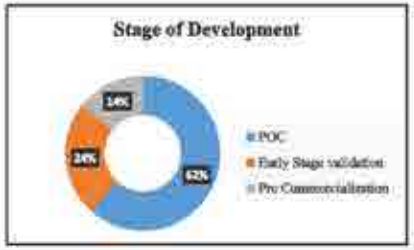
Two Products i.e. Influenza Vaccine & Vaccine for Marek's Diseases is ready for Commercialization. One project completed pre-clinical trial study and ready for Clinical trials while one project on animal vaccines is ready for challenge study. Besides new vaccine development, three process/technologies have also been developed in the area of Vaccines which are as follows:

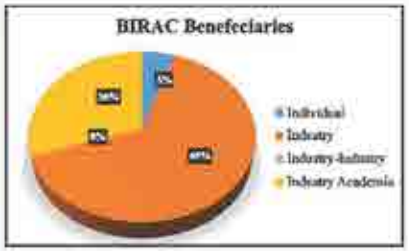
- New process for the production of thermo stable freeze-dried Brucella abortus strain 19 Vaccine for veterinary use.
- A novel technology for producing peste des petits ruminants (PPR) vaccine in suspension culture instead of adherent culture.
- eSAME technology that can be used to produce Virosomes (custom designed non-replicating measles viruses) for vaccines and viro-therapeutic agents which is currently being used for the development of Dengue Vaccine.

Making India a hub for design and development of novel, affordable and effective biopharmaceutical products and solutions BIRAC launched National Biopharma Mission (A collaborative mission of DBT and World Bank). One of the major goals of the mission is development of vaccines. The main target of the mission is to come with atleast 2-3 Vaccines closer to market in five years. The target vaccines are HPV, Dengue and Pneumococcal. Other than these three, Vaccines of National relevance are also being supported in this mission.









Clinical Trials:

Health is the measurement of development and "good health is the measurement of economic progress, an indicator of society's human resources, which is the primary objective of development." There exists a disproportionally low investment in health research in developing countries compared to their health disease burden.

Clinical trials are needed globally to reduce disease burden by helping in development of safe and effective new therapies, biosimilars and vaccines. As a research tool, clinical trials are fundamental in the effort to develop new products by gaining the data required by regulators, whether for product license extensions, for existing therapies, for common ailments, or to bring cutting-edge new therapies and vaccines into approved use. These solutions may be for non-communicable diseases such as cancer and diabetes, or, as is especially needed in the developing regions of the world, infectious diseases. With the evolution of India's disease burden as well as its pharmaceutical industry, the need for clinical trials has increased manifold.

BIRAC has made considerable progress in nation fight against several diseases, and supported clinical development of 23 innovative products which are currently at various stages.

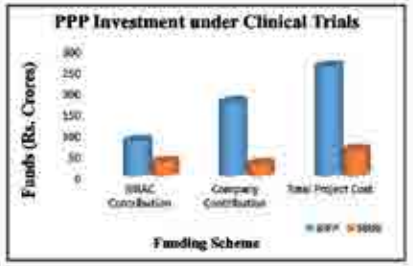
Total PPP investment under this area amounts to Rs. 324.98 crores wherein BIRAC has invested Rs. 121.58 crores by supporting 23 innovative projects. These 21 projects engaged 15 companies, 2 start-up, and 2 academic institutes.

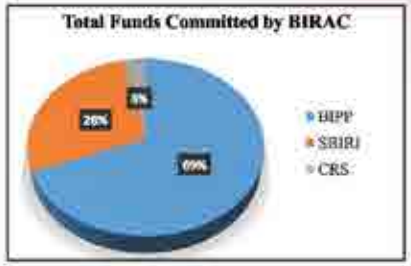
Three Vaccines; Rotavirus vaccine (ROTAVAC), JE vaccine (JEEV) and H1N1 pandemic influenza vaccine (Pandyflu) have resulted from BIRAC funded projects and are in market. ROTAVAC has also been included by Government of India in National Immunization program; market license has been obtained for JEEV in India for the age group of >1 year to < 3years and a total of 1,18,480 doses of Pandyflu vaccine have been supplied to Government of India in the year of 2011.

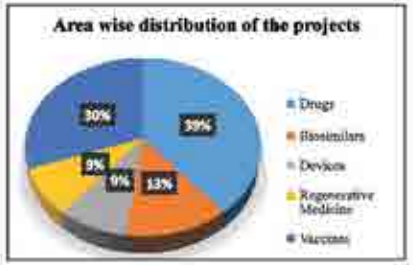
Two Biosimilars; First recombinant FSH product (Foligraf) and Rasburicase (Tuly) are the biosimilars which are in market developed with BIRAC support. Foligraf contains urofollitropin that is a purified form of follicle stimulating hormone (FSH) and is important in the development of follicles produced by the ovaris. First recombinant FSH product developed, manufactured and sold by an Indian company. Rasburicase to control Hyperuricemia under trade name TULY is a recombinant Uricase to control hyperuricemia in cancer patients undergoing chemotherapy and developed utilizing an innovative & economical production process.

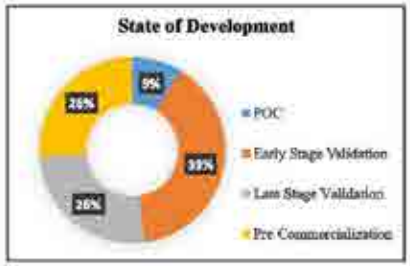
BIRAC also supported clinical trials of Devices; L605 Stents are developed through BIRAC support and is low cost ; self-expendables Stent Technology. Cobal+C is bare metal stent with a cobalt chromium coronary stent system. It is made up of cobalt chromium alloy L-605. The strut thickness is 73 µm. The average foreshortening is less than 11% and average recoil is less than 5%.

Two Products i.e. Influenza Vaccine & Vaccine for Marek's Diseases is ready for Commercialization. One project under PACE scheme completed Phase 1 Clinical trial and ready for the next phase.









Analysis:

- Industry Contribution is more in the projects supported under Clinical Trials while it is almost equal for the vaccine development.
- Industry is preferring to develop vaccines independently. Collaborations may be encouraged.
- Few of the projects are at developing proof of concept while others are at preclinical or scale-up stage.
- There is a good spread of projects among different indications although diabetes, pneumococcal, HPV, influenza and animal vaccines top the list while drugs for Diabetes & Biosimilars are supported more for Clinical Trials.
- Companies have invested more than Govt. for Clinical Trials of the products.
- Vaccines & Clinical trial projects may be supported more, through special calls, and monitored closely for successful outcomes.

AGRICULTURE

Agriculture is a potent resource for promoting sustainable development and reducing poverty in the 21st century. However, it requires a widening and perpetually changing array of knowledge and innovation to meet the diverse needs of the world's growing population and to resist or mitigate the effects of climate change. The forces that generate knowledge and drive innovation in agriculture will also continue to change. Agricultural development is now driven less by production than by the forces of markets, urbanization, globalization, and shifting patterns of consumption, competition, and trade rules. The scope for technical innovation in agriculture continues to widen with advances in biotechnology. Information and Communications Technology (ICT) and the private sector significantly influence the production, use, and dissemination of knowledge. Reforms directed at agricultural research, education, and services often considered the centre of innovation in the agricultural sector -have begun to make a difference, despite underinvestment in agricultural research and development.

In totality, a broad range of service providers (the public sector, private sector, farmer organizations, and others) have become relevant to the process of agricultural innovation. The importance of facilitating these services is clear. The challenge is to create sustainable mechanisms that will promote the creation, development, diffusion, application, and overall commercialization of knowledge and technology in a socially inclusive manner.

Over the years, BIRAC has supported close to 113 projects in the field of agriculture and allied areas. Recombinant DNA technology, marker assisted selection, and tissue culture are some of the key technologies wherein a sizable number of projects have been supported (Fig 1). Besides funding research studies involving high technological merit such as Agri-nanotechnology, and Agri- diagnostics, several projects related to Agri-instrumentation, and development of environmentally benign biopesticides and biofertilizers have also been supported. In addition to this, some interesting proposals in the field of Precision Agriculture were funded under a special call of SPARSH.

To further strengthen the innovation chain, BIRAC has supported few platform technologies which are expected to push forward the agriculture ecosystem further. This includes:

1. Pest Management through mating disruption using patented SPLAT formulation.
2. Gene editing using CRISPR/Cas9 technology
3. Seed invigoration using magnetopriming techniques
4. Efficient delivery of pesticides using nano-biotechnology

BIRAC has also been supporting research studies in the field of aquaculture and veterinary sciences. Some of the prominent ones include; deregulation trials of BmNPV resistant silkworm strain, use of bacteriophage for treatment of Vibrio harveyi infection in shrimp and development of an affordable and indigenous device for Bovine Sperm Sexing i.e., segregating and selecting of female semen (XX).

Under the national mandate of food security, BIRAC has specially and consciously funded projects targeting various traits/ research aspects in important crops like (i) Rice (yield, drought and saline tolerance, disease resistance), (ii) Tomato (resistance against sucking pest and virus), (iii) Brinjal (shoot and root borer), (iv) Maize (yield enhancement, tolerance against drought and heat, resistance against fungal diseases and enhanced level of β carotene) and (v) Brassica (higher yield and nutritional improvement by lowering Erucic acid and glucosinolate content) etc. Along with the above-mentioned crops, technical interventions have also been supported in other crops such as ginger, onion, potato, etc. for various desirable traits.

BIRAC in partnership with USAID and Indian Council for Agriculture Research (ICAR) is supporting development of high yielding, heat tolerant wheat cultivars suitable for Indo- Gangetic Plains. These new varieties shall be developed by building upon the available resources and breeding materials by utilizing information from model systems and currently available modern breeding, genetic, genomic, physiological, and biochemical tools. During the course of the study genes/ QTLs controlling heat tolerance will be identified, mapped and tagged; improved insight into physiological, genetic, biochemical, and molecular bases of the trait obtained, and a system will be put in place to utilize the new information in cultivar development.

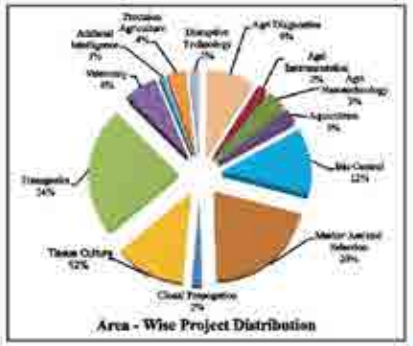
BIRAC has also supported a technology transfer program for development of biofortified and disease resistance banana from Queensland University of Technology (QUIT), Australia to India. Under this program, technology transfer has been carried out for developing transgenic varieties of Indian banana (Grand Naine and Rasthali) with enhanced micronutrients (iron and pro vitamin A) and disease resistance (Fusarium and BBTV).The program's objectives are being jointly translated by 5 Indian research organizations namely, National Agri-Food Biotechnology Institute (NABI), National Research Centre for Banana (NRCB), Bhabha Atomic Research Centre (BARC), Indian Institute of Horticulture Research (IIHR) and Tamil Nadu Agricultural University (TNAU).

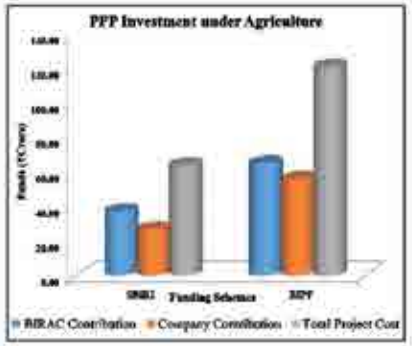
Under BIRAC supported agriculture projects, the total PPP investment has been around Rs. 184.92 crores, out of which BIRAC contribution has been Rs. 102.18 crores. Out of 113 projects supported so far, 61 projects were executed by industry alone, 43 projects involved industry- Academia partnership, 1 project has Industry - Industry partnership and 8 projects have been executed by the individuals. BIRAC interventions have resulted in generation of 9 IP in this sector.

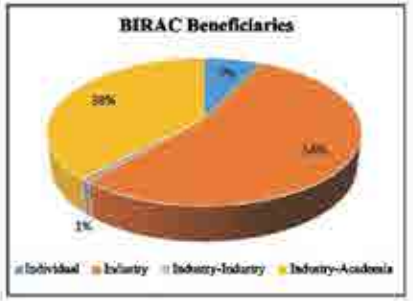
Further analysis of the funding pattern in agriculture suggests that maximum funds have been disbursed under BIPP scheme followed by SBIRI, PACE, SPARSH and BIG schemes. So far as the stage of technology development is concerned, maximum projects have been supported for development of Proof of concept, followed by early stage validation. Considering the fact that agricultural projects involve long gestation period relatively fewer projects were funded for late stage validation and pre-commercialization.

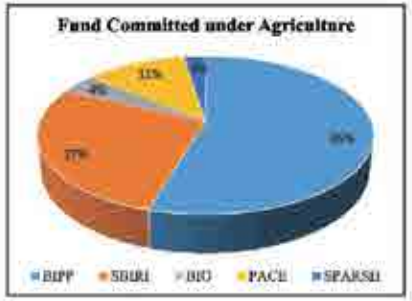
One of the companies supported by BIRAC, Aristogen Biosciences Pvt. Ltd has developed bacteriophage based all-natural, non-chemical antimicrobial preparation "Vibrioshield" that can control Vibriosis in shrimp culture by replacing antibiotics, thus ensuring higher yield and profitability.

To sum-up, agriculture as supported by BIRAC has a large portfolio of products/ technologies to address food security by minimizing crop losses and enhancing productivity.



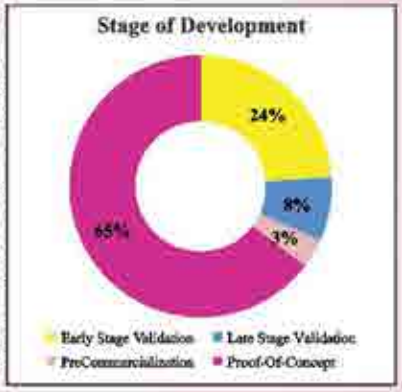






Analysis:

- Crop improvement either through recombinant DNA technology or Marker Assisted Breeding account for nearly 44% of the supported projects
- BIPP scheme still continues to capture maximum share of funds committed. This is largely due to the fact that field trials/ validation which are important aspects of product/technology development and involve long time and high cost are supported only under this programme
- BIRAC has been actively supporting new/ disruptive technologies. In all such cases it is imperative that the Proof of Concept (PoC) is generated first before proceeding with the validation process. Consequently, maximum number of projects that have been supported are aimed towards development of PoC.
- Precision agriculture is the need of the hour and the sector is increasingly catching the attention of the young entrepreneurs. To facilitate this effort, during the year BIRAC has funded 7 new proposals related to this aspect under SPARSH programme.
- Some of the research studies are now at advanced stage of validation and are expected to yield a product/technology ready for commercialization in near future.



Industrial Biotechnology (including secondary Agriculture)

Industrial biotechnology encompass the area which consists of development of technologies focussing on creation of new products useful to the industry, modifying or developing processes using enzymes, finding alternative technologies to replace petroleum based products and environmental remediation. This area has the potential to develop processes with reduced water and energy consumption.

A report from the World Economic Forum, 2010 estimated that by 2020 the market for biofuels, bio-based bulk chemicals and plastics, and bioprocessing enzymes would approach $95 billion. North America dominated the revenue share in 2015 owing to growing R&D initiatives by key industry players and rising awareness among public and private research institutes. The Indian industrial biotechnology segment primarily consists of enzymes, organic amino acids and yeast products and holds on 3% of market based on revenue. One area which is slowly picking up is technology development in environmental remediation. The major driver for the growth of this sector is the large number of initiatives undertaken by governments for environment protection and pollution control. The area is marred by a number of challenges such as:

- Lack of potential disruptive technologies (scalable, low on cost, less GHG, time to market)
- High investment and production costs
- Limited availability of raw material
- High investment in R&D and process development and massive investments to build new production facilities
- Complex innovation processes as well as absence of critical regulations
- The technology transfer gap between basic R&D and the commercialisation

- The combination of "technology push" and "market pull" along the value chain

BIRAC, since its inception has been trying to bridge the above challenges by providing funding, mentoring and training in this area. Total investment under this area amounts to ₹ 400 crores wherein BIRAC has contributed ₹ 185.8 crores for supporting 162 innovative projects. These 162 projects engaged 97 companies, 36 start-ups, 24 entrepreneurs and 32 academic institutes. The major achievements of BIRAC in this area are 43 technologies/product/PoC and 35 intellectual properties.

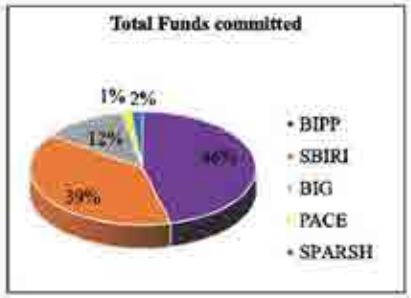
BIRAC in the last one year has had some remarkable achievements in the area of Industrial biotechnology and Secondary agriculture:

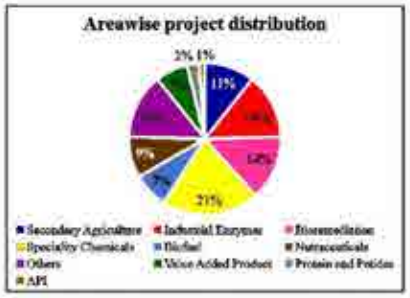
- A technology for conversion of methane to single cell protein has been developed and validated at 60 L with complete downstream processing.
- A green technology of solvent free extraction for purification of catechin from tea leaves has been demonstrated at 100 Kg scale.
- Anaerobic co-digestion developed for treating septage and leachate. Technology demonstrated at 100 L.
- A process for preparing Granulated Sludge in lab scale to enable quick start-up and easy operation of UASB in wastewater treatment.
- A project based on conversion of food waste to fuel has already reached to the commercialization stage.
- Pilot demo plant based on conversion of faecal waste to fertilizer is underway.

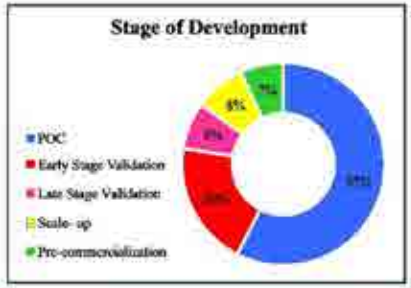
In order to promote the sector further, BIRAC has been taking specific initiatives:

- Special calls were announced in the area of "Waste to Value" and "Scale-up of Industrial Enzymes"
- A secondary agriculture entrepreneurial network has been launched with the aim to promote start-ups in the agri-food sector. The initiative will develop technologies such as value added products from fruits and vegetables. The aim of this network is to provide a conducive environment needed for technology commercialization. The efforts are being led by Punjab State Council for Science and Technology. Other partners are National Agri Biotechnology Institute and Centre for Innovation and Applied Bioprocessing and Bio-Next Punjab University.
- Hands-on training has been provided to multitude of scientists from industry in recombinant protein production, fermentation technologies and scale-up, downstream processing, strain development and membrane separations.
- Call for proposals in Synthetic biology for development of a bio-based economy

A large number of projects have moved on for follow on funding for scale-up or late stage validation. BIRAC was instrumental in providing grant for development of proof of concept. These include technologies for the production of rare sugars, recombinant streptokinase, Supercritical Fluid Extraction, Production of rare mushroom species, Docosahexaenoic acid and immobilized lipases, to name a few.

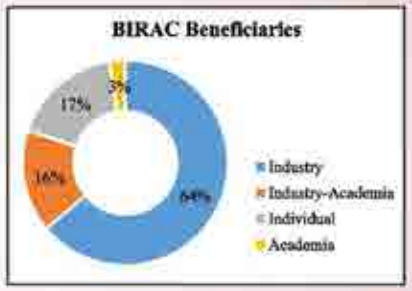






Analysis:

- BIRAC has supported of plethora of technologies in this are ranging from establishing of proof of concept to pre-commercialization. Thus, technologies which are at ideation stage and need crucial funding get a major boost.
- BIPP scheme is the scheme with largest share of funding in this area as it involves production and scale-up plants.
- Industry academia interaction is still at infancy in this area.
- The quantum of funding remains the maximum for speciality chemicals followed by an equal distribution between production of industrial enzymes and bioremediation or waste treatment technologies.
- Maximum funding is going for development of proof of concept.
- In order to promote the area, a holistic approach focusing on biofuels, bio-based bulk chemicals and plastics, and bioprocessing enzymes is needed.



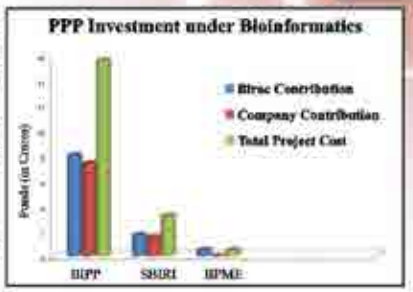
Bioinformatics (including Artificial Intelligence, Big Data Analysis, IoT's, software development)

In current era, bioinformatics has become an important part of many areas of biology. Bioinformatics is growing as an independent discipline and is fundamental to the growth of biotechnology. India has achieved remarkable success particularly in the software industry. Over the past decade, the bioinformatics market has significantly evolved across the globe owing to increasing application of genomics in biotech and pharmaceutical research & development. This growth in the global bioinformatics market has positive implications for the Bio-IT industry. The spectacular rise of the commercial Indian genomics industry and the broadening application of genomic techniques in biology and medicine has created a commercial market for Translational bioinformatics.

Bioinformatics is one of the fastest-expanding fields in India's biotechnology sector today and BIRAC is encouraging and focussing on the translational bioinformatics driven projects. Some of the examples of successful projects are as follows.

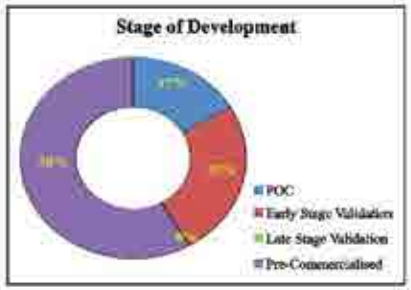
- A machine learning based software for the detection of diabetes retinopathy is developed and validated. Software (Icheck) has been launched. Currently software has been launched with new Name- ChronEye
- In-Silico hepatotoxicity prediction platform to conduct toxicity studies of any lead compounds.
- SanGenix named comprehensive NGS data analysis suite that offers a scalable and user friendly solution with predefined or custom workflows for seamless analysis of NGS data. Product is available on http://www.sangenix.com/Products.html

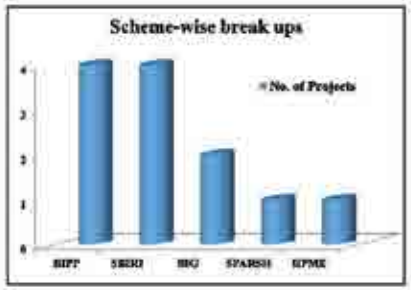
- High computing infrastructure set up for NGS data Analysis with more than 16 NGS pipelines & providing 25% discount price to the Indian academics and institutions. Services are available on http://www.scigenom.com/bipp
- A kit for the detection of onco mutation for more than 10 type of cancers & computational pipelines for the analysis of NGS data. A NGS based gene panel for the diagnosis of cancer has been developed.



Products in Pipeline:

- A system to track and monitor real-time patient data & predict future disease by using big data analysis on cloud through machine learning methods.
- Intelligent health care kiosk for immediate simple healthcare for simple common symptoms is under pipeline. An artificial intelligence based software for the health care kiosk. This medical kiosk will diagnose the vital symptoms and will provide e-prescription and also dispense the drugs.
- A software for improving auditory perception and speech performance of hearing impaired children and adults using their visual cortex.
- An integrated immunoassay device for community screening.





Analysis:

- 78% funds are disbursed through BIPP for bioinformatics sector
- 58% projects have been successfully reached to pre-commercialized stage. Rest of them are at early and late stage validation
- Few of the projects from Bioinformatics area involved Industry-academia collaborations though many are pursued by industry alone

Innovation Profiles

Healthcare

Therapeutics

AbGenics LifeSciences Pvt. Ltd.

Title of the Proposal

Development of AbTids as a new class of anti-infective biologicals

Brief description

The project aims to develop a new class of biologic antimicrobials called AbTids and their cocktail based on bacteria specific camelid heavy chain antibodies to specifically target Antimicrobial resistance (AMR).

Current Stage of development

Proof-of-Concept

Innovative elements

AbTids is a novel fusion biologic consisting of a toxic cationic peptide fused to an anionic CaMab via a cleavable peptide linker. The AbTids are activated upon cleavage of the linker at the site of infection by specific host proteases or by pathogen-secreted proteases. This prevents the possibility of off target activity.

Market Potential

The world anti-bacterial market is estimated at $41.76 billion in 2016 with very less number of products to tackle drug resistant bacteria. In India the market is worth INR Rs 5,000 crores and about 20% of the patients admitted to hospitals end up getting nosocomial infections. The burn applications alone has a market size of around USD $ 60 million.

National/Societal relevance

India has one of the highest anti-microbial burden in the world, and the issue of drug resistance is a major public threat. In India, over 58,000 babies died in one year as a result of infection with resistant bacteria usually passed on from their mothers.

Project achievements

a. **Progress vis-a vis objectives**- Camelid library generation against ESKAPE pathogens, obtaining hits, design and purification of AbTids and *in vitro* efficacy

b. **Technology/ Product (to be) developed-** New class of biologic antimicrobials - AbTids

c. **IP generated/ Potential for IP generation-** Application of the camelid antibodies and AbTids for controlling pathogenic bacteria, Patent Application No.116/MUM/2015 dated 13-01-2015. An antimicrobial combination of antibodies and antimicrobial peptides to target microbes. Patent Application No. TEMP/E-1/1398/2018 MUM- 10th Jan 2018. Heavy chain anti-candida antibodies derived from camels and their modifications for antifungal applications

d. **Resources Generated-** 4 new manpower hired and training provided in antibody engineering techniques for 5 employees. Protein purification facility with AKTA chromatography system established.

Plans to take innovation further

Upon proof of concept completion collaborations with larger pharma players will be established to progress these molecules to the clinic.

Risks envisaged

With Biologics, immunogenicity is a concern which can be mitigated by humanizing the CaMabs and AbTids. The design and formulation of the novel fusion protein will require rigorous optimization to prolong stability and improve efficacy, while reducing its immune signature.

Project Coordinator:
Sanjiban Banerjee

Team Members :
Sanjiban Banerjee

Contact :
AbGenics LifeSciences Pvt. Ltd
Fortune House Office# 102
Pune, Maharashtra-411045

Bheshaj Innovations Pvt. Ltd.

Title of the Proposal

Novel Formulation to minimize catheter infections

Brief description

The project aims to develop a Catheter Lock-Flush Solution, which would not only prevent infection and clotting but would also be safe to flush into the body.

Current Stage of development

Validation

Innovative Element(s)

The proposed product:

- Is prepared utilizing synergistically acting GRAS ingredients resulting in minimal/no side effects
- Offers rapid and multimode mechanism of action resulting in minimal/no antimicrobial resistance
- Is easy to use, store and ship, making it easy for regions with compromised healthcare facilities

Market Potential

The global market for the product is approx. USD 7.5 Billion with India at USD 0.5 Billion.

National/Societal relevance

Clearcath™ is a simple broad-spectrum antimicrobial cum anticoagulant formulation. "Clearcath" would address challenges specific to India and developing economies. It has been found to be highly effective against MRSA, VRE, MDRPA etc.

Project achievements

a. **Progress vis-a vis objectives**- Proof of Concept is ready. Currently, preliminary biocompatibility along with shelf-life studies are in progress.

b. **Technology/ Product (to be) developed –** It would take another 24 months to launch the product into the market.

c. **IP generated/ Potential for IP generation**

- Patent Title: Broad Spectrum Antimicrobial & Anticoagulant Composition
- India Patent App. No: 201621007809 Dt 24/02/2017
- PCT App. No: PCT/IN2017/000052 Dt 28/02/2017
- US Appl. No: N/A Dt 16/07/2018

d. **Resources Generated**

Grown into a team of six members. Collaborations have been forged with multiple laboratories (involved with *in vitro*, *in vivo*, biocompatibility studies, shelf life studies). Legal and financial consultant have been hired.

Plans to take innovation further:

Company is in talks with multiple companies in USA & Canada for product licensing.

Risks envisaged:

Categorizing the product as drug would delay its launch and tremendously increase the cost. This could be addressed via substantial *in vivo* studies data, citing discussions pertaining to mode of action, citing references on no systemic activities and guidelines for predicate products approved in developed economies such as USA & Europe.

Project Coordinator:
Dinesh Aggarwal

Team Members :
Vijay Kumar Gupta, Ravindra Sharma, Sumitra Rani, Mahesh Nanjundappa, Chirag Shah

Contact :
Bheshaj Innovations Pvt Ltd
HIG 2, Kabir Nagar, Near Ring Road 2, Raipur-492099

Cisgen Biotech Discoveries Pvt. Ltd.

Title of the Proposal

Clinical evaluation and scale-up of a novel therapeutic formulation for treating a fatal viral disease of dogs

Brief description

A novel enteric protected chicken IgY based formulation was developed against canine parvoviral enteritis

Current Stage of development

Validation

Innovative Element(s)

This is completely a new product. There is no equivalent product in the market.

Market Potential

The market is of approx. 3 million doses per year in India. Similar export market is also expected worldwide .

National/Societal relevance

The technology is developed. Product is being sold as prophylactic feed additive. The product will also be sold for therapeutic application after completing the dog challenge studies and regulatory clearance.

Project achievements

a) **Progress vis-a vis objectives-** The enteric protected formulation was verified for its clinical efficacy in clinically infected dogs. The formulation was also checked *in vitro*. A controlled dog challenge experiment will be initiated shortly.

b) **Technology/ Product (to be) developed-** The technology is developed. Product is being sold as prophylactic feed additive. The product will also be sold for therapeutic application after completing the dog challenge studies and regulatory clearance.

c) **IP generated/ Potential for IP generation:** Patent Number: 201641043995 - IgY formulation against canine *Parvoviral enteritis*

d) **Resources Generated-** Three man powers employed, internship done by three B. Tech students in the facility

Plans to take innovation further

Shortlisted in IIT-Kanpur BIRAC seed funding. Interest has been expressed by Indian angels in investing in Cisgen and the conversation is in progress.

Risks envisaged

This is entirely new market. A market has to be created by educating the veterinarians and pet owners.

Project Coordinator: V. Hassdam

Team Members : Vijaya Lakshmi V, R. Rachita

Contact : Cisgen Biotech Discoveries Pvt. Ltd., No.12/113, 10th Street, Dr. Kalaignar Nagar, Thiruvottiyur, Chennai, Tamil Nadu -600019

Cuor Stem Cellutions Pvt. Ltd.

Title of the Proposal

Cell Based Screening Platform using a human Mesenchymal Stem Cell derived model for Alzheimer's disease (AD) for novel drug target development

Brief description

Alzheimer's disease (AD) is a serious progressive health problem affecting more than 40 million people in mid-60s worldwide. Various mechanisms causing AD have been identified so far, but the specific molecular mechanisms responsible for the onset and progression of the disease are yet to be explored. To address this, they have developed a human stem cell model of AD from mesenchymal stem cells derived from perinatal tissues to develop a rapid screen to test the efficacy of AD drugs in human *in vitro* AD model.

Current Stage of development

Validation

Innovative Element(s)

An *in vitro* model of AD using the renewable, scalable and non-genetically manipulated human adult MSCs. It has immense potential to be brought to scale as human perinatal MSC derived AD model offers a high yield of functional neurons which provides an easily scalable, renewable, rapid and reproducible screening platform for AD-specific drugs.

Market potential

Pharmaceutical companies developing investigational new drugs for AD can use the developed model to identify effective drugs from a large panel to reduce expensive animal studies before clinical trials.

National/Societal relevance

Alzheimer's disease and other forms of dementia are a growing public health problem among the elderly in developing countries, whose aging population is increasing rapidly. It is estimated that by the year 2020, approximately 70% of the world population aged 60 and above will be living in developing countries. The use of perinatal stem cells derived AD model ensures a steady and reliable supply of cells for testing of both early stage AD drugs and investigational new drugs INDs without the use of animals in the early screens. Furthermore, these screens could also be used for testing indigenous drugs in traditional Indian medicine for evaluating for specific effect in reverting neurodegeneration.

Project achievements

a. **Progress vis-a vis objectives-** Developed well characterized CNS cells and AD specific neurodegeneration with quantifiable parameters. Initial drug analysis is underway for testing for reversal of neurodegeneration.

b. **Technology/ Product (to be) developed** - Stem cell derived rapid drug testing screen for AD.

c. **IP generated/ Potential for IP generation-** i) Method for derivation of cells of central nervous system from human mesenchymal stem cells- Provisional patent

ii) A rapid drug testing platform for drug of AD- to be applied

d. **Resources Generated-** Data not available

Plans to take innovation further

The company is in talks with other companies from Israel, Germany and Malaysia and Johnson and Johnson, Singapore for building client base. They are exploring partnership with Jn.J, Ncardia and other companies and in talks with Venture Capitalists for scale-up and world-wide commercialization.

Risks envisaged

There are no expected risk factors with respect to methodology and technology. The grantee will be working gradually in collaboration with potential investors to manage the commercialization.

Project Coordinator: Sudha Warrier

Team Members : Gopal Pawar, Gautam Sethi, Arun Kumar

Contact : School of Regenerative Medicine, Bangalore, Karnataka - 560065

Dhiti Life Sciences Pvt. Ltd.

Title of the Proposal

Development and production of recombinant proteins for their use in commercial production of in vitro diagnostic test kits

Brief description

Antibody detection rapid tests for Malaria, HCV and Syphilis have been developed using indigenously developed recombinant antigens specific to *P.falciparum, P.vivax*, Hepatitis C Virus and *Treponema pallidum*.

Current stage of development

Commercialization

Innovative Element(s)

Indigenous, low cost, in-house technology for developing diagnostic grade antigens for Syphilis and HCV and successfully commercialized it in the form of rapid tests.

Market Potential

Antibody detection rapid tests for HCV and Syphilis have been commercialized in India. Globally rapid tests hold about 66 percent of the diagnostic test market and are poised to grow at 7 percent CAGR. In accordance with that, demand for diagnostic grade recombinant antigens will also grow.

National/Societal relevance

It has helped to substitute for the import of diagnostic grade recombinant proteins, thereby leading into reduction of the cost of production and also saving foreign exchange.

Project achievements

a. **Progress vis-a vis objectives-** All the milestones have been achieved successfully.

b. **Technology/Product (to be) developed-** HCV antibody rapid test and Syphilis antibody rapid test have been developed. More than 30 lakhs units have been sold.

c. **IP generated/ Potential for IP generation-** NA

d. **Resources Generated-** 12 manpower working currently, expanded facility in terms of space and infrastructure

Plans to take innovation further

Products committed under this project are already under commercial production

Risks envisaged

None. HCV and Syphilis tests are huge success stories from commercial as well as well scientific point of view

Project Coordinator: Abhinav Shrestha

Team Members : Savita Sokhal, Radhika Mathur, Shailendra Rajawat, Rahul Dwivedi, Madhvendra Singh, Dilip Kumar

Contact : B 107, Okhla Industrial Area, Phase 1, New Delhi - 110020

ExoCan Healthcare Technologies Pvt. Ltd.

Title of the Proposal

Development of Clinical Grade Exosome Formulations

Brief description

A rapid, and low cost method for purification of exosome preparations

Current stage of development

Validation

Innovative Element(s)

Low cost, rapid, and benchtop solution for exosome purification as opposed to highly cumbersome ultracentrifugation methods.

Market Potential

A total of 100 billion USD market

National/Societal relevence

The technology will facilitate development of exosome based point-of-care cancer detection technologies. This will create significant impact in cancer diagnosis field and increase reach to mass.

Project achievements

a. **Progress vis-a vis objectives-** The process optimization is under validation phase currently

b. **Technology/ Product (to be) developed-** A product for exosome purification post isolation

c. **IP generated/ Potential for IP generation-** One new IP is under preparation for filing

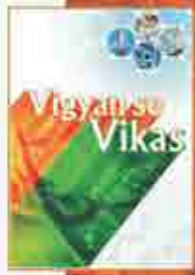
d. **Resources Generated-** One manpower has been employed

Plans to take innovation further

The company would licence out the product

Risks envisaged

Establishing business channel in this niche segment



Project Coordinator: Aman Sharma

Team Members : Aman Sharma

Contact : ExoCan Healthcare Technologies PVT. Ltd. 103, NCL Innovation Park, Pune, Maharashtra-411008

Eyestem

Title of the Proposal

Proof of concept study to evaluate safety and efficacy of two dimensional 2D photoreceptors vis-a-vis three dimensional 3D optic cup like retinal organoids in animal models of retinal injury

Brief description

Photoreceptors in 2D and 3D suspension have been developed to create unique therapy for retinitis pigmentosa. Retinal Pigment Epithelium in treatment of age related macular degeneration has also been developed.

Current stage of development

Proof-of-Concept

Innovative Element(s)

A unified protocol that is unique and patented which allows for generation of both RPE and PR through a common process

Market Potential

Dry AMD is a US$ 20 billion market globally and has no cure. Over 170 M people are affected with the disease. Over 4 M people are afflicted with Retinitis Pigmentosa which is an incurable disease of the eye chiefly affecting kids.

National/Societal relevance

Most cell and gene therapy products in the west are priced at $250k per injection. This is unaffordable for a country like India which needs to develop its cell and gene therapy platforms for treatment of Indian patients.

Project achievements

a. **Progress vis-a vis objectives-** 2D and 3D photoreceptors have been grown and characterized to have the same characteristics as natural photoreceptors, have been transplanted for in vivo efficacy studies

b. **Technology/Product (to be) developed-** Study to evaluate safety and efficacy of two dimensional 2D photo-receptors vis-a-vis three dimensional 3D optic cup like retinal organoids in animal models of retinal injury

c. **IP generated/ Potential for IP generation-** Filed a PCT for the unified protocol in India

d. **Resources Generated-** Employed 5 people and have trained them on cell differentiation protocols which are unique

Plans to take innovation further

To raise funds for this project through venture capital funds

Risks envisaged

The possibility that an immune response from the host body interferes in cell therapy to be effective cannot be ruled out.

Project Coordinator:
Jogin Desai

Team Members :
Rajarshi Pal, Reena Rathod, Sushma Swamy, Vijay Bhaskar, Rajani Bathi

Contact :
Eyestem, 106 A Shagun Complex, B-88 Swastik Society, Navrangpura Ahmedabad- 380009

Genzir Technologies Pvt. Ltd.

Title of the Proposal

Development of kits for isolation of adipocyte-derived stem cells for prolotherapy and other regenerative medicine

Brief description

Device to isolate stem cells/stromal cells from adipose-tissue for cosmetology purpose and autologous regenerative medicine. Features of the device are:

- A single unit, disposable point-of-care device with semi-automatic control.
- Microbe-free and reduces disparities/time from procedure to procedure.

These can be used for autologous infusions/injections into a patient's body or sight of treatment, for drug discovery studies, for stem cell based bio-inks or biogels, patches etc.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Regenerative medicine, device design and simplicity in use, point-of-care device.

Market Potential

As per the market survey in India, use of adipose derived stem cells (ADSC) in regenerative medicine has a CAGR of 28.12 by 2020. Considering orthopedic market globally, global Knee replacement market is about 9.3 Billion USD and is expected to touch 12.4 billion USD in 2024. Current size of the Indian orthopedic devices market is around USD 375 M.

National/Societal relevance

With rise in chronic ailments and the economic burden due to such diseases, there is a need to shift from common prophylactic allopathic medicines to a cure- either permanent or long-term relief. Hence, there is a need to implement and improvise regenerative medicine. Devices to isolate stem cells from fat for autologous therapies and research will facilitate in turning regenerative medicine into a common practice to heal medical problems at cost-effective, sanitized, time-saving manner with minimal efforts.

Project achievements

a. **Progress vis-a vis objectives-** Testing the device Vs manual procedure for isolating cells from adipose tissue. Via ability of cells with device and characterization of stem cells and differentiation studies with cells isolated with the help of the device. Lab validation of device

b. **Technology/Product (to be) developed-** Devices to isolate stem cells/stromal cells from adipose-tissue for cosmetology purpose and autologous regenerative medicine.

c. **IP generated/ Potential for IP generation-** Filed Indian patent application No. 201741021803, dated June 21, 2018 and PCT IN2018050407, dated June 21, 2018.

d. **Resources Generated-** Manpower- 10, Trained- 2PhD students, 2 technicians. Enterprise created Funds- Bootstrapping, BIG grant and a probable future collaboration with KIHT, Andhra.

Plans to take innovation further

Looking for investors and collaboration talks are on with KIHT, Andhra. If incubated, KIHT will help in bringing the product to the market at 5% equity.

Risks envisaged

Regulatory approvals; USFDA is in the process of approving autologous stem cell therapy from Adipose tissue. Patent filed hence copying or look alike products are not a major concern.

Project Coordinator:
Vasu Ravuri

Team Members :
Vasu Ravuri

Contact :
Genzir Technologies Pvt. Ltd.
H.No. 12-2-826/1/B Asif Nagar Hyderabad-500028

Indian Institute of Chemical Technolgy (IICT)

- Collaborator : Incozen Therapeutics Pvt. Ltd.

Title of the Proposal

Mitochondria-targeted esculetin as an anti-atherosclerotic agent

Brief description

A novel mitochondria-targeted esculetin Mito-Esc molecule has been designed and showed that Mito-Esc greatly ameliorate oxidant-induced endothelial dysfunction as well as angiotensin-II-, high fat diet-induced, and age-associated atherosclerosis in ApoE-/- mice. This study is about the dose-dependent efficacy of Mito-Esc by an oral formulation, for its ability to reduce both Angiotensin Ang -II and high fat diet -induced atherosclerosis in Apoé -/- mice.

Current stage of development

Validation

Validation Innovative Element(s)

Mitochondrial targeting of antioxidants is an attractive strategy to preferentially deliver the molecule of interest to the sites of free radical production, especially in those pathological conditions wherein, mitochondrial dysfunction due to excess ROS production plays a major role in disease progression. This strategy will help 1) reduce the concentration of the molecule that is being employed to scavenge ROS, 2) increases the bioavailability of the administered molecule because of the increased lipophilic nature due to the presence of TPP+ cation.

Market Potential

Mitochondrial-targeting of drugs or drug-like compounds is a new arena and, if successful, would eventually lead to a good market/commercial potential for mitochondria-targeted esculetin as an anti-atherosclerotic therapy.

National/Societal relevance

Atherosclerosis is a major cardiovascular disease, the disease burden is huge across the globe and there is a continuous need for the development of new and better therapeutic interventions in this area.

Project achievements

a. **Progress vis-a vis objectives-** 10g of Mito-Esc has been synthesized, an oral formulation of Mito-Esc to be administered has been developed and preliminary PK profile and tissue distribution studies of Mito-Esc has been done.

b. **Technology/ Product (to be) developed-** Mito-Esc as an anti-atherosclerotic therapy

c. **IP generated/Potential for IP generation-** Granted an US patent entitled "Antioxidant compound having anti atherosclerotic effect and preparation thereof" US9963476B2

d. **Resources Generated-** Manpower: Project Fellows-2

Plans to take innovation further:

To approach appropriate stake holders for either licensing or partnership to take the molecule to the next level

Risks envisaged

Although, results with Mito-Esc for the treatment of atherosclerosis seems promising, it would still need to be proved better than the existing drugs in the market

Project Coordinator: Singirikhar Kalaiarasi

Team Members : Surender Reddy Bathula, Rambrahma Sistla, Srikant Viswanatha, Sridhar V

Contact : Indian Institute of Chemical Technology (IICT), Tarnaka, Uppal Road, Hyderabad, Andhra Pradesh - 500007

Indian Institute of Technology-BHU

Title of the Proposal

Understanding the mechanism of action through cell biology and upgradation of herbal drug in solution and biodegradable patch for the treatment of diabetic foot ulcer

Brief description

Wound healing solution and biodegradable scaffold stabilizing nanometer size polyherb panchavalkala has been developed. The developed scaffold is capable to release the polyherb in a sustained manner continuously for 5 days within the therapeutic limit. The biodegradable patch has the ability to mimic the extracellular matrix and helps passing the nutrients of cells, aeration and removal of exudes. Biocompatible nature of the drug loaded solution and biodegradable patch helps to proliferates the cells without any additional toxicity. *In vivo* and clinical studies reveal the efficacy of developed solution and biodegradble patch towards wound healing

Current stage of development

Discovery

Innovative Element(s)

A stable ayurvedic solution is prepared for efficient wound healing, it has the ability to minimize the risk of repeated dressing, cost of treatment and patient compliance. Moreovec the benign nature of the polymer matrix add a value to the environmental issues.

Market Potential

There are large number of with or without diabetic wound patients in India or abroad who need treatment to prevent quick and convenient healing without amputation in extreme cases. Further, ayurvedic medicines are well known for its non-toxicity, low cost and without any side effect. The materials developed for wound healing/diabetic foot ulcer should be cost effective, efficient and patient compliance. Up scaling of the product is relatively easy and will benefit large number of patients

National/Societal relevance

There are large numbers of patients having wounds of different stages and nature and become a prime importance especially in India as most of the people does not take care of their wound properly. It causes often amputation and several other injuries in body which needs to be taken care of seriously. Development of wound healing solution and a biodegradable scaffold incorporating ayruvedic drug offers a cost effective and technologically advance way of wound management

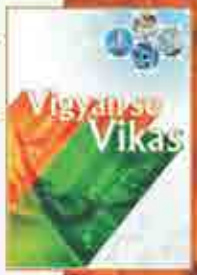
Project achievements

a. **Progress vis-a vis objectives-** Cellular level studies being conducted using ayurvedic drug embedded in scaffold; Effectiveness of patch for the healing of wound/diabetic foot ulcer in animal model is being studied

b. **Technology/ Product (to be) developed-** Patch for diabetic foot ulcer

c. **IP generated/Potential for IP generation-** Two patents have been filed for wound management while for diabetic foot ulcer is underway

d. **Resources Generated-** One SRF and two PhD students are employed in the project



Plans to take innovation further

To develop materials for diabetic foot ulcer and its commercialization

Risks envisaged

None

Project Coordinator: Pralay Maiti

Team Members : Manoranjan Sahu, Sourjya Sensarma, Arpan Biswas, Himangshu Koley

Contact : Indian Institute of Technology (BHU), Materials Science and Technology, Varanasi, Uttar Pradesh- 221005

Indian Institute of Technology-Bombay

Title of the Proposal

Functional amyloid derived hydrogels as a scaffold for three dimensional *in vitro* tumor model for evaluating anti-cancer therapeutics

Brief description

Fmoc-amyloid derived nano-fibril based hydrogels that self-assemble due to interactions of Fmoc moiety in response to their physiochemical milieu, have a property to mimics features of extracellular matrix. An easy-to-use, inexpensive, and scalable technology for production of complex-shaped, Amyloid hydrogel derived spheroid or 3D microtissues or 3D macromolecular structure for testing of potential anti-cancer therapeutics by any cancerous cell lines is proposed

Current Stage of development

Discovery

Innovative Element(s)

Amyloid hydrogel as a scaffold for developing a robust 3D *in vitro* tumor model by any cancerous cell line for evaluating potential anti-cancer therapeutics

Market potential

Market for 3D cell culture is expected to grow to a staggering 3.7 billion US dollars by the year 2021. Novel and better Scaffold-based 3D cell culture products are expected to dominate the market in near future and account for the largest share of the 3D cell culture market. The high growth in this segment is attributed to the ability of scaffold-based products to mimic *in vivo* conditions, thus driving their adoption among end users.

National/Societal relevance

Conventional two-dimensional cell cultures for testing effects of anti-cancer agents are simple and convenient, but present significant limitations in reproducing the complexity and pathophysiology of *in vivo* tumor tissue. 3D culture systems are garnering interest in cancer research since tissue architecture and the extracellular matrix ECM significantly influences tumor cell responses to micro environmental signals. The present invention will aid in the development of 3D *in vitro* tumor model of any cancerous cell line on these novel self-assembling classes of hydrogels as a scaffold for testing anti-cancer therapeutics. Usage of this technology for testing anti-cancer drug before licensing will reduce the gap between bench to bed side

Project achievements

a. **Progress vis-a vis objectives-** Till date, they have completed the first objective as mentioned in the proposal and initiated gene expression analysis. Characterization of tumor formed of different cancerous cell line with various functional amyloid derived hydrogels was demonstrated

b. **Technology/ Product (to be) developed-** Scaffold for 3D *in vitro* tumor model for testing anti-cancer drug

c. **IP generated/ Potential for IP generation-** Technology has numerous potential for IP generation

d. **Resources Generated-** Manpower has been recruited, purchase of equipment PCR is under process and other consumables required for execution of the project has been purchased

Plans to take innovation further:

After finishing all three objectives, technology/product will be further processed for licensing

Risks envisaged

Challenge will be to plan to scale effectively

Project Coordinator: Samir K. Maji

Team Members : Namrata Singh

Contact : Indian Institute of Technology-Bombay, Powai, Department of Chemical Engineering, Mumbai- 400076

International Center of Genetic Engineering & Biotechnology

Collaborator : Syngene International Ltd

Title of the Proposal

A Phase I, clinical trial to assess the safety and immunogenicity of *P.falciparum* vaccines

Brief description

Proposed Phase 1 clinical trial will assess the safety and immunogenicity of two *P.falciparum* vaccines: Monovalent malaria vaccine and Bivalent malaria vaccine. Both vaccines are formulated with Alhydrogel.

Monovalent vaccine antigen PfMSPFu24 is a chimera of PfMSP-119, induces invasion inhibitory antibodies and PfMSP-311 induces inhibitory antibodies involved in antibody dependent cellular inhibition, ADCI.

Bivalent vaccine consists of a combination of PfMSPFu-24 and PfF2 receptor binding F2 domain of PfEBA-175. This combination vaccine would induce antibodies against PfF2 that block EBA175-glycophorin A interaction, against PfMSP-119 that block MSP1 processing to inhibit parasite invasion and against PfMSP-311 that inhibit parasite growth by ADCI.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Monovalent and Bivalent falciparum malaria vaccines may provide protection against malaria by targeting parasite growth by different mechanisms like inhibiting erythrocyte invasion and by ADCI.

Market potential

There are no vaccines available for falciparum malaria. An efficacious malaria vaccine has a high market potential both in India and areas such as Africa, South East Asia and South America where *P. falciparum* malaria is a leading cause of morbidity and mortality primarily in children.

National/Societal relevance

Malaria in India is present both in urban and rural areas. There is no vaccine available for malaria yet and there are issues with drug resistance and compliance with completion of drug course. An efficacious malaria vaccine will be an effective tool to prevent malaria in India.

Project achievements

a. **Progress vis-a vis objectives-** IND dossier submitted to DCGI/CDSCO. Chemistry, Manufacturing and Controls dossier submitted to CDL Kasauli

b. **Technology/Product (to be) developed-** The vaccines are composed of recombinant antigens. The Drug substances PfMSPFu24 and PfF2 and Drug Products Monvalent and Bivalent formulated with Alhydrogel have been manufactured under cGMP at Zydus, Ahmedabad.

c. **IP generated/Potential for IP generation-** The vaccine formulations have the potential for IP generation

d. **Resources Generated-** NA

Plans to take innovation further

After Phase Ia trial and subsequent proof of concept as efficacy Phase IIb trial in malaria endemic areas, will be seeking partnership with industry for commercial manufacturing and licensing.

Risks envisaged

New vaccine development is expensive and will remain costly until the recovery costs have been paid off.

Project Coordinator: Virander S Chauhan

Team Members : Charan Chinnis V, Paushali Mukherjee, Ahmad Rushdi Shakri, Rajender Jena, Geetanjali Uppal, Ankita Singh, Anil E

Contact : International Center of Genetic Engineering and Biotechnology, Aruna Asaf Ali Marg, New Delhi- 110067

Jamia Hamdard

Collaborators : Vimta Labs Ltd. & National Institute of Pathology

Title of the Proposal

Preclinical evaluation of Centrin knockout live attenuated Leishmania clinical grade parasite vaccine against visceral leishmaniasis

Brief description

Hira Nakhasi's group at the CBER/USFDA in collaboration with Poonam Salotra at the National Inst. of Pathology, ICMR, New Delhi under the Indo-US Vaccine Action Program, developed a *L donovani* strain with centrin1 LdCen1 gene double knockout. Deletion of LdCen1 arrested the growth of only the intracellular stage of the parasite. This attenuated parasite was later found to be safe and provided mice and hamster protection against virulent challenge. This set these parasites for further preclinical toxicity of the parasite and subsequently as vaccine in humans.

Current stage of development

Validation

Innovative Element(s)

A gene deleted live attenuated Leishmania parasite as vaccine candidate

Market potential

Based on prevailing epidemiological estimates, considering on an average 10 sub-clinical infection per case, around 90,000 people will be the potential customers of this vaccine in the first phase. The total market size in South East Asia is about 300 million with 100 million in India alone.

National/Societal relevance

As of March 2016, about 200–400 thousand of new cases of visceral leishmaniasis (VL) have been reported to occur worldwide . In India, VL is endemic in the states of Bihar, Jharkhand, West Bengal and Uttar Pradesh, with more than 65,000 of cases in Bihar alone. There are still no effective vaccines against leishmaniasis.

Project achievements

a. **Progress vis-a vis objectives-** Currently the preclinical evaluation of the vaccine candidate for toxicity is in progress

b. **Technology/Product (to be) developed-** After completion of the successful preclinical evaluation, the product will be used for clinical trials

c. **IP generated/ Potential for IP generation-** The following two; one in US and the other in India patents have been already issued over the vaccine candidate. In addition, a third international patient has also been applied. The descriptions of the patents are as below:

1. LIVE ATTENUATED LEISHMANIA VACCINES. US patent number: WO 2005/021030.
2. LIVE ATTENUATED LEISHMANIA VACCINES. India patent numoer: 243725
3. International application No. PCT/US2004/028008 filed 2004

d. Resources Generated- Sufficient intellectual input and manpower are in place

Plans to take innovation further

In progress

Risks envisaged

No risk particularly envisaged at the moment.

Project Coordinator: Angamuthu Selvapandiyan

Team Members : Hira Nakhasi, A. Selvapandiyan, Poonam Salotra, Sanjai Singh

Contact : Jamia Hamdard, Hamdard University, 1st Floor, Faculty of Science Building, Hamdard Nagar, New Delhi - 110062

National Centre for Antarctic & Ocean Research

Collaborators : Foundation for Neglected Disease Research & Anthem Biosciences Pvt. Ltd.

Title of the Proposal

Development of PM181108 as an anti-tubercular agent

Brief description

PM181108A is a novel peptide antibiotic from Antarctic soil/sediment, isolated and purified as a natural product from Streptomyces through fermentation. Combination studies with first line Isoniazid, Rifampicin, and Ethambutol & Pyrazinamide and second line Amikacin, Capreomycin, Kanamycin, D-cycloserine and fluoroquinolones exhibited synergism/no antagonism suggesting its potential in MDR treatment. PM181108A demonstrates a time and concentration dependent kill kinetic profile. PM181108A was tested for in vivo efficacy in a mouse model of TB and showed a bactericidal effect.

Current Stage of development

Discovery

Innovative Element(s)

It is an anti-tubercular agent with a novel mechanism of action and is active against both drug sensitive and drug resistant pathogens.

Market potential

Unmet need lies for new anti-tubercular agents on drug resistant tuberculosis, without any safety or toxicity issues which plague even the most recent anti-TB drugs including bedaquiline.

National/Societal relevance

Few drugs are available to tackle the drug-resistant TB. TB is the largest killer among infectious diseases in India

Project achievements

a. **Progress vis-a vis objectives-** Progress is being made towards upstream and downstream processing, yield improvement and formulation development along with its mode of action is being pursued.

b. **Technology/ Product (to be) developed-** The molecule is currently in late pre-clinical testing. It will have to go through regulatory toxicology Phase 1, 2 and 3 clinical trials prior to approval as a treatment for TB. We estimate that, if the molecule successfully completes these studies, it could reach market by 2025.

c. **IP generated/ Potential for IP generation**- They have filed 2 patents prior to this grant. They anticipate new IP to be generated in the form of formulation patents and other life-cycle management patents.

d. **Resources Generated**- The project requires BSL-3 level trained personnel and has trained/created employment for at least 2-3 people.

Plans to take innovation further

To complete the rodent GLP toxicology with the funds available through this grant. If successful, they will raise funds for the future studies, including clinical trials from BIRAC and other sources.

Risks envisaged

Regulatory, safety and toxicology studies

Project Coordinator: Rahul Mohan

Team Members : Sindhu Narayanan, Prasad Shivmecharan

Contact : National Centre for Antarctic and Ocean Research, Headland Sada, Vasco-da-Gama, GOA

Oniosome Healthcare Pvt. Ltd.

Title of the Proposal

Development and validation of Nanofibrous Ocular Patch

Brief description

A major challenge emanating in the design of topical ophthalmic preparations is their short precorneal residence time. Retention of a drug delivery system in the front of the eye is thus desirable. Due to advances in nanotechnological field, Nano fibrous patch based retentive system has been proposed and developed that can preferably be delivered in a solid ultra thin patch and ultimately remain attached to the corneal/non corneal tissue owing to their inherent characteristics. Nano-patch of present invention provides comfortable and controlled delivery of encapsulated therapeutics constantly over a period of several days

Current Stage of development

Validation

Innovative Element(s)

The invention provides a continuous scalable process and to produce preservative free, sterilized unit dosage form with controlled drug release behaviour. Developed systems will improve therapeutic efficacy and patient adherence.

Market potential

Present product, being a solid unit ophthalmic product improves a product life and thus serve a real value addition for product commercialization. Simple easy fabrication process under aseptic environment with minimum unit operation steps reduces the product cost.

National/Societal relevance

Product will seek to enhance sustainable development in urban and rural regions aiming to provide sustainable solutions for Glaucoma.

Project achievements

a. **Progress vis-a vis objectives-** Pre-formulation studies for drugs and excipients completed

b. **Technology/Product (to be) developed-** Validation, Preclinical study, clinical study, tentative time to enter into market would be 3-4 year

c. **IP generated/ Potential for IP generation-** Under Process

d. **Resources Generated-** NA

Plans to take innovation further

Partnership with MNC and existing company

Risks envisaged

Regulatory approval

Project Coordinator: Sarvesh Malviya

Team Members : Sandeep Jain, Sandeep Godara

Contact : Oniosome Healthcare Pvt. Ltd., F-352 Industrial Area, Phase-80, Mohali, Punjab - 160071

Oniosome Healthcare Pvt. Ltd.

Title of the Proposal

Pre-clinical studies of Bleomycin Sulphate bearing Nanostructured Lipid Particles for Targeting Brain Cancer

Brief description

They intend to develop bleomycin sulphate loaded lipid nanoparticles for crossing blood brain barrier. Bleomycin sulfate Nanostructured lipid particles offer lucrative advantages over conventional chemotherapy regimen like improved bioavailability at the site of tissue, enhanced stability, easy scale up with low cost.

Current Stage of development

Validation

Innovative Element(s)

Bleomycin sulfate Nanostructured lipid particles offer lucrative advantages over conventional chemotherapy regimen like improved bioavailability at the site of tissue, enhanced stability, easy scale up with low cost as compared to conventional available market preparation.

Market potential

Bleomycin sulphate has largest market share in the anti-cancer drug market for brain cancer. The nanoparticle encapsulated bleomycin sulphate can have a very good commercialization potential.

National/Societal relevance

Worldwide, brain cancer was the 17th most common type of cancer as reported by the World Cancer Research Fund.

Project achievements

a) **Progress vis-a vis objectives-** Standardization of production of lipid nanoparticles and conduct cell line study of developed prototype of lipid nanoparticles

b) **Technology/ Product (to be) developed-** Safe and efficacious Bleomycin sulphate loaded nanoparticles which have high yield, max encapsulation efficiency and prolong in vitro release.

c) **IP generated/ Potential for IP generation-** Under Process

d) **Resources Generated-** NA

Plans to take innovation further

Partnership with MNC / Existing Company

Risks envisaged

Regulatory approval

Project Coordinator: Sarvesh Malviya

Team Members : Sandeep Jain, Pallavi Bagla

Contact : Oniosome Healthcare Pvt. Ltd., F-352 Industrial Area, Phase-80, Mohali, Punjab - 160071

PNB Vesper Life Science Pvt. Ltd.

Title of the Proposal

Clinical development of Novel CCK receptor antagonists for the treatment of inflammatory pain

Brief description

PNB-001 is the lead molecule that belongs to the 4th chemical series of PNB Vesper Cholecystokinin CCK program. PNB-001 demonstrated, in both *in vitro* and *in vivo* preclinical pharmacology models, excellent CCK inhibitory and anti-nociceptive activities to pain resulting from inflammation. All required safety evaluation and PK studies have been completed in GLP certified facilities. The product has excellent stability. DCGI has accorded permission to carry out Phase I clinical trial.

Current Stage of development

Validation

Innovative Element(s)

Successful in synthesising the molecule with high purity in large scale. The molecule has shown excellent efficacy and safety in studies conducted in variety of animal models.

Market potential

Global market potential for pain medication was $50 billion (Global pain relieving drug market analysis 2010-2025, report publication date April 2010). Of this, inflammatory pain market alone is close to $15 billion.

National/Societal relevance

Pain is a significant public health problem that costs society at least $560-$635 billion annually. Pain is currently treated with opioids, which are considered as a major reason for several deaths.

Project achievements

a) **Progress vis-a vis objectives-** Preparation of GMP Formulation, conduct of stability studies and Placebo manufacturing were completed in April 2018. Phase 1 single ascending dose studies will be completed in December 2018. Phase 1 multiple ascending dose studies will be completed in December 2019..

b) **Technology/ Product (to be) developed-** The product has been synthesized and formulated as per GMP.

c) **IP generated/ Potential for IP generation-** United States Patent awarded. Patent No.: US 8,921,577 B2 Dated Dec 30 2014

d) **Resources Generated-** NA

Plans to take innovation further

After successful phase 1 clinical trial, plans will be established for fund raising and licencing arrangements with major pharma groups.

Risks envisaged

PNB-001 possesses all potential risk factors involved in the development of new chemical entities. From the perspective of toxicity, in rodent and non-rodent species dogs, PNB-001 was impeccably safe. No toxic effect was observed in all the regulatory toxicology and safety pharmacology studies conducted. Hence, it is speculated that the same safety might be translated into the humans too. Another risk factor is absence of efficacy. In rodents, PNB-001 was very effective in preventing/treating pain. From the liver microsome data, it is expected that the human exposure to be higher than that of the rodents, translating to more drug on-board and better efficacy.

Project Coordinator: Sairam Parthasarathisubai

Team Members : Sadashiva Pillai, Kiran Mantlak, Ramesh Narayanan

Contact : Door No. 40/1045-g, 8th Floor, Amrutha Towers, M G Road Cochin, Kerala- 682011

Regenerative Medical Services Pvt. Ltd.

Title of the Proposal

A Prospective, Open-label, Multicentric Study to Assess the Safety and Efficacy of Autologous Adult Live Cultured Buccal Epithelial Cells Uregrow™ in Subjects with Urethral Stricture

Brief description

Uregrow™ –An autologous Adult Live Cultured Buccal Epithelial Cells having advantages like minimally invasive, less post-surgical complications, allows reconstruction of larger urethral strictures up to 04 cm, less post-surgery erectile dysfunction and surgery procedure is 30 minutes as compared to available treatment.This technology consists of three stage procedures mentioned as below:

- Biopsy of buccal mucosa taken under local anesthesia from the inner cheek of the patient by the doctor.
- By enzymatic digestion of tissue & separation of epithelial layer from dermal layer, autologous adult live cultured buccal epithelial cells are isolated, cultured, expanded *ex vivo* and formulated as a suspension of cells in culture medium in vial ready for implantation in the same patient.
- The epithelial cell suspension is implanted cystoscopically at the stricture site

Current Stage of development

Validation

Innovative Element(s)

New innovative developed product Uregrow™ for treating urethral stricture benefits - less painful, local implantation with minimum invasion and faster recovery.

Market Potential

Urethral stricture market in India in year 2018 is 68.3 USD million which will increase to 109.3 USD million by year 2024 at a CAGR rate of 8.16%. The global urethral stricture market in Asia pacific countries in year 2018 is 26.3 USD million which will increase to 41.1 USD million by year 2024 at a rate of 7.73% CAGR.

National/Societal relevance

No similar product or technology in the world till date. With success results in clinical trial, Regrow hopes to offer this treatment to patients with unmet medical need and improve the standard of care for this disease.

Project achievements

a. **Progress vis-a vis objectives-** Successfully completed the clinical trial. No safety related issues and no SAE was recorded in the clinical trial. More than 90% efficacy was observed and patient's urological function restored to normal.

b. **Technology/ Product (to be) developed-** Permanent curative and easy method based on natural process. Further minimally invasive procedure and implantation can be done easily via cystoscopic.

c. **IP generated/ Potential for IP generation-** Completed national phase filing of the proposed product with patent Application number 201621038900.

d. **Resources Generated-** Regrow Biosciences have developed World Class facility with clean room and Biosafety level II operations. More than 20 people trained in cell culture and analysis of cells.

Plans to take innovation further

In India, take to market and commercialize, for China- working on technology transfer, USA & EU- Registration of the biological product by early next year in 2019.

Risks envisaged

Regulatory framework in India is lagging and various committees are involved in decision making process.

Project Coordinator: Satyen Sanghvi

Team Members : Vinayak Kedage, Nimish Shah, Rajesh Pratap Singh

Contact : Regenerative Medical Services Pvt. Ltd., ACME Plaza, Andheri-Kurla Road, J B Nagar, Mumbai- 400059

Raman Parkesh (KIIT)

Title of the Proposal

Venoms derived drugs for multi drug resistant-tuberculosis

Brief description

Project will demonstrate unique proof of concept leads. Preliminary work unearthed a venom fraction showing high potency for tuberculosis, better than frontline drugs. Idea is to obtain rare and unexplored venom to identify potent leads for multidrug-resistant-TB. Venoms are known to have good bioavailability and favorable pharmacokinetic properties. Plan is to generate stapled and constrained peptides owing to their advantages such as enhanced affinity and efficacy, increased cell permeability and less proteolytic activity. Hence, POC leads will have the potential to become a potent drug for MDR-TB within a short time.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Idea to explore the studies who have validated venom activity against MDR-TB but at high MIC values. The toxicity associated with high MIC values will be resolved by reducing the peptide size and structure based drug designing.

Market potential

The total market size of anti- TB drugs in developing countries is worth $730 million, which is expected to remain stable for first-line drugs and would continue to expand for second-line drugs.

National/Societal relevance

TB is a worldwide pandemic.

Project achievements

a. **Progress vis-a vis objectives-** Under procurement of crude venoms and venom fractionation. In-house development and optimization of biological assay is done and screening of venom fractions against Mtb-H37Rv has been started.

b. **Technology/ Product (to be) developed-** To open venom based therapeutic start-up in India and establish venom-derived lead molecules against tuberculosis with pharmacologically desirable properties. The expected time needed to enter the market – 5 years.

c. **IP generated/Potential for IP generation-** Since the idea is novel and unique, it is patentable. Patents can be filed based on: application treatment of tuberculosis, formulations and preparations, as combo therapy, scaffold optimization, synthetic mimics.

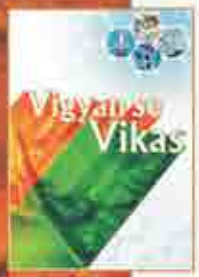
d. **Resources Generated-** Manpower generated 03 , currently employed 01

Plans to take innovation further

To explore local societies to obtain venoms from uncommon species such as Irula co-operative society. They would explore funding from public bodies for later stage of drug development.

Risks envisaged

Host toxicity associated with high MICs, to overcome drug resistance



Project Coordinator:
Raman Parkesh

Team Members :
Sumant Kumar

Contact :
Institute of Microbial Technology,
Sector 39-A, Chandigarh- 160036

Rasayani Biologics Pvt. Ltd.

Title of the Proposal

Evaluation of NTPX-07 for the potential treatment of Cancers

Brief description

Platinum based oral drug is prepared with an innovative green technology using a patented process .Currently the drug is undergoing Phase I clinical trial at a leading oncology site in India. For this clinical trial, it is proposed to be used in treatment of solid tumours refractory to conventional treatments and metastasis tumours. It has proven its efficacy in the pre-clinical studies in prostate, ovarian, pancreatic and lung cancers.

Current Stage of development

Validation

Innovative Element(s)

All the current platinum chemotherapy compounds are associated with severe dose limiting toxicity resulting in poor Quality of Life for cancer patients. Moreover drug resistance renders use of these compounds for limited use. NTPX-07 has been made by a green process, duly recognized by the Green Chemistry Foundation. This process generates minimum toxic waste and non- ionization which results in platinum nano particles with good *in vivo* efficacy in cancer cells and supportive for normal cells. Furthermore NTPX-07 exhibits a favourable safety profile as confirmed in pre-clinical toxicity studies which has potential for an extended therapeutic window.

Market potential

Platinum analogues are used in the management of all types of cancer. The current statistics for lung cancer indicate 18,25,000 new cases per year where Carboplatin and Cisplatin are mainstay of chemotherapy. Other prevalent cancers in the Indian population are ovarian and pancreatic cancer.

National/Societal relevance

NTPX-07 is the first indigenously developed anti-cancer intervention with the support of DBT. The pre-clinical data generated during the stage I of the project has been evaluated and accepted by the regulatory body and permission has been obtained from DCGI to undertake Phase I Clinical Trials. Oral Platinum analogues are important as they can be administered in OPD. This has immense importance as this reduces hospitalization, nursing and other allied costs that are equivalent to almost 70% of the treatment costs. Hence, an approved oral Platinum intervention is eagerly awaited by Oncologists.

Project achievements

a. **Progress vis-a vis objectives-** Phase I Clinical Trial is making progress and two cohorts are completed.

b. **Technology/ Product (to be) developed-** Ready for Commercialization

c. **IP generated/ potential for IP generation-** There are certainly opportunities for finding new applications as screening will generate more data. These applications will help in protecting technology in countries where earlier applications have not been filed.

d. **Resources Generated-** RBPL employed relevant scientific manpower to conduct the clinical trial. The laboratory facilities to produce drug and its testing are created RBPL has generated funding from investors

Plans to take innovation further

RBPL is looking for strategic partners/investors with global reach and complimentary fit to take the drug development ahead.

Risks envisaged

Getting Regulatory approvals on time plays a major role in drug development. Also drug development requires uninterrupted fund flow and any delay can be extremely costly in terms of time to commercialization which is the final aim of the drug development process.

Project Coordinator:
Ramesh Patil

Team Members :
Surendra Nagre, Nandkiran Khot, Avinash Kadam, Radhe Pujari, Sunanda Khedkar, Deepa Pillay, Vivek Pathod

Contact :
Rasayani Biologics Pvt. Ltd.,
B-3, Annuttamdham Laxmi Part Society,
Pune, Maharashtra- 411030

Shilpa Medicare Ltd.

Title of the Proposal

Development of Anti-VEGF fusion protein for AMD

Brief description

A continuous bioprocess platform for production and purification of biosimilars is under development with an aim to reduce the cost of the drugs by reducing the cost of inputs while increasing productivity. They have developed constructs which enable development of clones which produce 70-120 picogram per cell per day (pcd) of recombinant protein. These clone/s are being used in continuous fermentation processes to produce 1-2 g/L/day of the desired protein followed by purification to meet biosimilarity criteria.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Novel constructs which resulted in development of clones showing 70-100 pcd productivity have been developed. The clone/s have been used in continuous fermentation by perfusion combined with capture and further downstream processing constituting a continuous bioprocess for production of recombinant protein.

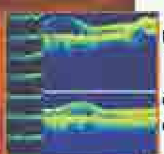
Market Potential

India has 15 million patients of Diabetic Retinopathy and 3-3.5 million patients of wet age related macular degeneration AMD, assuming 10 of them purchasing a biosimilars, and assuming 20 potential competitors, the market size of proposed biosimilar anti-VEGF product is 100000 patients per annum. At a sale price of Rs 2500/- per dose, 10 doses per annum per patient, the market potential in India alone is Rs. 250 Cr. An export market would constitute an upside to this market.

National/Societal relevance

Age related macular degeneration accounts for 8.7% of all blindness worldwide and is the most common cause of blindness in developed countries. The projected number of people with the disease is 196 million in 2020, increasing to 288 million in 2040. India currently has 15 million patients with Diabetic Retinopathy who are in dire need of a cost effective Anti-VEGF treatment for the disease. The product addresses the above needs in wet AMD and DME/DR that will make the product available at Rs. 2500-3000 per dose as compared to competition that is available at Rs. 35,000-60,000/- per dose on a dose adjusted basis.

Project achievements



a. **Progress vis-a vis objectives-** Clone showing high productivity of 70 pcd have been developed. Continuous perfusion fermentation process has been developed. Three batch data with this process is being generated. Process for purification of the protein has been developed. Characterization of the purified protein is under progress.

b. **Technology/ Product (to be) developed-** The development of the product is expected to be completed by January 2019. Approval for animal studies, animal trials, approval for clinical trials, clinical trials and market authorization are expected to take two years. Hence the product is expected to reach the market in 2021.

c. **IP generated/ Potential for IP generation-** IP already generated is in use.

d. **Resources Generated-** 10 personnel involved in various aspects of the development have been trained. Facility for continuous fermentation has been created. Facility for spent media analysis using UPLC with QDa detector has been created.

Plans to take innovation further

Once product development is completed, animal studies and clinical studies will be carried out with in-house funds. The product will be manufactured at the cGMP facility under construction.

Risks envisaged

There could be other anti VEGF treatment that could become a threat to the developed product. There could be competition from other biosimilar players.

Project Coordinator: K. R. Rajyashri

Team Members : Rohit Dangi, Madhusudhan Bigam, Anjali Magdum, Gopal Krishna, Prashant Mudaliyar, Prajwala Banope, Chary Kokkonda

Contact : Shilpa Medicare Ltd., Nav Jivha, Biotechnology Department, BVB College of Engineering & Technology, Hubli - 580031

Srikara Biologicals Pvt. Ltd.

Title of the Proposal

Development of a live, attenuated Fowl Adenovirus 4-based candidate poultry vaccine against Hepatitis-Hydropericardium Syndrome

Brief description

Aim of the project is to develop a novel live attenuated poultry vaccine against Hepatitis-Hydropericardium Syndrome HHS based on a novel naturally avirulent FAdV4 isolate with the grant-in-aid received from BIRAC under the BIG scheme.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Experimentally attenuated viruses are not suitable for vaccine development, a naturally avirulent strain carrying several novel features compared to other avirulent strains of FAdV4 to develop a live attenuated vaccine are being used in the project.

Market Potential

India is the second largest exporter of poultry meat with a market size of Rs. 58,000 crores and a growth rate of 8-10 pa. HHS is reported from across India. Because the existing inactivated vaccine has a poor field efficacy, a vaccine with improved protective efficacy has a great market potential.

National/Societal relevance

Poor field efficacy of the inactivated vaccine and the availability of antibiotic-supplemented poultry diet at a more competitive price prompted the farmers to opt for the latter. This resulted in contamination of human food supplies with a variety of antibiotics, which is considered one of the contributors for the development of Multi-drug resistant pathogens. Therefore, development of effective vaccines at a competitive price should put an end to such dangerous practices.

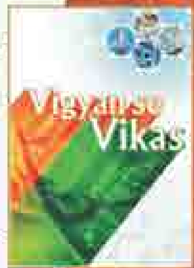
Project achievements

a. **Progress vis-a vis objectives-** Currently in the process of producing vaccine virus for testing. Also they are screening the clinical samples for FAdV4 isolates.

b. **Technology/ Product (to be) developed-** Technology under development

c. **IP generated/Potential for IP generation-** Presence of novel features in the isolate and non-availability of a vaccine technology based on naturally avirulent strain of FAdV4 strongly supports a promising IP potential for the technology.

d. **Resources Generated-** Hired a female researcher. Some of the essential equipments were also bought. Similarly work collaborations were also established to carryout in vivo studies.



Plans to take innovation further

In talk with different stakeholders for future funding and collaboration to take the technology to the market.

Risks envisaged

The proposed isolate is not fully characterized for its non-pathogenic phenotype. Also, it may be less efficacious than expected under the field conditions. Alternate strategies are in place to overcome these challenges.

Project Coordinator: Mohan Babu Appaiahgari

Team Members : Mohan B Appaiahgari, Gautam Kalam, Sarala Rani Kayamputta, Sumalatha

Contact : Srikara Biologicals Pvt. Ltd., 20-3-117A1 Yerra Mitta, Tirupati - 517507

Vandita Kakkar (FITT)

Title of the Proposal

Proof of Concept studies on combinatorial novel nanolipid hybrid of White Curcumin and Tacrolimus for Dermatitis

Brief description

Envisaging the gaps of the current treatment for dermatitis, a nanohybrid of white curcumin/tetrahydrocurcumin with tacrolimus has been prepared. The combination is expected to improve the associated inflammation, oxidative stress and also modulate the immune system. In lieu of the serious side effects of tacrolimus, ointment at a 33-67 percent reduced concentration has been formulated than the available marketed ointment ProtopicÂÂ® 0.1 percent. The addition of vectors will further improve its therapeutic efficacy.

Current Stage of development

Validation

Innovative Element(s)

Invention pertains to the nanocouturing of an anti-oxidant and anti-inflammatory molecule, tetrahydrocurcumin. Present invention caters to the need of all categories of skin inflammation, at a therapeutic concentration as low as 2% along with an immunosuppresant drug at very low concentration in form of a topical ointment which exhibits minimal side effects, is safe and cost effective for use not only in adults but paediatric population as well.

Market Potential

The treatment market is valued at US$ 4.04 Billion, and is expected to reach US$ 7.66 Billion by 2025. The product is expected to fetch the market USD 20.9 Million.

National/Societal relevance

Dermatitis is a chronic skin inflammatory condition affecting 15-30 percent of the paediatric and adult population. Till date there is no safe therapy available for children. THC-Tacro nanohybrid ointment is unique with its capability to cure the skin inflammation in all categories of population. It has high commercial feasibility. The product works at a concentration as low as 0.2 percent of THC and 0.01-0.02 percent of tacrolimus which makes it a patient friendly, safe, cost effective and above all the topical delivery.

Project achievements

a. **Progress vis-a vis objectives**- 2L of nanoparticles have been prepared with high drug content. Preparation of scaled up Tacro-THC ointment 500 G is expected to be completed by the end of September, 2018.

b. **Technology/ Product (to be) developed-** Product is currently under development. It will take more than two years to enter the market

c. **IP generated/Potential for IP generation**- Patent Application No. 201711028760; Patent title: Topical nanoformulation of tetrahydrocurcumin:THC

d. **Resources Generated-** Two project assistants and one technical help has been employed under this project

Plans to take innovation further

Plan to out license the product

Risks envisaged

1. Analytical method validation for estimation of white curcumin and tacrolimus in solvent systems and biological fluids is a great challenge
2. Reproducibility and scaling up the product at industrial level
3. Preparation of dossier for submission to DCGI
4. Regulatory approval

Project Coordinator: Vandita Kakkar

Team Members : Dinesh Singla, Bikash Medhi

Contact : Department of Pharmaceutics, UIPS, Sector-14, Panjab University, Chandigarh - 160014

Viravecs Labs LLP.

Title of the Proposal

Validation of a novel technology to generate stable transgenic systems with no off-target effects.

Brief description

The said technology paves a path to introduce foreign genes into mammalian genomes with no off target effects and high efficiency. It has application in corrective gene therapy particularly in the rare disease market.

Current stage of development

commercialization

Commercialized in the name of (Product/Technology Name)

CleanLines

Date of commercial Launch

2018-07-01

Number of units sold

04

Number of end users

04

Innovative Element(s)

As compared to competitor products, the said technology is 60-70% higher in efficiency while maintaining the accuracy.

Market Potential

Researchers working in the field of rare diseases can utilise this technology for corrective gene therapy studies *in vitro* as well as *in vivo*.

National/Societal relevance

Of the 7000+ known rare diseases, only 5 have approved therapies. The rare diseases that are genetic in nature can be best treated by the process of corrective gene therapy. The developed technology by the company has eased the process of introducing foreign genes into mammalian systems thereby addressing a global unmet need.

Project achievements

a. **Progress vis-a vis objectives-** Completed

b. **Technology/ Product (to be) developed-** A novel technology to generate stable transgenic systems with no off-target effects.

c. **IP generated/ Potential for IP generation-** NA

d. **Resources Generated-** 4 employees. Revenues of approximately INR 25 lakhs generated

Plans to take innovation further

Company is looking for out licensing the technology to a suitable partner

Risks envisaged

Competitors large scale can be difficult to match

Project Coordinator: Rohan H. Kamat

Team Members : Sriranth Budati, Sudipta Sarma, Lakshma G

Contact : Viravecs Labs LLP, II Main, AECS 2nd stage, Sanjaynagar Bangalore, Karnataka- 560094

Vishal Rai (C-CAMP)

Title of the Proposal

Protein Labeling Technologies

Brief description

The technology for precise engineering of protein for single-site installation of synthetic fragments required disruptive innovation. Due to multiple unresolved challenges, it was widely believed that chemical technologies are not capable of enabling precise engineering of native proteins. Proposed technologies deliver "precision single-site protein labeling" and open multiple avenues for protein-based therapeutics.

Current Stage of development

Validation

Innovative Element(s)

Proposed technologies allow modular and precise single-site labeling of native proteins for the first time. It enables: a. Synthesis of homogeneous protein-drug and antibody-drug conjugates that were otherwise inaccessible. b. Precise installation of probes in proteins and enzymes without perturbing their structure and function.

Market Potential

The global protein labelling market was valued at USD 1.28 billion in 2016. Growth rate: 11.7 CAGR. The global protein therapeutics market was valued at USD140.11 billion in 2016. Growth rate: 6.5 CAGR.

National/Societal relevance

Direct societal relevance: Antibody-drug conjugates for directed cancer chemotherapeutics. A potential application for homogeneous conjugate vaccines. Indirect societal relevance: The patents led to the first Indian biotech company that delivers precise protein engineering of native proteins.

Project achievements

a. **Progress vis-a vis objectives** - All proposed milestones have been successfully achieved.

b. **Technology/ Product (to be) developed** - A few products based on hotspot technology are already developed and are on sale through Plabeltech.

c. **IP generated/ Potential for IP generation**- Three international patent applications have been filed to protect the IPs: WO-2017158612; WO-2018047197; WO-2018104962

d. **Resources Generated**- Workforce employed: 1Lab facility created: A furnished laboratory with a centrifuge, fine chemicals, proteins, enzymes, antibodies, glassware, and analytical kits. Access to state-of-the-art analytical instruments from IISER Bhopal. Enterprise created: Plabeltech Private Limited is established in March 2018. Fund mobilization from other sources: IISER Bhopal provided the financial support for filing all the PCT applications. The application for national phase filing is under consideration.

Plans to take innovation further

Partners with a global presence are invited for discussions. A great opportunity to access state-of-the-art technologies for,

a. Precision protein conjugation; b. homogeneous antibody-drug conjugates; c. ordered immobilization of proteins and antibodies; d. analytical tools for protein sequencing.

Risks envisaged

Partners for global sales and marketing & funds raising

Project Coordinator: Vishal Rai

Team Members : Srinivasa Rao Adusumalli, Vishal Rai

Contact : Department of Chemistry, IISER Bhopal, Bypass Road, Bhauri, Bhopal- 462066

Translational Health Science & Technology Institute

Collaborators : Bioneerk India Pvt. Ltd. & National Centre for Cell Science

Title of the Proposal

Development and PoC validation of a novel approach to treat HIV infection by integrating anti-viral activity with stimulation of host cell innate immunity

Brief description

This project aims to develop a first in class therapeutic approach and a new drug lead, which displays potent activity against HIV-1 infection in cells. Importantly, this lead molecule employs a novel dual mode of action that combines direct anti-viral activity integrase inhibition along with stimulation of a key innate defense response of the host cell. This project originated from a larger interest at THSTI for generating small molecule stimulators of cellular autophagy, but without the inhibition of mTOR. THSTI has developed a pool of molecules, which are very potent inducers of autophagy. Among this pool of molecules, there is a subclass, which is also having an inhibitory activity against viral integrase.

Current stage of development

Discovery

Innovative Element(s)

Following are three innovative elements.

1. Dual mechanism of action that combines viral integrase inhibition as well as induction of autophagy of host cell to boost innate immunity.
2. The drug lead is not inhibiting mTOR which is a key protein involved in cell housekeeping function. Autophagy induction independent of mTOR inhibition is considered to be a safer approach for therapeutic value.
3. Integrase inhibitors are clinical validated approach for HIV treatment. There are already three drugs approved in market and few others are in clinical development. So this dual approach of inhibiting viral integrase along with induction of autophagy stands a high chance of clinical success.

Market Potential

The unique pharmacology of this new drug lead has a potential to address issues of resistance due to virus protein mutation and drug toxicity of existing integrase inhibitors which are approved and being marketed.

National/Societal relevance

India hosted a large population of HIV infected people with limited access to cost effective treatment. Also, the current treatment has issues of drug toxicity and resistance.

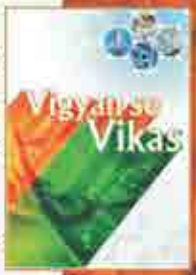
Project achievements

a) **Progress vis-a vis objectives**- A new drug lead has been identified based on cellular studies. The identified drug lead has also been found to metabolically stable and orally bio-available when dosed to mice and rats.

b) **Technology/ Product (to be) developed** - In next 6 -12 months, animal efficacy experiments will be started in monkey model of HIV infection.

c) **IP generated/Potential for IP generation**- The patent to protect new class of molecules and lead structures has been filed.

d) **Resources Generated** - NA



Plans to take innovation further

Pharma or biotech collaboration will be developed after successful completion of PoC studies in monkey model to support studies leading to clinical validation and approvals.

Risks envisaged

Proof of Concept in animal model is a key experiment which shall define the success of this project.

Project Coordinator: Dinesh Mahajan

Team Members : Debasish Mitra, Sridipa Jaiswal, S. Kothare Sameena Khan, Kanury Rao

Contact : Translational Health Science and Technology Institute, Faridabad NCR Biotech Science Cluster, Gurgaon-Faridabad Highway, Haryana - 121001

Weinnovate Biosolutions Pvt. Ltd.

Title of the Proposal

Novel combination-gel for rapid healing of Diabetic foot ulcers

Brief description

Diabetic foot ulcer is a pressing issue today. More than 78 million people affected globally. Diabetic foot ulcer consist of difficult to heal/ nonhealing wounds, resulting in amputations. There are around 8,000 amputations happening each year in Indian only due to diabetic foot ulcers. Current treatment deals with only prevention of infection and very few options available for wound healing. HEALRAP is an unique formulation with cell growth trigger molecules, which allow blood vessels and adjacent cells to grow rapidly in wound lumen. This product consists of unique nanoparticles which take care of infection and their reoccurrence. It is an easy to apply Gel and cheaper than the current treatment options.

Current stage of development

Validation

Innovative Element(s)

The product consists of unique nanoparticles which take care of infection and their reoccurrence.

Market Potential

The patients with DFUs spent four times more than those without Rs.19,020 ~$295.95 vs. Rs. 4,493 ~$69.91 , DFU market is huge in India as India has 73 million diabetic patients with 25% of them having a risk of developing a high risk chronic wound. 4 out of 5 people with diabetes live in low- and middle-income group and they spend around 32 million rupees for their treatment.

National/Societal relevance

India is a Diabetic capital of the world, with increasing number of diabetics, foot care will be a huge challenge to address. When today, we need a healthy population to work for the growth of country, disability due to diabetic foot amputation is going to be a curse.

Project achievements

a. **Progress vis-a vis objectives-** *In vivo* irritation studies and sensitisation testing ongoing. Expression levels of EDG receptors and protein expression of p38, ERK by PCR, RT-PCR and Western blotting over. *In vivo* acute toxicity study for dose optimization and excision wound experiments on diabetic animal model is underway

b. **Technology/Product (to be) developed-** One product HEALRAP pro will be launched by 2018 and other HEALRAP will have to undergo clinical trials which will be launched by 2024.

c. **IP generated/Potential for IP generation-** Indian patent application filed along with a PCT WO2018015976A1. Currently filing in UK and USA is under process.

d. **Resources Generated-** Total 7 people hired, Received investment of 50 L

Plans to take innovation further

Collaborating with mid sized pharma/CRO to partner or Licence the HEALRAP which has long time to market authorization. With partnership fund will be raise for another round of investment in 2020 to finish the clinical trials and then licence the product to pharma giants.

Risks envisaged

Global wound management market consists of large private companies having variable market share among the segments.

Project Coordinator: Milind Choudhari

Team Members : Milind Choudhari, Prasad Bhagat, Shraddha Yelkar, Sandeep Sonawane, Ashish Mokashi

Contact : Weinnovate Biosolutions Pvt. Ltd., NCL Innovation Park, Dr. Homi Bhabha Road, Pashan, Pune, Maharashtra- 411008

Windlas Biotech Ltd.

Collaborator : National Institute of Pharmaceutical Education and Research, Mohali

Title of the Proposal

Clinical evaluation of formulations based on NanoCrySP technology

Brief description

NanoCrySP, is a novel, patented, bottom-up, spray- drying based technology for generating drug nanocrystals dispersed in the matrix of crystalline excipient. This solid powder of drug nanocrystals and excipients, obtained by spray drying, is called as nanocrystalline solid dispersion NCSD. This spray drying based technology generates particles in size range of 0.5-20µm, while the nanocrystals embedded in its matrix are below 1000 nm. Various small molecules like sugars/sugar alcohols, amino acids and fatty acids act as crystallization inducing excipient for drug molecules. The technology is highly suitable for low to medium dose drugs to generate their nanocrystals in the form of a solid powder

Current Stage of development

Validation

Innovative Element(s)

The technology is unique in terms of generating a solid powder of nanocrystals in contrast to existing techniques that generate nanosuspensions. NCSD generated using NanoCrySP would require minimal downstream processing for conversion into final dosage form. Drugs that are difficult to mill to nano-sized particles using top- down technologies, can be easily processed using NanoCrySP

Market Potential

The large number of poorly water soluble drugs, belonging to Biopharmaceutics Classification System BCS II and IV, with dissolution rate limited bioavailability are good candidates for NanoCrySP technology

National/Societal relevance

IP rights for current technologies for generation of nanocrystals are held by multi-national companies, thus limiting their access to Indian pharmaceutical companies. NanoCrySP can help in import-substitution of these technologies and develop novel nanocrystals based products with better therapeutics

Project achievements

a. **Progress vis-a vis objectives-** The objectives of the first milestone has been completed including prototype formulation, sourcing of reference products, formulation fine tuning and generation of comparative dissolution profile

b. **Technology/ Product (to be) developed-** Celecoxib and Curcumin NCSD have been scaled up to quantity of 1 Kg. The two products are currently in pre-clinical stages of investigation of increase in bioavailability in animals and toxicity studies

c. **IP generated/Potential for IP generation-** The technology is already protected by patents in India, USA and Europe. There is a possibility of generation of additional patents during development of commercial products of Celecoxib and Curcumin NCSD

d. **Resources Generated-** M/s Windlas Biotech has created a pilot scale facility for spray drying in the Dehradun manufacturing unit

e. **Plans to take innovation further-** Apart from the currently developed molecules of Celecoxib and curcumin other BCS Class II and IV drugs shall be accommodated in this platform technology

Risks envisaged

The commercialization of the products shall be based on the outcome of human bioavailability studies. Additionally, competitor technologies pose challenge to commercial success of the products developed using NanoCrySP technology

Project Coordinator: Nilesh Windlass

Team Members : A. K. Bansal, Madhusudan Dutta

Contact : Windlas Biotech Ltd., 40/1, Mohabewala Industrial Area, Dehradun, Uttaranchal- 248110

Innovation Profiles

Healthcare

Devices & Diagnostics

ABC Genomics India Pvt. Ltd.

Title of the Proposal

A Point of Care POC Genetic Testing Device for TB Markers Suitable for Primary Health Care Centers Phase I

Brief description

To develop and validate a rugged & low-cost diagnostic point-of-care device for TB markers, TB Tester, suitable for use by personnel at primary healthcare centers PHCs , hospitals, and diagnostic labs. The device will employ pre-validated genetic markers and state-of-the-art DNA amplification technology at a fraction of the cost incurred today

Current Stage of development

Proof-of-Concept

Innovation Element (s)

Innovation lies in its ability to merge an extremely powerful isothermal amplification technology with a low-cost platform for a problem of national and global importance. Innovation also lies in its ability to perform in the hands of relatively untrained personnel at primary health care centres due to the demonstrated capability of direct amplification i.e., amplification without DNA extraction.

Market potential

The key to developing a viable POC is its simplicity and low cost. Both these parameters have been diligently incorporated in the TB Tester. With a growth rate of 20% for genetic screening market in India, device has excellent commercialization potential

National/Societal relevance

Nearly 1/5th of the global tuberculosis patients; 3.4 million, are in India. Tuberculosis can be stopped within 6 months with treatment costing as little as Rs 1,000. Yet, India ranks number 1 in disease burden with a prevalence of 299 TB patients per lakh of population totalling to 3.4 million and approximately 10 of the patients dying every year.

Project achievements

a. **Progress vis-a vis objectives**- The sample processing scheme had been developed and validated. The TB Tester prototype & chip/cartridge is also developed and currently the device is under validation.

b. **Technology/ Product developed**- Under development: TB Tester is expected to be ready and enter market by mid 2019

c. **IP generated/ Potential for IP generation**- Potential for IP generation lies in integration of genetic screening assay on low cost POC device, hardware and TB App

d. **Resources Generated**- Personnel trained, Low-cost microfluidic facility for disposable chips/cartridge

Plans to take innovation further

Seeking partners who are willing to sponsor manufacturing of the TB Tester at a scale that is beyond beta testing and further clinical validation equivalent in its power to an FDA cleared assay.

Risks envisaged

Regulatory clearance for manufacturing and deployment are the key challenges to be met.

Project Coordinator: Sabih A. Farooqi

Team Members : Somesh Mehra, Anita Jain

Contact : ABC Genomics Pvt. Ltd., Lucknow Biotech Park, Sector G, Jankipuram, Kursi Road, Lucknow Uttar Pradesh 226021

Adiuvo Diagnostics Pvt. Ltd.

Title of the Proposal

Portable hand held dermascope for real time non-invasive detection and monitoring of skin infections using multi-wavelength UV fluorescence

Brief description

Pathoscope device is a novel, non contact, non invasive, reagent-less hyperspectral-imaging device, which compiles comprehensive wound parameters that are displayed as a color-coded, well-labeled wound report within 2 minutes of imaging, aiding clinicians in evidence based first line treatment protocol, guided swabbing, guided cleaning and guided debridement.

The report displays data on : 1.Presence of infection , 2.Level of infection, 3. Identifies and classifies clinically relevant genus of bacteria, 4. Spatial wound map of infection and co-colonization, 5. Wound size and wound depth

Current Stage of development

Validation

Innovative Element (s)

Visual inspection of the wound regions followed by superficial swab and culture method is the standard technique to assess and identify the bacteria/fungus colonizing the infected wound. Swabbing is error prone and culture takes greater than 3 days for identification. The device aids in real-time assessment of the infecting pathogen without any reagents and classifies bacteria into gram and clinically relevant genus type. The device also aids in continuous wound monitoring in-terms of bio-burden, wound size and depth during the period of hospitalization aiding in rapid wound closure and first line treatment protocols.

Market potential

Wounds cover 1.5 million hospitalized patient developing bedsore/pressure ulcers, 2.4 million pregnant women undergoing C-Section, more than 20 million diabetic foot ulcer patients and 6-7 Million burn victims, secondary site surgical infections which are catered by 1,50,000 General Physicians, 18000 General Surgeons, 8000 dermatologists, 65000 Private Clinics, 8000 podiatrists, vascular surgeons, Healthcare Workers, 27,000 PHCs and CHCs Target Customer/Users.

National/Societal relevance

Wound assessment and management of infection is crucial with the rise in ulcer cases and chronic wound. More than 2 third of lower limb amputations are due to infection on the ulcer region of the foot that are not managed, 7- 10 of Hospitalised patients develop skin infections in ICU wards, Annual Burn incidences in India 6-7 million which requires continuous infection management. Infections post surgery at the surgical site is the third most commonly reported nosocomial infection in India

Project achievements

a. **Progress vis-a vis objectives**- Initial pilot studies on 119 patients in 3 major market segments i.e. Dermatology, Diabetic foot ulcer and surgical site, has been completed. The device was able to screen bacteria and fungus within 2 minutes covering 90% of the clinically relevant pathogen occurrences. The device guided doctor in accurate sampling, first line anti-fungal treatment, real time monitoring of wounds after antibiotic administration, predicted co colonization influencing treatment decision.

b. **Technology/ Product (to be) developed**- The device will undergo multi centric clinical validation and fine tuning to improve accuracy for market readiness.

c. **IP generated/ Potential for IP generation**- Indian Application: 201741010111 PCT application PCT/IN2018/050161 filed and pending, 1 device Design registration, 2 pending

d. **Resources Generated**- 5 manpower, 3 interns and collaboration with major manufacturers

Plans to take innovation further

Applicants are collaborating with an optoelectronic manufacturing company in India and leveraging their manufacturing facility and sales channel. They will also set up our own in-house assembly unit, marketing and sales channel

Risks envisaged

None

Project Coordinator: Geethanjali [illegible]

Team Members : NA

Contact : Adiuvo Diagnostics Pvt. Ltd, 1 206 NC Balaji Nagar, [illegible], Nellore - 524002

Aindra Systems Pvt. Ltd.

Title of the Proposal

An Affordable, Point-of-sample-collection screening tool for Cervical Cancer

Brief description

Mission is to build innovative products and technologies in the space of computational pathology for making healthcare more accessible, affordable and agile. CervAstra, an affordable and portable, point-of-care Cervical Cancer Screening tool automates the analysis of the Pap smear slides. The slides are stained, scanned, digitized and then analyzed using proprietary Computational Pathology platform to triage them into normal, suspect and abnormal samples. The images are then sent over a Tele-pathology medium to pathologists for further confirmations and recommendations.

Current Stage of development

Validation

Innovative Element(s)

The uniqueness of this Innovation comes from the fact that there is dis-aggregation of the existing centralized model by creating enabling Point-of-Care products. There are no integrated point-of-care screening devices that function effectively for Cervical Cancer triaging. Existing automated systems for pap smear triaging are centralized and extremely expensive and cannot be used for screening programs.

Market potential

The Market potential of this product is encapsulated in the following segments in the country.

1. Gynec clinics: there are about 10,000 standalone clinics countrywide.
2. Community Hospitals: there are about 10,000 Tier-2 and Tier-3 hospitals.
3. Diagnostic Labs: there are about 60,000 labs of the total 120,000 labs.

National/Societal relevance

An estimated 350 million Indian women aged between 30 yrs - 65 yrs in the risk category for Cervical Cancer. Addressing this issue requires one to see problems being addressed for a Low and Medium Income Country. It therefore requires that technology is harnessed to make the solution affordable while making it an effective weapon to address the problem. The social impact of a product of this nature, which addresses a screening problem for a cancer that is completely curable, is enormous.

Project achievements

a. **Progress vis-a vis objectives-** Project progressed to the Clinical Study phase and company has cleared Stage-1 of the ISO 13485 certification

b. **Technology/ Product (to be) developed-** Cluster, the platform to connect pathologists and clinicians is being developed and to be ready by Jan 2019.

c. **IP generated/ Potential for IP generation-** Filed for National phase patent applications in India, US, Europe, South Africa, Indonesia, Malaysia and Sri Lanka.

d. **Resources Generated-** Manpower expanded from 4 to 10. Raised more than $600k from multiple sources.

Plans to take innovation further

Raising funds for commercial launch of the products.

Risks envisaged

Computational Pathology being a novel area will face challenges in adoption and will need awareness creation in the market and an innovative business model to take it through.

Project Coordinator:
Adarsh Natarajan

Team Members :
Sajan Immanuel, Hariharasudhan PK, Mukesh Maliya, Swathi, Shobha, Pooja, Kumar

Contact :
Aindra, 26, 19th Cross, 24th Main, 5th Phase JP Nagar, Bangalore, Karnataka - 560078

Alfa Corpuscles Pvt. Ltd.

Title of the Proposal

Development and PreClinical Validation of Low Cost, Indigenous, Novel IPOM for Hernia Repair

Brief description

IPOMs used for the repair for Ventral Hernia are faced with problems of delamination of the Barrier Layer, visceral and bowel adhesion, bowel obstruction, erosion and fistula formation leading to morbidity and mortality. Applicants are developing a Novel IPOM combining plasma etching to increase surface activity and nano electrospray for coating with PLCL a biocompatible and bioabsorbable polymer, which can separate anatomical structures during the early healing phase, induce a minimized inflammatory response in order to reduce both encapsulation and adhesions to the barrier itself and restores normal cleavage planes such that it is safe, effective and affordable.

Current Stage of development

Proof-of-Concept

Innovative Element (s)

1. The use of RF Plasma etching as a process, on a polymer surface to increase its bonding with another polymer in order to create a strong bond and prevent delamination in fabrication of a Composite Hernia Mesh for use as an IPOM.
2. The use of nanoelectrospray as a process to deposit a thin layer of a polymer onto the surface of a another polymer surface in the fabrication of a Composite Hernia Mesh for use as an IPOM
3. The combination of RF Plasma etching and nanoelectrospray in fabrication of a Composite Hernia Mesh for use as an IPOM with a strongly bonded polymer layer interface.
4. Fabrication of a Composite Hernia Mesh for use as an IPOM using PLCL as a absorbable polymer layer.

Market potential

The IPOM market is expected to be nearly $ 1.83 Billion and the factors driving this market are increasing acceptance of tension free repairs, changing demographic trend in developing and transitional nations, rising demand for advanced meshes and widespread acceptance of laparoscopic repair.

National/Societal relevance

Currently available IPOM cost between Rs. 18,000 to 36,000 per unit for a size of 15X15cms. It is targeted to make this product available to the market at price points of approx Rs. 7,500 to 9,000. It is expected that with a reduction in cost and availability of a Novel IPOM with reduced incidence of complications due to prevention of adhesion formation with Bowel and Viscera, a larger number of surgeons both in the private and public sector hospitals will be able to offer the benefits of technically superior Laparoscopic Ventral Hernia Repair with IPOM to patients and bring about a significant overall reduction in the cost of the treatment.

Project achievements

a. **Progress vis-a vis objectives-** Developed test samples and have till date completed process optimization on vendor equipment and have placed orders for the same. Once installed manufacturing of the test samples for pre clinical and animal testing will be initiated.

b. **Technology/Product (to be) developed-** The Novel IPOM is expected to be ready for Human Trials by 2020.

c. **IP generated/ Potential for IP generation-** Already filed a Provisional Patent bearing Indian Patent Application no. 201811026236 dated 13/07/2018

d. **Resources Generated-** Employed one PG Research Fellow and Purchased Equipment for Vacuum RF Plasma treatment of Substrate

Plans to take innovation further

Looking forward to manufacturing of the product in house with regulatory approvals.

Risks envisaged

Resource risk for PLCL supply in small batches, project cost may rise as many equipment and consumables are imported.

Project Coordinator:
Alok Sardana

Team Members :
Santosh Saraswat, Vandana Sardana, Bijay Kumar

Contact :
Alfa Corpuscles Pvt. Ltd. 25/36, First Floor, East Patel Nagar, Delhi-110008

Amity University (Amity Center for Mycobacterial Disease Research)

Collaborator: Genomix Molecular Diagnostics Pvt. Ltd.

Title of the Proposal

Shielding Livestock from Paratuberculosis using Point of Care Diagnostics PoCD

Brief description

Developing a Point of Care Diagnostics for Paratuberculosis involving first Penside Antibody Detection Kit for paratuberculosis. This kit can be directly used by Farmers for testing individual animals without need of veterinarian or diagnostic specialist and no equipment. This kit can diagnose infection in five minutes. First indigenous Plate ELISA Antibody Detection Kit as Herd Screening Kit for paratuberculosis is also being developed.

Current Stage of development

Validation

Innovative Element (s)

These both kits are utilizing novel secretory proteins antigens for the detection of antibodies.

Market potential

These kits will be crucial in the screening of organized farms for still birth cases and to screen village level/ penside screening purposes. Awareness of paratuberculosis is mounting and economic burden by this disease is being realized. The market value is many crores per year. There is huge demand for these kits in paratuberculosis endemic areas like African countries, Malta area, far east Asia and Indian subcontinent

National/Societal relevance

India being an agrarian based economy cannot afford to have peratuberculosis infected herds. Paratuberculosis is considered as potential zoonotic disease and therefore is part of "one health". This infected population affects the farmers economically that in turn is detrimental for economic stability and growth. Paratuberculosis affecting primarily the ruminant during young age has practically has no cure. Poor farmers, dependent on their livestock as the sole source of income, are the most venerable group. Indigenous and cheaper point of care diagnostics would directly benefit the farming communities of India and that in turn would boost the economy of our country by implementing control strategy after the diagnosis

Project achievements

a. **Progress vis-a vis objectives-** 1. Produced recombinant antigens in bulk, 2. Production of antibody detection kits in bulk is underway for validation

b. **Technology/ Product (to be) developed-** 1. Onsite LAMP PCR for Paratuberculosis, 2. Antigen Detection System for Paratuberculosis

c. **IP generated/ Potential for IP generation-** Patent filed for Antibody Detection kit

d. **Resources Generated-** Two SRFs have been employed. Short term project works of two M.Sc. Microbiology students have been completed. Training of few B.Sc. and M.Sc. students is underway.

Plans to take innovation further

Licensing

Risks envisaged

None

Project Coordinator: Jagdip Singh Sohal

Team Members: Rathnagiri Polamreddy, Mukta Jain, Radhamadhab Pradhan, Revathi Puthali, Saurabh Gupta, Mangu Singh, Pradhan

Contact: Amity University, 14- Gopal Bari, Amer Road, Jaipur, Rajasthan-302001

Aprus Bio Medical Innovations Pvt. Ltd.

Collaborator: The South India Textile Research Association

Title of the Proposal

Development of Novel, Biodegradable Adult Incontinence Device

Brief description

Technology Platform of APRUS, which combines natural bio-active, bio-degradable, eco-sustainable, high-absorbency polymers with inherent anti-microbial and hemostatic activity, has been used to develop cost-competitive, high-absorbent, fully bio-degradable, compostable sanitary and personal hygiene devices. APRUS is collaborating with SITRA in developing an adult incontinence that help differentiate them from those currently marketed include unique underwear-style design, use of predominantly plant derived, bio-degradable, compostable absorbent materials, use of bio-plastic derived from eco-sustainable plant materials with anti-microbial, odor-preventing technology, product features that minimize environmental impact and cost effective solution delivered using Indian labor for Indian/ global markets.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The USP of APRUS incontinence device include unique underwear-like design comprising 100 eco-sustainable, bio-degradable shell, Bio-degradable, compostable core-pad with nonwoven fabric top sheet and water resistant back sheet, no use of harsh chemicals, absorbent core comprising bio-degradable polymers with high absorbency and anti-microbial and odor-absorbing properties.

Market Potential

Global market for absorbent hygiene products is over US $50 Billion. Although current consumption in India is low, it is expected to grow at least 3 times the current volume by 2025. A differentiated, eco-friendly, bio-degradable product will not only see significant market acceptance in India, but also globally.

National/Societal relevance

One of the major environmental pollutants is discarded personal hygiene devices and diapers. Disposable diapers constitute the 3rd largest consumer item in landfills and represent 30 percent of non-biodegradable waste and present a significant health hazard. Products currently in the global market as well as India, contain toxic materials consisting acrylates, polypropylene, furans and chlorine. Consequently, there is an immediacy and urgency in developing environmentally friendly, bio-degradable products that would meet and exceed the product characteristics of currently marketed/commercialized products while being bio-degradable, eco-sustainable and environmentally friendly. The product being developed meets these parameters without compromising on an individual's needs, comfort and dignity.

Project achievements

a. **Progress vis-a vis objectives-** The POC has been established.

b. **Technology/Product (to be) developed-** Adult Incontinence Device.

c. **IP generated/ Potential for IP generation-** The Company has filed a provisional patent application on the background technology for the development of sanitary and personal hygiene devices and intends to file a second provisional on the technology improvements made.

d. **Resources Generated-** APRUS has raised to date funds primarily from promoters, angel investors and competitive grants to an extent of INR 2 Crores.

Plans to take innovation further

The next step is to carry out pre-commercial manufacture, qualitative comparator analysis against marketed product and market feasibility studies. APRUS will raise funds not only through VCs/PEs, but also through speed-to-market strategies including strategic partnerships, out-licensing efforts, channel partners etc.

Risks envisaged

Economies of Scale, Brand Identification and Customer Loyalties, Capital Requirements and Distribution Channels

Project Coordinator: Anand Lele

Team Members: Ayyavu Kumar Nandan, Sunil Sikdar, Lakshminarayanan, and Preethi M

Contact: Bangalore Bioinnovation Centre, Ltd., Unit no. 107-111, Bangalore Helix Biotech Park, Electronic City Phase-1, Bangalore

Arogya MedTech Pvt. Ltd.

Title of the Proposal

CEREBROS: Low-cost,portable,multi-modal device for rapid screening & triaging of neurological emergency at point-of-care using cloud analytic among eldery followed by golden-hour retrieval and timely intervention by integrating with emergency system

Brief description

CEREBROS is a comprehensive end-to-end 360-degree solution consisting of an IoT Internet-Of-Things device integrated with Artificial-Intelligence based Tele Neuro-Monitoring platform to provide:1.Early screening and triaging of neuro-emergencies and diseases at point-of-care.2.Continuous brain-status monitoring and 3.Golden-Hour retrieval at nearest appropriate health-center, so patients' are benefited from advances in neuro-therapies. At the heart of CEREBROS is an easy-to-use, low-cost, portable, radiation-free, non-invasive brain-scanner in the form of wearable headset with embedded-system optimized using "smart-algorithms". Being integrated with telehealth platform it can be used by any minimally trained healthcare providers AYUSH/Rural Doctors, Paramedics, Nurse ANM,GNM , Community Health Workers like ASHA, Anganwadi.

Current Stage of development

Proof-of-Concept

Innovative Element (s)

Current options are two-fold: A.Structural neuroimaging CT/MRI -Not portable, costly 200k-2mn,high opex and require technicians/physicians on-site. B.Functional Scanners using single-modal sensors-Comparatively cheaper but still costs $30K-$80K,needs technician/neurologist onsite. CEREBROS falls in this category, but significantly low-cost $1000 COGS ,multi-modal EEG and NIRS ,portable, radiation-free, easy-to-use. Provides continuous neuro-monitoring and remote diagnosis at POC using telehealth. Details: http://bit.ly/Competitor-Adv.

Market potential

CEREBROS will capture market-share from different brain-neuroimaging market segments https://www.futuremarketinsights.com/reports/brain-imaging-and-neuroimaging-market

Brain-monitoring	: $12.22 Billion 2021 from $8.80 Billion 2016 growing at 5.8 CAGR
CT-scanners	: $6.20 Billion 2022 from $4.76 Billion 2017 growing at 5.4 CAGR
EEG Devices	: $1.3 Billion 2021 from $879.0 Mn 2014 growing at 6.8 CAGR
Emerging optical-imaging NIRS	: $1.75 Billion 2020 from $989.0 Million 2015 growing at 12.1 CAGR

National/Societal relevance

Being portable, IoT-enabled and affordable, CEREBROS can be deployed at all Government PHCs and rural/district hospitals. Also due to overburdened public-health, we have seen mushrooming of Private careproviders locally. But CT/MRI is highly capital intensive. With minimal investment, low opex and telehealth, CEREBROS is an ideal point-of-care brain scanning solution for them.

Project achievements

a. **Progress vis-a vis objectives-** Prototype device development: 1. Sensor PCB and Data acquisition/processing PCB design, fabrication, assembly completed 2. Firmwire development completed 3. IoT enablement and GUI development started 4. Headwear design started

b. **Technology/ Product (to be) developed-** Two separate prototype devices, one capturing EEG data CEREBROS-UNO-EEG and the other capturing NIRS data CEREBROS-UNO-NIRS is being developed. The next step is clinical validation. Expected commercialization is 2019 Middle.

c. **IP generated/ Potential for IP generation-** Point-Of-Care Monitoring Device For Neurological Disorders And Neurovascular Diseases And System And Method Thereof" Indian Patent Appl No: 201631012963, International Patent PCT : PCT/IN2017/050137

d. **Resources Generated -**
1. Electronics engineers specializing in Biomedical Engineering.
2. Electronics/Instrumentation lab with specialization in Bio-Signal processing.
3. Raised total funding of 1.8 Crore including equity, grants and awards.

Plans to take innovation further

Arogya is partnering with University of Buffalo to explore the technology's use in detection and management of neonatal hypoxic-ischemic encephalopathy HIE.

Risks envisaged

None

Project Coordinator: Abhijit Das

Team Members : Subro Mitra, Koushik Bakshi, Rajib Sengupta, Anirban Dutta

Contact : Arogya MedTech Pvt. Ltd., 1.22, Hafiz Mohammed Ishaque Road, Rhoto para, Mandirpara, Kolkata, West Bengal - 700082

Avinash Dental Laboratories & Research Institute Pvt. Ltd.

Title of the Proposal

Design and Development of Silicone based Cartilage like Ear, Nose, Eye, orbital Implants for cranio-facial reconstruction

Brief description

Developed Silicone based Implantable bio-materials for different uses like tissue expander, ear, nose orbital implants. As it is developed indigenously, cost of such products are also less compared to counterparts like medpore implant. Medical grade silicone is used as a base materials along with hydroxyapatite, titanium oxide etc. to overcome the silicone material's side effects like tissue fibrosis around the implant and infection. Other materials like Polylactic/polyglycolic acid copolymer, polydioxanone, polyglactin 910, polydioxanone, Silastic sheets, Porous polyethylene, Teflon etc. are also attempted so as to make more bio compatible for human uses.

Current Stage of development

Proof-of-Concept

Innovative Element (s)

Applicants have prepared Silicone-based biomaterial, reinforced with different types of easily available bio-active materials; like Titanium oxide, hydroxyapatite and other materials , thus conferring uniqueness in BioIntegration of implant in living tissue. These bioactive molecules add to the value of Silicone, by conferring several properties that mimics the cartilage.

Market potential

Various biomaterials like Medpore, methacrylate etc., are there in the market, being unsuitable as implants. Either they are hard or their rate of rejection is high. A global shortage of cartilage-like implant is there incuding in India. Therefore the economic value of final product is high, in the long run.

National/Societal relevance

The cartilage-mimicking bio-composite implant, that have been developed till date can be mass produced in an industrial scale, could earn foreign money, to generate employment through industry development which in turn would help in economic growth of our country. Both medical-grade silicone and the different bioactive material are easily available, and ideal for industrial scale-up production, thereby increasing earning potential. New techniques are being developed to use a combination of bone/cartilage /chondrocytes, growth factors, and resorbable plates to encourage native growth to repair defects. Apart from facial defects these can be used in Cranial vault defects.

Project achievements

a. **Progress vis-a vis objectives-** Silicone-based new composites were reinforced with different bioactive materials. After formulation, preparation and mechanical characterization, Bacterial Adherence test, Anti-microbial Sensitivity test performed for each material. Animal testing are in progress.

b. **Technology/ Product (to be) developed-** Currently Animal testing is in progress, therefore it may take another two year time for commercial production entering to the market.

c. **IP generated/ Potential for IP generation-** Yet to apply for the IP but there is potential.

d. **Resources Generated-** Currently the main source of earning and fund mobilization is from dental clinic and dental Laboratory. Six people are working with dedication under Dr. B.K.Biswas's guidance.

Plans to take innovation further

Partnerships with industry for fund raising in future.

Risks envisaged

Clinical trial is needed for the final outcome of the product. As silicon has some disadvantages, it needs long term follow-up. Rejection of the implant may also come up depending upon the host response.

Project Coordinator: Biswajit Kumar Biswas

Team Members : Sohini Sen, Sandip Bag, Rana Biswas and Sampa Dey

Contact : 210,Canal Street, Sreebhumi, Lake Town Kolkata, West Bengal 700048

Bagmo Pvt. Ltd.

Title of the Proposal

A smart blood bag monitoring device for safe and reliable blood transfusion in rural India

Brief description

Blood availability in rural area should be increased and in this regard, a novel blood bag monitoring solution is developed. The proposed solution addresses quality of issued blood bags from blood banks, i.e. individual blood bag monitoring solution, so that reliability of blood products can be assured. In the current scenario blood storage centers store less amount of inventory because of the fear of blood wastage. The proposed solution can reduce wastage of precious blood products, which in turn will increase the stock level of blood in storage centers.

Current Stage of development

Validation

Innovative Element(s)

Current method in developed world for monitoring blood bag is to attach temperature sensitive polymers which is prohibitively expensive for indian market. The proposed solution is tracking the temperature in an indirect way and which can achieve same results in an affordable way. The same technology is applicable for other bilogical high value products as well.

Market potential

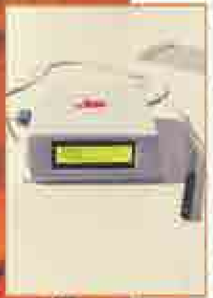
In India targeted market size is INR 18Billion and that is by only considering blood supply chain. Other developing countries may also need similar technology to tackle transfusion transmitted infection spreading. Once the product is ready with certifications overseas market will be explored.

National/Societal relevance

Bagmo can improve the efficiency of resource poor rural primary healthcare by enabling an efficient and easy to use blood bag monitoring system and blood storage centre information system. The proposed solution is expected to increase availability of blood and hence reduce maternal mortality due to haemorrhage.

Project achievements

a. **Progress vis-a vis objectives-** It has been planned to develop the product, validate and start gathering permissions for pilot studies. The team has completed primary prototype and validated with one installation and expected to complete two more installations in coming months. Currently aiming to start pilot study and impact assessment about the technology is going on.



b. **Technology/ Product (to be) developed-** Currently piloting the device is under process and looking for funds to finish the pilot study and measure the impacts in health matrices. Secondary version of prototype is currently being developed and which will be used for applying quality tests.

c. **IP generated/ Potential for IP generation-** A provisional patent has been filed.

d. **Resources Generated-** Manpower Employed: 6, Facility created: Assembly line for the proposed product for pilot study. Manufacturing the prototype in batch of 10 numbers.

Plans to take innovation further

It has been planned to accelerate the startup to complete pilot study which will be useful for licensing the technology or raise funds.

Risks envisaged

As the government is the largest provider of rural healthcare, technology should be accepted to government system.

Project Coordinator: [illegible]

Team Members: [illegible], Poncy PM, Vyshakh, Shafeek, Kamaruddheen, Roncy

Contact: Bagmo Pvt. Ltd., [illegible] street, [illegible] road, [illegible], Kerala - [illegible]

Biomoneta Research Pvt. Ltd.

Title of the Proposal

Z-Box: Electrodynamic Ablation of Pathogens from Healthcare Environments

Brief description

Biomoneta designs devices that extract and kill pathogenic contamination from the environment. The ability of this devices to kill microbes present at very high concentrations in air enhances the ability of hospitals and home care professionals to lower the rate of healthcare associated infections, especially multidrug resistant infections.

Current Stage of development

Validation

Innovative Element (s)

This technology exploits the *in situ* creation of antimicrobial surfaces to trap and kill tens and millions of microbes using air as a carrier medium. The ability to trap and kill, as opposed to merely trap, with very high efficiency is the key differentiating factor of this technology.

Market potential

Air decontamination technology has enormous application in multiple industries sensitive to microbial levels or infection spread such as healthcare, pharma and biotech manufacturing produce and meat storage, long distance travel such as in airplanes etc.

National/Societal relevance

The World Health Organization states that Healthcare associated infections, HAIs, are the most frequent adverse event in healthcare delivery worldwide. HAIs contribute significantly to mortality, hospital costs and loss of earnings due to hospitalization. Infections acquired in the ICU in the developing world are 2-3 fold higher than the 30 percent rate observed in the developed world, with infections acquired from devices being up to 13 fold higher.

Project achievements

a. **Progress vis-a vis objectives-** Project completed. Technology PoC demonstrated in the lab. Prototype deployed in the field for preliminary observations.

b. **Technology/ Product (to be) developed-** Prototypes to be validated in the field i.e. clinical settings. Final design expected to be ready for manufacture in 18 months.

c. **IP generated/ Potential for IP generation-** Patent applications filed with the Indian Patent Office and the PCT. Preparations underway for filing in the US.

d. **Resources Generated-** 4 people employed. Testing laboratories and protocols created. Angel funding secured.

Plans to take innovation further

Working to sign a partnership to manufacture and sell air decontamination devices. Talks also underway to license the technology for specific decontamination applications.

Risks envisaged

Market validation very dependent on deployment environment. Understanding various deployment conditions and ensuring device engineering is adequately robust is primary risk.

Project Coordinator: [illegible]

Team Members: [illegible]

Contact: [illegible], Karnataka - [illegible]

BiolMed Innovations Pvt. Ltd.

Title of the Proposal

Evaluation and validation studies on BiolMed BGS - a novel osteoconductive bone graft substitute

Brief description

Bone graft substitutes are important for accelerated healing and remodeling of bone defects caused by trauma, infection and some other conditions. Optimal combination of porosity, pore size, mechanical strength and rate of bioresorption along with excellent biocompatibility are essential characteristics of a bone graft substitutes. The product, Serioss™ is a 3D silk fibroin scaffolds based on patented process which has optimal combination of all above properties, unlike other synthetic products available today. These are highly effective scaffolds with suitable combination of mechanical properties, along with excellent biocompatibility. This product is a true replacement for autografts.

Current stage of development

Validation

Innovative Element(s)

Bone graft substitutes need optimal combination of porosity, pore size, mechanical strength, bioresorption along with excellent biocompatibility. Using the patented process, the company has developed silk fibroin scaffolds with all these properties. This is first of its kind product that uses silk fibroin for bone grafting applications.

Market Potential

Global bone grafts and substitutes market is valued at USD 2.35 billion and anticipated to grow at CAGR of 4.5% to reach USD 3.48 billion by 2023. Indian market share is 6-8 percent of global market. This translates into INR 650 Cr market.

National/Societal relevance

BiolMed Serioss™ aims to provide a high quality affordable solution to Indian orthopaedic surgeons for bone grafting surgeries. Currently, surgeons are forced to use autografts. This is the golden standard in the industry today due to unavailability and unaffordability of synthetic bone graft substitutes in India. Autografts have their own limitations like need of two surgeries and insufficient supply of bone. Serioss™ will be extremely useful, since it has all the desirable and essential properties of a bone graft substitute and will be available at a very competitive price. Secondly, it is based on silk fibroin. India happens to be the second largest producer of Bombyx mori silk. However all the silk produced is currently used for only textile applications. By developing such value added niche applications for an ancient material, BiolMed will help strengthen the mature sericulture industry in India and thus help in the upliftment of Indian seri farmers.

Project achievements

a. **Progress vis-a vis objectives**- Advanced Preclinical toxicity studies.

b. **Technology/Product (to be) developed**- Osteoconductive bone graft substitute.

c. **IP generated/ Potential for IP generation**- None.

d. **Resources Generated**- One B.E., One Ph.D. and one M.Sc. employed on the project.

Plans to take innovation further

BiolMed is in discussion with investors to raise funds to take Serioss through human clinical investigations.

Risks envisaged

Successful completion of preclinical investigations, clinical validations and market penetration.

Project Coordinator: Swati Shukla

Team Members : Anuja Patil, Premnath Venugopalan

Contact : BiolMed Innovations Pvt. Ltd., 100, NCL Innovation Park, Dr. Homi Bhabha Road, Pashan, Pune, Maharashtra-411008

BiolMed Innovations Pvt. Ltd.

Title of the Proposal

Development of Silk Fibroin composite matrix for use in breast reconstruction and augmentation surgeries

Brief description

The project aims at developing a proof-of-concept for silk fibroin composite matrix to be used in breast reconstruction surgeries. Breast reconstruction needs Acellular Dermal Matrices or synthetic meshes. Both ADMs and meshes have own constrains and an unmet need of synthetic matrix offering benefits of both is identified. The Company has developed Serimat™ which is optimized for properties such as pore size and porosity, tensile strength, degradation and biocompatibility.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The Company has developed unique composite matrix of regenerated silk fibroin, non-woven mesh and woven sheet of silk fibroin that has macro, micro and meso level porosity. This novel process resulted in the surface texture, increased surface roughness suitable for cell adhesion, cell proliferation and also angiogenesis.

Market Potential

Current numbers of breast cancer patients are 1.5 lac, and 60,000 opt for reconstruction after mastectomy. Each surgery uses either ADM or synthetic mesh, costing around Rs.20000. This translates into a market of 120 Cr. Thus, there is good commercialization potential in this product.

National/Societal relevance

Breast cancer is highly prevalent cancer in India and in the world. Removal of breast as part of treatment, leads to psychological trauma for the patient. Reconstruction of the breast assists immensely in rehabilitation of the patient thus improving quality of life of the patient. Products available for use in reconstruction today are either Acellular Dermal Matrices or Synthetic meshes. ADMs have been in use since year 2005 and have limitations like unavailability/ unaffordability. In addition, in India there is no manufacturer in the field of mesh or ADMs.

The Company has offered a solution to this problem by developing Serimat™, which has benefits of both ADM and synthetic mesh, without limitations. Affordable quality product will enable Indian woman to choose breast reconstruction post mastectomy. Women from rest of the world would benefit by the product similarly.

Project achievements

a. **Progress vis-a vis objectives**- The PoC has been established. A follow on SBIRI grant for the toxicity studies and efficacy studies is granted by BIRAC.

b. **Technology/Product (to be) developed**- Silk fibroin composite matrix to be used in breast reconstruction surgeries.

c. **IP generated/ Potential for IP generation**- Patent drafting under progress.

d. **Resources Generated**- One B.E. employed on the project.

Plans to take innovation further

Follow-on SBIRI grant for the toxicity studies and efficacy studies is granted by BIRAC. This will be followed by human investigations and market entry by 2021.

Risks envisaged

Though Silk has a long clinical history of usage as sutures, this is a new process and indication, therefore there is a need to walk entire regulatory pathway. New process needs to be proven safe in humans.

Project Coordinator: Swati Shukla

Team Members : Anuja Patil, Premnath Venugopalan

Contact : BiolMed Innovations Pvt. Ltd., 100, NCL Innovation Park, Dr. Homi Bhabha Road, Pashan, Pune, Maharashtra-411008

Bionic Hope Pvt. Ltd.

Title of the Proposal

A Low cost, EMG controlled robotic prosthetic Hand with a sense of touch for upper limb amputees

Brief description

Technology for making prosthetic hands for amputees. Device helps them in doing their day-to-day activities. Most of the hand amputees live without a prosthetic hand simply because they can't afford it. Bionic Hope is changing that by making an affordable, advanced prosthetic hand. One of the distinguishing features is the ability to provide Sense of touch, which means users will be able to feel the objects they grasp, unlike anything else in the market. Present device is super quick to learn and easy to operate.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

i. Muscle Displacement Sensors , ii. Sense of Touch, iii. Customizable hand sizes

Market potential

Around 0.8 million upper limb amputees in India, while there are about 3.5 million amputees all over the world who need hand prosthesis. Twenty thousand hand amputations occur every year just in India due to road and rail accidents.

National/Societal relevance

1. Help amputees to overcome social stigma and personal embarrassment by regaining their confidence in themselves as differently abled.
2. Opportunity to provide them the employment to come back to their normal lifestyle to ensure the socio-economic well-being of the users.
3. To a large extent are biodegradable materials used so it does not harm the environment in the long run .

Project achievements

a. **Progress vis-a vis objectives-** Prototype was tested on Nine Amputees and got positive feedback. Development of SOT device is complete.
b. **Technology/ Product (to be) developed-** A MVP based on testing and validation of the prototype will be completed by end of this year.
c. **IP generated/ Potential for IP generation-** There is a Potential of IP generation during the development of SOT Device in neuropathy and bionics.
d. **Resources Generated-** NA

Plans to take innovation further

Post Proof of concept the company plans on creating a Minimum Viable Product and perform validation testing with Hospitals

Risks envisaged

Regulatory requirements for medical devices in India.

Project Coordinator: Llewellyn Grenold Loy Dsa

Team Members : Kumari Priyanka, Prasanna Ranjan Behera, Anil Nair, Akshay Saxena, Wachanti Ria

Contact : Bionic Hope Pvt. Ltd. A 603, Amora Towers, Sundtpoff 100 Ft Road, Ambadi Road, Vasai Road, West Thane, Maharashtra 401202

BlackFrog Technologies

Title of the Proposal

Sanjivani - A Vaccine Carrier

Brief description

BlackFrog Technologies is working on developing an insulated portable carrier with an independent Peltier-chip enabled cooling system - SANJIVINI, to serve the healthcare needs of developing countries. The device is aimed to make remote delivery of temperature-sensitive vaccines like Polio and critical medications like anti-venom vials, insulin etc to remote areas without loss of the medications potency. Given the 2-8 degrees Celsius standard for most laboratory cold-storage, BlackFrog is devising an auxiliary utility to this product wherein tissues or blood collected from patients can be safely carried back to the central laboratory as well.

Current Stage of development

Validation

Innovative Element(s)

The design of the product has been optimized to minimize heat-entry and ensure refrigeration from Solid-state cooling, which is otherwise a highly inefficient process.

Market potential

Currently focusing on hospitals and laboratories in South-India for transporting biological samples. The end-goal of the product is to replace the blue-box with ice-packs which are a standard issue device provided by WHO.

National/Societal relevance

Immunization Technical Support Unit under India's Health Ministry claims 25% of all vaccines go to waste in India due to poor cold-chain management. The wastage is close to 50% for some other vaccines like BCG. Sanjivani seeks to provide refrigeration for these biological materials as well as provide accountability.

Project achievements

a. **Progress vis-a vis objectives-** Developed a Proof-of-Concept that works on direct AC power. Optimizing the function to ensure the least possible battery consumption and simultaneously testing the product in the field
b. **Technology/ Product (to be) developed-** Approximately 7 months more to finalize the battery design and conclude the industrial design of the prototype.
c. **IP generated/ Potential for IP generation-** In process of applying for a Design Patent.
d. **Resources Generated-** Blackfrog Technologies Pvt. Ltd. has an in-house prototyping setup. 5 engineers are working full-time on the project.

Plans to take innovation further

Plan to apply for BIRAC's SBIRI scheme with support from Manipal University TBI, wherein applicants are currently incubated.

Risks envisaged

Competition from big players in international market.

Project Coordinator: Mayur U. Shetty

Team Members : Ostoon D Souza, Somnath Maddula, Sharon Andrew, Akshay M, Avinash Thakur

Contact : BlackFrog Technologies Pvt. Ltd. D.No. 1-72 E, Kegil Village, Heroor, Kundapur, Karnataka 576204

Brijesh BV (C-CAMP)

Title of the Proposal

Device for rapid and accurate point of care measurement of total serum bilirubin for Diagnosis of neonatal hyperbilirubinemia

Brief description

Neonatal jaundice or hyperbilirubinemia is one of the most prevalent conditions in new-borns. Almost 60 percent of neonates go through one form of jaundice or other. A point of care device to diagnose Neonatal Jaundice that works on whole blood and can effectively diagnose Bilirubin levels in neonates using just a drop of blood is developed. The device will be handheld and portable, with accuracy at par with that of laboratory analysers. The sample volume is so low that it can potentially reduce the incidence of Iatrogenic Anaemia in neonates.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

This product can diagnose Jaundice instantaneously and accurately at a point of care for a neonate using unadulterated whole blood without using any reagents, unlike other devices which depend on the serum to do a diagnosis of Neonatal Jaundice which doesn't make the device true point of care and causes a delay in diagnosis.

Market potential

Jaundice occurs in 60 percent of term infants and 80 percent of pre-term infants. This being the case, there is a need for effective diagnosis in 100 percent of the neonates. Thus all the facilities from primary to tertiary health care centers which care for neonates are the potential target customers.

National/Societal relevance

Over 120,000 babies, worldwide, die due to jaundice every year. India, being a developing country has different levels of care offering to diagnose neonatal jaundice, right from the bare essential of just clinical diagnosis in rural and primary health care centers, to a combination of both transcutaneous and laboratory-based analysis systems in posh tertiary hospitals. Present device can fit into both the rural care scenario as well as the tertiary care scenario and effectively improve the quality of jaundice management in all these centers by providing a quality point of care diagnosis.

Project achievements

a. **Progress vis-a vis objectives**- Initial versions of software, hardware have been developed and integrated and have been proved to work together. An initial prototype has been developed and initiated laboratory validation. Applicants are planning to do validation with a greater data set once there is ethical clearances for getting a greater set of volunteers.

b. **Technology/ Product (to be) developed-** Applicants are working on developing beta prototype with all the feedback from alpha prototype. Neural network is not trained yet and they are working towards achieving greater accuracy with the device.

c. **IP generated/ Potential for IP generation**- Filed for a provisional patent under the title Device and method to perform quantitative measurements of whole blood constituents, and will file the final patent in the coming months.

d. **Resources Generated**- One full-time intern hired and a company incorporated under the name Neospec Labs.

Plans to take innovation further

After beta prototype development applicants intend to get all regulatory approvals to conduct clinical trials and raise further equity funding to achieve commercialization.

Risks envisaged

The cost associated with the disposable component of the device needs to be under INR 150. Design efforts are being focused towards this, but if the cost doesnt fit below that threshold, it might need a reevaluation of the business model.

Project Coordinator: Brijesh B V

Team Members : Mohan Kumar Shivan, Narayana G.S.

Contact : Brijesh B.V, No. 2402, 12th B cross, Mahalakshmipuram, Bangalore, Karnataka - 560086

Cartosense Pvt. Ltd.

Title of the Proposal

Portable Surgical Navigation System

Brief description

Surgical navigation in neurosurgery is the gold standard of care globally, but most patients in emerging markets lack access to this high standard-of-care. Cartosense is developing a compact surgical navigation system that guides neurosurgeons to accurately target deep-seated structures in the brain through safe and minimal skull openings.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Aim is to develop a navigation system based on proprietary tracking technology in a novel form factor that is compact, occupies minimal space in cluttered OTs, and is very cost-effective to build. The patient registration algorithms will allow operating on patients in any position, unlike existing products.

Market Potential

Neurosurgical guidance systems represent a growing market, already worth USD 400M globally. The domestic market is a potential 50-100 Cr in annual revenues. The product currently being developed is part of platform technology that opens access to USD 2B+ global markets in brain and spine surgery, and interventional radiology.

National/Societal relevance

Majority of patients that undergo brain surgery have post operative complications, such as functional deficits, seizures, hemorrhages, etc. because of the complicated nature of procedures. This technology will facilitate careful and targeted access, and reduce human error, which is paramount in ensuring that brain surgery is safe. In India, navigated surgery is only available in the busiest/most expensive hospitals in Tier 1 cities. The aim is to democratize access to minimally invasive and safe surgery.

Project achievements

a. **Progress vis-a vis objectives**- Technology for tracking surgical instruments and low-latency wireless communication between the tracking system has been developed. A sterilizable surgical probe and a universal adapter are currently being designed with a focus on usability and ergonomics.

b. **Technology/Product (to be) developed**- A large working-volume optical tracking system that can track smart wireless surgical instruments with high-accuracy. Time to market: 1 year

c. **IP generated/ Potential for IP generation**- Indian patent 201821018357 has been filed.

d. **Resources Generated**- Facility is being setup, a senior industrial designer has been engaged.

Plans to take innovation further

Clinical validation is being targeted by end of the project.

Risks envisaged

Setting up a high-quality and cost-effective supply chain for the trackable instruments and getting them right in the first time is crucial for meeting cost and commercialization timelines.

Project Coordinator: Nishit Chankeshia

Team Members : Sreejesh Chandrappan, Hem Rampal

Contact : Cartosense Pvt. Ltd., Flat No. 3, Vijay Kiran Apt, Plot No.187, Shanta Anand Mukherji Rd, Tilak Colony, Nasik, Maharashtra - 422005

Cutting Edge Medical Devices Pvt. Ltd.

Title of the Proposal

Scintiglo - a portable urine protein analyzer device for Mass Healthcare

Brief description

SCINTIGLO, is a novel PoC diagnostic device for quantitative estimation of proteins in urine. It helps in accurate and early diagnosis of kidney damage and is a dedicated device based on a novel Platform Technology indigenously being developed. The Cost per test on SCINTIGLO for Microalbuminuria is projected to be around 3 to 8 times less with an accuracy matching the industry gold standard.

Current stage of development

Validation

Innovative Element(s)

The PoC urine analysis market is filled with dip-sticks/dip-strips and smartphone or dedicated costly devices to read them. They are very costly and have many inaccuracies inherently because of the biochemistry involved. The Company has come up with an intelligent dedicated NON-DIPSTICKS based highly accurate and sensitive urine protein analyser which can very easily identify not only albumin but all other proteins too in the urine and other colourless body fluids instantly and very accurately. It also has the capabilities of data logging and telemetry.

Market Potential

The methods currently available for the early diagnosis of kidney damage are either very costly and scans or not sensitive enough. Hence, the device has a market potential for Diagnostics and Home Healthcare.

National/Societal relevance

The device being developed shall help in supporting and saving in Aayushman Bharat Scheme by a timely diagnosis of kidney damage. In addition, every pregnant woman needs to be monitored at least 4 times for Proteinuria to early diagnose complicated pregnancy. In addition, home based healthcare could be made available effectively through the device.

Project achievements

a. **Progress vis-a vis objectives-** Product development for commercialization and huge community based clinical trial on around 5000 patient samples is in progress.

b. **Technology/Product (to be) developed-** A portable urine protein analyzer being developed and validated.

c. **IP generated/ Potential for IP generation-** Patent already applied and incremental IP also shall be protected.

d. **Resources Generated-** 7 technically qualified people are working on the project and now have experience in various aspects of medical device development. In addition, a Grant from MILLENNIUM ALLIANCE for Clinical trial and product development has been received. The Company has won a Television Reality show on Innovation and Entrepreneurship on CNN NEWS18 called PULSE THE VENTURE.

Plans to take innovation further

Market launch and Fundraising for rapid expansion and deeper market penetration.

Risks envisaged

Market penetration and expansion.

Project Coordinator:
Pankaj Pansheria

Team Members :
Rohit Sharma, Ankush Pansheria, Arpan Yadav, Mithilesh Kumar Pal, Naveen Nagore, Shahnaz Ansari, Nidhi Pal

Contact :
Cutting Edge Medical Devices Pvt. Ltd., Sector 24/K, Sultania Nagar, Indore, Madhya Pradesh-452006

Debasis Biswas (KIIT)

Title of the Proposal

Developing improved diagnostics for Dengue, based on NASBA assay of non-invasive clinical samples

Brief description

A NASBA assay for detection of Dengue viral RNA from urine, a non-invasive clinical sample. NASBA is a one-step isothermal process for amplifying RNA. The amplification can be achieved within 60 minutes. This diagnostic assay is a sensitive and specific molecular diagnostic technique for Dengue detection from urine samples. The assay is field-adaptable owing to the isothermal nature of amplification and relative ease of sample collection. Broader diagnostic window is also obtained by the assay as prolonged viral excretion in urine samples for a period of 16 days has been recently demonstrated in literature.

Current stage of development

Validation

Innovative Element(s)

The assay is field-adaptable owing to the isothermal nature of amplification and relative ease of sample collection.

Market Potential

Globally, dengue incidence is rising and apart from the endemic regions, it is emerging in new territories. This kit has a tremendous potential of commercialization since it provides a cost-effective, molecular diagnostic tool in a field adaptable manner and over a longer duration of the disease, compared to the currently available technique of RT-PCR from blood samples.

National/Societal relevance

India is witnessing a recent increase in the burden of Dengue with the number of cases rising year by year. Current diagnostic tests for dengue are constrained by the requirement of blood samples and by the limited time-window in the natural course of the disease, during which they are applicable. The development of improved diagnostics for dengue shall have far-reaching benefits.

Project achievements

a. **Progress vis-a vis objectives-** Following objectives have been achieved:
   1. Collection of samples from patients as per inclusion and exclusion criteria.
   2. Extraction of RNA from collected samples.
   3. Standardization of NASBA assay.
   4. Assay evaluation for Sensitivity and Specificity.

b. **Technology/Product (to be) developed-** The technology is under development. It can be commercialized as a stand-alone kit comprising of all reaction components required for the molecular diagnosis of Dengue from non-invasive clinical samples like urine. It will take 3-4 years to enter market following multi-centric evaluation and field trials.

c. **IP generated/ Potential for IP generation-** Filing of a provisional patent is underway.

d. **Resources Generated-** 1. Two Senior Research Fellows.

Plans to take innovation further

Innovation is at the stage of validation. Once completed, field trials shall be initiated.

Risks envisaged

Apart from technical advantages and logistic benefits, commercial success of this kit would depend on favourable review, wide publicity and endorsement of opinion leaders.

Project Coordinator:
Debasis Biswas

Team Members :
Ankita Agarwal, Sudipan Gupta, Dipesh Kale, Snehal Rajesh Kakade, Shweta Dhingra, Gurvir Bhatia, Ashwin Rao

Contact :
Department of Microbiology, All India Institute of Medical Sciences, Bhopal, Saket Nagar, Bhopal, MP- 462024

Df3d creations Pvt. Ltd.

Title of the Proposal

Cloud based platform for creation of 3d printed Surgical Guides online

Brief description

Cloud based platform for creation of 3d printed Surgical Guides online.

Current stage of development

Validation

Innovative Element(s)

Online platform to create surgical guides online for mandibular reconstruction thereby reducing the time needed and reducing the overall costs.

Market Potential

High impact on increasing accuracy and efficiency of surgical outcomes.

National/Societal relevance

Affordable solution for reconstruction during Oral Cancer Surgeries

Project achievements:

a. **Progress vis-a vis objectives-** Currently in verification phase

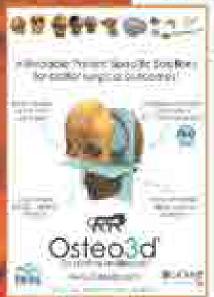
b. **Technology/Product (to be) developed-** Cloud based platform for creation of 3d printed Surgical Guides online.

c. **IP generated/ Potential for IP generation-** IP will be applied.

d. **Resources Generated-** N.A

Plans to take innovation further

Commercial launch.



Risks envisaged

Adaption curve by surgeons who use conventional technologies.

Project Coordinator: Deepak

Team Members : Nachi, Himaja, Pavan, Geetik

Contact : 519, 3rd Floor, 24th Main, 2nd Sector, HSR Layout, Bangalore, Karnataka - 560102

Dzeal Pvt. Ltd.

Title of the Proposal

Rotary endodontic file in basket form

Brief description

A new file design that increase the success rate of root canal treatment of tooth by reducing the incidence of file separation and efficient cleaning of root canals without sacrificing sound dentine.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Multiple joined thin wires and absence of flutes decrease the chances of file separation in the canal, it would be very easy to retrieve the complete file out of canal without any additional equipment and expertise. No active cutting down of dentine, as excess removal of dentine by solid extra flaring files weakens the tooth structure.

Market Potential

25 Billion Market Potential. Market penetration of 5 percent will give approximate commercialization potential of 1.2 Billion.

National/Societal relevance

Dental caries and related dental procedures are very high in dental clinics across India. The proposed device will be of use in these procedures.

Project achievements

a. **Progress vis-a vis objectives-**

1. Manufacture the file in required specifications- Completed.
2. Mechanical tests as per the ISO standards- Completed.
3. Comparative study with the existing file- Under going.
4. Clinical validation with ex vivo study for clinical efficacy, clinical study for operators ease and patients comfort- planned as next step.

b. **Technology/Product (to be) developed-** BIG file is under development and they plan to enter the market in 18 months.

c. **IP generated/ Potential for IP generation-** An Indian & PCT Application is filed.

d. **Resources Generated-**

1. Enterprise Dzeal Private Limited is formed.
2. Facility for in house assembling and testing has been created.
3. Manpower for 6 position recruited.

Plans to take innovation further

Plan to do clinical validation and manufacturing-commercialization by raising funds.

Risks envisaged

Safety: Mechanical tests shows better results than existing system. Efficacy: under study. Market: Involves educating and training the dentists in new technology.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : [illegible] Sector 18, Palm Beach Road, [illegible] Maharashtra - [illegible]

Embryyo Technologies Pvt. Ltd.

Title of the Proposal

Design, prototyping and testing of novel, self expandable, axially flexible non-vascular stents at one-tenth the cost of similar products

Brief description

The innovation is a novel design of a self-expandable esophageal stent that can help restore the lumen patency of the esophagus in the cases of esophageal cancer. Unlike the commercially available esophageal stents that are composed of expensive shape memory alloys, such as Nitinol, the proposed product is created using a novel metal-polymer composite in a scrolled design configuration. Thin foils of medical grade stainless steel are sandwiched between layers of medical grade silicon to form a composite sheet which is inexpensive as compared to nitinol and is capable of expanding to 3 times the initial constrained diameter.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

A novel design to overcome a number of drawbacks of the commercial stents, such as stent migration, foreshortening, and recoil. The core materials are easier to machine than Nitinol, reducing the manufacturing cost of the end-product by approximately 90%.

Market potential

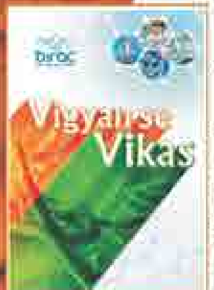
The global market for non-vascular stents are growing at an expected CAGR of 5.3% from 2014-2020, to reach an approximate worth of 741.7M USD by 2020, and the number of cases of esophageal cancer expected to rise by 140% by 2025. The proposed device will have a significant role to play.

National/Societal relevance

Esophageal cancer is the fourth-most common cause of cancer-related deaths in India. Nearly 100 esophageal stents are deployed in the country every day, as per clinicians. There is a cost barrier for many patients in affording the existing expensive commercial stents. Additionally, issues such as stent migration and placement errors caused due to foreshortening of commercial stents can extend the duration of and cause complications during surgical procedures. The proposed technology satisfies the unmet clinical need for a stent that minimizes placements issues, foreshortening, dog-boning, stent migration etc. at an affordable cost.

Project achievements

a. **Progress vis-a vis objectives-** Completed the engineering testing for parameters such as flexibility, radial stiffness, abrasion, corrosion etc. and biocompatibility testing as per ISO 10993 on an engineering prototype of the product.



b. **Technology/ Product (to be) developed-** A platform technology that can be applied to esophageal, duodenal, colorectal stenting and to similar clinical conditions that affect other non-vascular lumens in the body.

c. **IP generated/ Potential for IP generation-** A Complete patent application and PCT application has been filed with title "RADIALLY SELF-EXPANDABLE ROLLED UP TUBULAR STENT". IP jointly owned by Embryyo Technologies Private Limited and CSIR- NCL Pune.

d. **Resources Generated-** Generated employment for 5 people. The technology will further create employment in the later stages where other skills are also required.

Plans to take innovation further

The business strategy involves outsourcing the manufacturing and distribution through established local and global manufacturers and distributors of medical devices and follow a geography-specific/application-specific licensing model.

Risks envisaged

Finding affordable clinical research facilities for establishing pre-clinical efficacy of the device using cadaveric and animal studies is a minor risk. Mentorship required for technical documentation on the device for regulatory submission.

Project Coordinator: Prateek Jain

Team Members : Mahesh Kumar

Contact : Embryyo Technologies Pvt. Ltd., 100, NCL Innovation Park, Homi Bhabha Road, Pashan, Pune, Maharashtra – 411008

Forus Health Pvt. Ltd.

Collaborators: Healthcare Technology Innovation Center, IIT Madras & Narayana Nethralaya Foundation

Title of the Proposal

Shishunethra - Preventing blindness in Infants

Brief description

The 3nethra neo is a compact, portable and easy to use mydriatic digital wide field imaging system used for the photo documentation of ocular diseases that manifest in human eyes. The ergonomically designed light weight hand piece allows for single handed operation and offers 120 degrees FOV to capture high resolution images of the posterior and anterior segments of the eye.

Current stage of development

Commercialization

Name of the commercialized Product/Technology- 3nethra neo

Date of commercial launch- 2017-01-16

Number of units sold- 73

Number of end users- 73

Innovative Element(s)

The current practice requires an ophthalmologist to perform the screening procedure and the findings are hand drawn documentation which are not effective for tracking progression/regression of ocular diseases. 3nethra neo can be operated by any trained technician and offers digital photo documentation thereby enabling a more informed clinical decision.

Market Potential

Enabling all the NICUs with 3nethra neo to ensure that all premature babies are screened for Retinopathy of Prematurity. It is established that 5% of full term babies also have some form of an ocular disorder, which provides further opportunity.

National/Societal relevance

Out of the 15 million global pre-term births annually, India has the highest at 3.5 million. All the premature babies cared at NICUs are susceptible to developing a condition called Retinopathy of Prematurity. ROP which can result from unregulated supply of oxygen. ROP is a potentially avoidable cause of irreversible, total blindness in infants who are born premature and in India its incidence is reported to be 37-54% with about 7-15% requiring treatment. Lack of ROP specialists, lack of effective retinal screening solutions are the limitations addressed by 3nethra neo having a portable camera which can be operated by even trained technicians.

Project achievements

a. **Progress vis-a vis objectives-** Objectives included System design and validation, Software development for image sharing and diagnostic assistance, compliance with medical standards, prototype validation and commercialization. All the objectives have been met.

b. **Technology/Product (to be) developed-** The product is 3nethra neo: A compact, portable and easy to use mydriatic digital wide field imaging system used for photo documentation of ocular diseases that manifest in human eyes.

c. **IP generated/ Potential for IP generation-** Method and Computing unit for imaging of wider angle fundus of an eye of a subject 1233/CHE/2015, WO2016/142752 A1 An illumination device for illuminating close objects and method thereof 472/CHE/2015, WO2016/128657

d. **Resources Generated-** Few engineers were trained on developing complex ophthalmic products.

Plans to take innovation further

Plans to develop a ROP camera with fundus fluorescein angiography and a ROP camera with laser.

Risks envisaged

None.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : Forus Health Pvt. Ltd., [illegible] Bangalore, Karnataka 560070

Genomix Molecular Diagnostics Pvt. Ltd.

Collaborator: National Research Centre on Equines–ICAR, Hisar

Title of the Proposal

Scheduling Equines from Fatal Zoonotic disease- Glanders and Equine Infectious Anemia EIA in India using Point of Care Diagnostics POCD

Brief description

Glanders caused by *Burkholderia mallei* is a fatal infectious disease of equines with zoonotic significance and has been identified as an agent in bioterrorism. Existing diagnostic techniques for glanders and EIA are complicated by use of lot of reagent components like Complement Fixation Test (CFT) and are subjective. The innovation based on defined and homogenous purification of recombinant proteins has advantage over CFT or Agar Gel Immune Diffusion assay. ELISA or LFA envisaged for developing in the project along with existing recommended technique would be very helpful for efficient surveillance of Galanders.

Current stage of development

Validation

Innovative Element(s)

The present proposed methods of ELISA and multi-epitope based Lateral flow kits do not use any of the pathogen derived raw material which avoids potential hazardous risk in preparation of the kits. The joint effort to develop large scale GMP grade rapid diagnostic kits will be first of its kind for these two important diseases for equine healthcare point of view. The epitopes selected for developing diagnostics in this project is another novelty.

Market Potential

The focus of the innovation is to take the existing R&D technology to translational mode as these two diseases are notifiable and one of it, glanders is a potent zoonotic in nature and is re-emerging. There is tremendous export value for the product targeting the equine industry in Middle East, Europe and USA.

National/Societal relevance

Active surveillance of equine population using sensitive and specific diagnostic tool is utmost necessary to assess current status of EIA & Glanders. Both are notifiable disease. Positive cases are notified by the NRCE to State Animal Husbandry Authority and Animal Husbandry Commissioner, Ministry of Agriculture & Farmers Welfare, Govt of India. As there is no vaccine and treatment against these disease prevailing control policy entails elimination of the positive animals and follow-up surveillance around 5-20 km radius of the outbreak zone.

Project achievements

a. **Progress vis-a vis objectives-** The aim is to develop a simple, inexpensive, sensitive and specific diagnostic kits like ELISA and LFA for Glanders and EIA. Reagents prepared at the collaborators place were used in development of ELISA and Rapid diagnostic kits and were validated at collaborated place with OIE validated sera panel. Recombinant protein production and purification completed at 5 L scale. ELISA and RDT kit manufacturing are ongoing as per GMP and ISO 9001 &2008 guide lines.

b. **Technology/Product (to be) developed-** Four products, 1. LFA for Glanders; 2. ELISA kit for Glanders; 3. LFA for EIA; 4. ELISA kit for EIA.

c. **IP generated/ Potential for IP generation-** Two national patents were filed for Hcp1 and TssA. 1) Recombinant TssA protein for detection of antibodies against Burkholderia mallei and uses thereof 3610/DEL/2015; 2) Recombinant Hcp1 protein for detection of antibodies against Burkholderia mallei and uses thereof 4120/DEL/2015. New diagnostic methodologies based on these proteins may lead to generation of new IP.

d. **Resources Generated-** Three research students were trained including one Ph.D candidate is working on this project.

Plans to take innovation further

Four to five independent products will be released into market once the products are validated by third party and drug control license is obtained.

Risks envisaged

None.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : [illegible]

Genrich Membranes Pvt. Ltd.

Title of the Propose

Oxygen Enrichment unit (OEU) for increasing life expectancy of aging patients suffering from COPD and Asthma

Brief description

Hollow fibre based membrane technology for gas separation is practiced for various niche market segments including oxygen enrichment of air for medical, fermentation and industrial applications, biogas enrichment, hydrogen recovery and dehumidification of air. Oxygen Enrichment Unit for oxygen therapy will revolutionize the concept of oxygen therapy in our country while reaching to every needy patient. The product is portable, simple, energy efficient, indigenous and accessible to each needy patient.

Current stage of development

Validation

Innovative Element(s)

Advantages of membrane technology over the conventional technologies like PSA/cryogenic include ease in operation and scaling-up, energy efficient, cost-competitive, small footprints, etc.

Market Potential

India has ~34 million COPD patients of 350 million globally and 90% COPD deaths are from Below Poverty Line section of society. COPD will be third leading death-cause by 2030. Considering average treatment cost including capital, service and recurring cost per patient, Indian TAM is USD975 million. Dehumidifier is untapped market in India.

National/Societal relevance

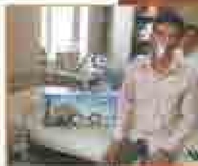
90% deaths due to COPD in India are from low- and middle-income sections due to unavailability and inaccessibility of the current treatment options. The current methods including oxygen from cryogenic plants or PSA-based oxygen concentrators depend partially or fully on imported technology and/or hardware, thereby are costly and are available mostly in big hospitals. Though oxygen cylinders are available in urban areas, logistic issues make them costly for semi-urban and rural/remote areas. The proposed OEU will address the problem at the door step of the patients instead the patient coming to the cities and bigger hospitals.

Project achievements

a. **Progress vis-a vis objectives-** Upgrading current technical facility to improve HF-membrane performance. Agreement with one hospital in semi-urban area is signed field trials. Design, fabrication of portable and compact devices are in progress. After completing field trials and necessary certification, market entry is envisaged in next 9-10 months.

b. **Technology/Product (to be) developed-** Portable, membrane based, Oxygen Enrichment unit (OEU).

c. **IP generated/ Potential for IP generation-** Process optimization of in-licensed lab-scale technology is completed. Process and product patent for Oxygen Enrichment Unit OEU and air-dehumidifier will be filed soon.



d. **Resources Generated-** Nine jobs created and currently five chemical engineers trained/employed. Additionally, seven project interns trained. Upgraded the technical facility to improve membrane performance. INR 50 lakh raised as equity funding from NSTEDB, and around INR 6.5 lakh won as award money through various startup competitions.

Plans to take innovation further

Aiming to raise fund for facility scale up, productization and, certification. Simultaneously, exploring strategic partnerships for two products-oxygen enrichment unit and air-dehumidifier.

Risks envisaged

Conducting filed trials at speciality hospitals is time and cost intensive and obtaining quality certification like ISO and CE are very expensive.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : [illegible]

Habib Ali (IKP)

Title of the Proposal

ARM-ABLE : An interactive arm training rehabilitative device. Fun therapy, Better recovery

Brief description

A game based neurorehabilitation device for individuals with upper limb deficit. This device allows patients to adhere to therapy and stay motivated, enabling them to perform 10X more repetitions than usual, such that it augments their recovery process.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Innovation includes Biomimetic Trajectories, Groove System, Affordable and Accessible, Full Range of motion, Multiple Planes, Tele - Rehabilitation, Intelligent and adaptive games etc.

Market Potential

More than 5000 Potential clinics in India and more than 20 Lakh individuals can benefit from such a device. In terms of numbers this translates to a TAM of 1000 Crore INR and SAM of 500 Crore INR.

National/Societal relevance

Along with the increase in incidences of stroke, non-compliance with physiotherapy and rehabilitation results in low recovery rates. The proposed device will motive the patients to adhere to the rehabilitation therapy.

Project achievements

a. **Progress vis-a vis objectives-** Partially completed the three objectives. Prototyping is completed and refining the design for manufacturing and assembly processes.
b. **Technology/Product (to be) developed-** Prototype of the interactive arm training rehabilitative device.
c. **IP generated/ Potential for IP generation-** Indian patent and a PCT filed.
d. **Resources Generated-** 2 People employed

Plans to take innovation further

Working on Fund Raising and getting regulatory approval for the product.

Risks envisaged

Generating Clinical evidence and supporting data. Ensuring regulatory compliance and data security.

Project Coordinator: Habib Ali

Team Members : [illegible]

Contact : Habib Ali, 11-5-[illegible] Hills, Hyderabad, Telangana - 500004

Helixworks Technologies Pvt. Ltd.

Title of the Proposal

Parallel assembly of very short oligonucleotides to build gene length DNA

Brief description

DNA synthesis and recombination methods are still too limited, slow and costly to produce necessary DNA fragments for the large scale projects to create the breakthroughs in applications desired. Helixwork is actively developing its novel DNA synthesis platform to accelerate the engineering capabilities with biology.

Current stage of development

Proof-of-Concept.

Innovative Element(s)

The patent pending DNA Synthesis technology employs a novel enzymatic method that is agnostic to the DNA sequence and is capable of synthesising complex DNA regions of short and long fragments despite of their arrangements.

Market Potential

According to Allied Market Research, the global synthetic biology market is expected to reach $38.7 billion by 2020.The target customers are segmented into three categories R&D customers, synthetic biology companies or Biotech start-ups and industrial organizations.

National/Societal relevance

Synthetic DNA is a raw material for genetic engineering research and development across different industries such as biotech and pharmaceutical companies, chemical industry etc. It also finds application in the medical sector in terms of developing novel cancer and prenatal therapies, vaccines and antibodies production, in vivo diagnostics etc.

Project achievements

a. **Progress vis-a vis objectives-** Achieved assembly of Human Insulin (INS) gene using only oligonucleotides employing a software-aided ssDNA assembly approach and have shown that the same strategies could be implemented and scaled to commercial level.
b. **Technology/Product (to be) developed-** Scalable software-aided ssDNA assembly approach for gene assembly.
c. **IP generated/ Potential for IP generation-** A patent application is under the process to be filed for the technology that has been developed. "A novel ssDNA and RNA synthesis method mediated by RNA ligase."
d. **Resources Generated-** 3 persons employed and trained.

Plans to take innovation further

Actively engaging with researchers and in talks to collaborate and provide gene synthesis services.

Risks envisaged

Major challenges is scaling the technology to deliver high quality products and keeping a realistic pricing.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : Helixworks, [illegible] NRI Block, [illegible] A.P. - 522501

Iatome Electric India Pvt. Ltd.

Title of the Proposal

Commercialisation and Development of Compact High Frequency X-Ray Machines

Brief description

To design and develop X-Ray machines with contemporary features. The technology involves high frequency switching, composite insulation and shielding, battery operation and intelligent electronics.

Current stage of development

Validation

Innovative Element(s)

High frequency switching, composite insulation and shielding, battery operation and intelligent electronics.

Market Potential

The Indian market potential is estimated to be about Rs.250 Crores.

National/Societal relevance

The products are import substitutes. The features such as battery operation, wireless imaging and portability allow the use in remote locations.

Project achievements

a. **Progress vis-a vis objectives-** Wireless imaging validation is in progress. For the mobile X-Ray unit, regulatory certification is complete and manufacturing set-up is in progress.

b. **Technology/Product (to be) developed-** Mobile X-Ray, Portable X-Ray and Wireless Digital Sensor.

c. **IP generated/ Potential for IP generation-** There is potential for 5 patents which are yet to be applied.

d. **Resources Generated-** Currently, 25 people are employed and the Company is creating a 10,000 sq feet manufacturing set-up.

Plans to take innovation further

The Company is seeking private funds for expansion.

Risks envisaged

Regulatory compliance and competition from imports.

Project Coordinator: Biju S Nathan

Team Members : P K Chandran, Lavanya, [illegible] C K

Contact : Iatome Electric India Pvt. Ltd., No 305, Ranga Vilas, New Dharmi Nagar, PN Palayam, Coimbatore, Tamil Nadu - 641037

Indian Institute of Technology, Bombay

Title of the Proposal

Point of care diagnostic test kit for Free and bound cholesterol, HDL and LDL in whole blood

Brief description

This project is intended to develop a complete point-of-care kit containing colorimetric strip and reader for quantification of total cholesterol and HDL using the whole blood. The colorimetric strip will be made by immobilization of the enzyme onto the paper surface by conjugation with polymer and specific surfactant solubilization chemistry. The proposed methodology will be capable of determining HDL cholesterol without plasma centrifugation and addition of phosphotungstic acid.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The amount of hemoglobin present in the blood has a significant effect on the enzymatic method of determination of cholesterol. In the proposed method RBC membrane filter is pre-treated with salt potassium chloride isosmotic agent sorbitol to reduce RBC lysis to higher extend to minimize haemoglobin interference. The proposed colorimetric test will be homogeneous strip method without the need for any centrifugation and other sophisticated instruments. Colorimetric sensor use in the electronic reader is TCS3275 which is first in this category in such type of devices.

Market Potential

Current HDL and triglyceride strips cost around USD 5 each and strip analyzer around USD 80 which is much costlier than the method developed under this project. Strips developed will be much affordable than current marketed HDL and triglyceride diagnostic strips. Colorimetric reader cost will be a one-time investment. As of now, no Indian manufacturer strips are available in the market for total detection of cholesterol levels, so the proposed diagnostic device and strips.

National/Societal relevance

Number of heart attack patient is growing in India every year where primary reason is cholesterol deposition. It has been seen that early detection of increase in cholesterol level helps to prevent heart attack and myocardial infraction. The proposed diagnostic kit will be available at affordable price in India and it will save time and energy of patient and physician both. Till date no relevant product is available from any Indian manufacturer, which ultimately made this test costly and unreachable for common Indian.

Project achievements

a. **Progress vis-a vis objectives-** Validation of reagent strip for Total cholesterol; Immobilization of Cholesterol oxidase and cholesterol esterase and enzymes for triglyceride estimation; Development of reagent strip for HDL cholesterol and triglyceride; Optimization of the reagent strip for Total cholesterol, HDL- cholesterol and Triglyceride.

b. **Technology/Product (to be) developed-** A paper-based diagnostic assay for total cholesterol, triglyceride and HDL cholesterol. Paper optimized for binder and dye concentration (0.5 HPMC & O-Dianisidine 3 mg/ml) and conducted the stability studies.

c. **IP generated/ Potential for IP generation-** None

d. **Resources Generated-** 1 project staff employed.

Plans to take innovation further

Plan to take this project to commercialization with DynaSense.

Risks envisaged

1. Developed reagent strip is moisture sensitive, 2. Method cannot be used in metabolic alkalosis condition, 3. Reducing agents in blood may affect the sensitivity of the reaction.

Project Coordinator: Rohit Srivastava

Team Members : Santosh Bodakhe, Anurag Mehra

Contact : Indian Institute of Technology (IIT)-Mumbai, Powai, Department of Chemical Engineering Mumbai, Maharashtra - 400076

Indian Institute of Technology, Delhi

Collaborator: All India Institute of Medical Sciences, Delhi

Title of the Proposal

Continuous Non-invasive Blood Pressure Waveform Measuring Device for Cardiovascular Health

Brief description

The innovation focuses on developing an affordable, accurate, non-invasive, patient specific continuous blood pressure measuring device. The device shows continuous BP pulse waveform instead of providing only two discrete point systolic and diastolic BP values which help in monitoring cardiovascular health. It works on the principle of arterial tonometry where right BP depends on the right amount of flattening of the radial artery. The step-wise mechanism in the present device allows designing and achieving the optimum required flattening through a novel signal pick up mechanism in a patient specific manner. The device can be easily operated using the GUI developed in MATLAB.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Devices present in the market are expensive and locked system. Device under development is open and uses off-the-shelf pressure sensor. Also, the novelty lies in the fact that it defines the right pulse pressure based on the maximum peak-peak value of the pulse pressure amplitude and the reasoning has been established based on a complete computational analysis done on a device-tissue interaction.

Market Potential

Present Non-invasive devices, which includes Sphygmomanometer, Omron blood pressure monitoring device, Finapres using Penaz technique etc, cannot measure continuous Blood pressure waveform and Collins Tonometer is quiet expensive. Hence, they are not affordable for individual use or for mass usage. The present device can fill up an important gap in the affordable segment.

National/Societal relevance

Hypertension monitoring in low resource setting is an unmet need in India. Cardiovascular diseases caused 2.3 million deaths in India in the year 1990 this is projected to double by the year 2020. Hypertension is directly responsible for 57% of all stroke deaths and 24% of all coronary heart disease deaths in India. Population based cost-effective hypertension control strategies need to be developed in India, where cost effective technology like the present one can be influential.

Project achievements

a. **Progress vis-a vis objectives-** A portable, tabletop, cuffless noninvasive PPW measurement device has been designed to meet the need. The device is well integrated with the automation for mobilizing the sensor. An in-house algorithm is generated to detect the correct level at which right PPW can be captured.

b. **Technology/Product (to be) developed-** The Continuous Noninvasive Blood Pressure Waveform Measuring Device may take more than an year post clinical validation to reach the market.

c. **IP generated/ Potential for IP generation-** One Indian patent has been filed based on the earlier manual version. Patent Application No: 201611027931, A Novel Device for Measuring Pressur Pulses Based on Applanation Tonometry.

d. **Resources Generated-** Two research associates employed.

Plans to take innovation further

In the process of setting up a start-up and looking for angel investor.

Risks envisaged

None at this stage

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : Kusuma School of Biological Sciences, IIT Delhi, Hauz Khas, New Delhi - 110016

Indriyam biologics Pvt. Ltd.

Title of the Proposal

Snake Venom Detection Biosensor

Brief description

An easy to operate multi-port biosensor for the identification of snake envenomation and to monitor the victim of snakebite. This invention replaces the conventional nonspecific polyvalent anti-snake venom ASV technology to specific monovalent technology and thereby significantly reducing the allergen load on the patient and associated side effects, which resolves the longstanding problem and much needed solution with far reaching benefits which further reaches out for the benefit of civilians. The final product is a multi-port biosensor for the identification of snake envenomation and to monitor the venom quantitatively in the victims.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Newness is the market significance of the product, Easy to use, sensitive and species-specific biosensor platform, quick reaction steps and portability to make system usable for non-professional end users. These types of neglected diseases need quick validation, target identification and quantification for effective therapeutic benefit.

Market potential

Snake envenomation, leading bites and death cases are reported in India. The product under development will help in effective diagnostic and therapeutic strategy that is lacking in this case. Also can target South Asia and African countries as they are also severely in bad shape in containing this disease.

National/Societal relevance

Snakebite envenomation remains a public health concern in many countries especially in Indian sub-continent. Worldwide more than 5 million bites are reported per year, with 2 leading to severe sequelae. About 80,000 people die of snake bites worldwide each year, more than half of them in India. The states with largest number of snakebite cases include Maharashtra, West Bengal, Uttar Pradesh, and Tamil Nadu. Snakebite was recognized by World Health Organization as a Neglected Tropical Disease WHO, 2017.

Project achievements

a. **Progress vis-a vis objectives-** Scaling up

b. **Technology/ Product (to be) developed-** Under Development

c. **IP generated/ Potential for IP generation-** None

d. **Resources Generated-** A dedicated research and development that can focus on Venomics.

Plans to take innovation further

Scaling up phase and moving further to cover other countries severely affected by Snake envenomation.

Risks envisaged

Major challenge expected is "negelectness" in every sector. Risk mitigation with well-planned marketing strategy.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : Indriyam Biologics, Biomedical Technology Wing, SCTIMST, Poojapura, Thiruvananthapuram, Kerala - [illegible]

InnAccel Technologies Pvt. Ltd.

Title of the Proposal

NoXeno-A safer and easier Nasal foreign body extractor for clinicians in under-served areas

Brief description

Noxeno is the first product that provides an affordable, safe and easy way to remove anterior nasal foreign bodies in any setting.

Current stage of development

Commercialization

Name of the commercialized Product/Technology- Noxeno

Date of commercial launch- 2017-12-02,

Number of units sold - 20,

Number of end users- 30 currently

Innovative Element(s)

Noxeno has a patented hinge to allow access behind the NFB and turns into a hook by simply squeezing the trigger. When pulled in this position the NFB is forced out. The modular nature of the system allows for easy operation and noxeno to be a platform product for different attachments.

Market Potential

The total annual incidence of NFBs in India is estimated at 25 million cases and is expected to rise to 35 million cases by 2020. The product will serve the market of 25,000 paediatricians, 18,000 ENT and the over 100,000 General Physicians in India. Global market estimate is 5X India.

National/Societal relevance

NFB in children 3-6 years is a common ENT emergency in rural and semi-urban areas in India. Removal by physicians without appropriate training and suitable tools may lead to higher risks of various clinical consequences. NFBs may be displaced backwards and reach the nasopharynx with a risk of inhalation and choking. The NFB during removal may also fall into the mouth of the child- increasing the risk of aspiration into the lungs, which could be fatal. Today other than Noxeno there is no dedicated tool for nasal foreign body removal available to all physicians. . There are some makeshift tools like hooks, ET catheters and forceps used to remove NFBs and as of 2018 an expensive balloon based disposable device Katz Extractor that can be used. However, none of the existing products have been optimized for GP users in resource-constrained settings.

Project achievements

a. **Progress vis-a vis objectives-** Noxeno has gone from idea through proof of concept to a fully functional clinically validated product that has finished pilot production and first sales.

b. **Technology/Product (to be) developed-** Working on further attachment modules to address ear and throat foreign bodies as well.

c. **IP generated/ Potential for IP generation-** Patent pending technology licensed from DBT. Design registration in progress and IP evaluation for new attachments.

d. **Resources Generated-** Two engineers and a sales executive employed. Important testing and prototyping equipment was purchased through the project.

Plans to take innovation further

Applied for additional grant funding. Indian distributor partnerships established and government procurement is in progress.

Risks envisaged

Manufacturing consistency maintenance, scaling and Comfort level of non-ENTs to use the product are possible risk factors.

Project Coordinator: Jagdish Chaturvedi

Team Members : Vaiyapuri Alagumalai, Vishal Prasad, Pooja Kulkarni, Siraj Dhanani, Dhaval Patel, Seema Chopra

Contact : Innaccel Technologies Pvt. Ltd. (Innaccel Accelerator Services Pvt. Ltd.), Aanand Towers, Municipal No.4, Museum Motor Roy Road, Hypergrowth Lagan, Bengaluru, Karnataka - 560025

Innaumation Medical Devices

Title of the Proposal

AUM voice prosthesis

Brief description

AUM VOICE PROSTHESIS at less than 1 USD using platinum cured medical grade silicon. A simple device that converts your food pipe into a voice box and helps throat cancer patients after laryngectomy speak again.

Current stage of development

Pre-commercialization.

Innovative Element(s)

Currently globally two devices are available costing between USD 400-1000. Most throat cancer patients in India belong to poor socio-economic background. AUM VOICE PROSTHESIS at less than 1 USD provides a quality product at a fraction of the price.

Market Potential

10 lakh new cases of cancer each year in India of which roughly 25,000 cancers affect the throat. Of these at the least, 5000 -10000 patients potentially stand to lose their voice box. Globally - 1.5 million patients up to 1/3rd need laryngectomy.

National/Societal relevance

Almost 80% of throat cancer victims/ patients whose voice box is surgically removed, come from poor economic and financial backgrounds, thereby making it almost impossible for them to buy and use expensive devices/ implants. AUM VOICE PROSTHESIS gives them a new lease of life. "Speech is not a privilege, it is a right".

Project achievements

a. **Progress vis-a vis objectives-** Successfully completed clinical trials with more than 200 patients with extremely positive results. Geared up for a commercial launch in September, 2018 with focus on manufacturing, distribution and training.

b. **Technology/Product (to be) developed-** The product is already developed.

c. **IP generated/ Potential for IP generation-** Applied for an Indian and International patents and copyrights and are awaiting the award of the same.

d. **Resources Generated-** Production and distribution is ready for a full-fledged commercial launch in September, 2018. Also geared up on the infrastructure with respect to setting up a R&D unit and a room at the factory premises.

Plans to take innovation further

Collaborating with SOCIAL ALPHA, a TATA Group initiative apart from BIRAC BIG to mobilize resources to scale up manufacturing, distribution and training surgeons. Also applied for a MSME loan under CGTMSE Scheme.

Risks envisaged

Training the surgeons on hands on fixing of the prosthesis will be another key challenge apart from setting up distribution networks.

Project Coordinator: Vishal U S Rao

Team Members : Shantanu Mahesh, Vishwas U S

Contact : Innaumation Medical Devices, #48 Flat 2D Y2, 8th Main, 18th Cross, Malleshwaram, Bangalore, Karnataka - 560003

Inochi Care Pvt. Ltd.

Title of the Proposal

Combined Negative Pressure and Oxygenation Therapy for Accelerated Healing of Chronic Wounds

Brief description

The technology being developed is a multi-therapeutic wound healing device for faster healing of medically complex wounds. The device provide multiple advance wound care solutions such as negative pressure wound therapy, oxygenation, wound irrigation and various combination therapies. The proposed multi therapeutic device would be able to overcome the challenges of halted wound healing by exudates removal, reducing inflammation and oedema, enhancing cell proliferation and controlling microbial growth.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The system utilizes more than one proven therapeutic means of wound healing, configured to enhance wider range of bio mechanism favourable for accelerated wound healing. The system provide a range of advance wound care therapies along with their combinations. Lightweight, power efficient design for ease of use in remote setting. Portable, ergonomic and compact design for better bed side positioning and patient mobility. Integration of more than one therapeutic means makes it useful for various types of wounds like exudating wounds, diabetic ulcers, pressure sores, infected wounds etc. User friendly and interactive system interface.

Market Potential

Wound care market is a fast growing market due to increasing trends of lifestyle diseases like diabetes and obesity which are major risk factors for non-healing wounds. Chronic wounds affect approximately 1-2 percent of the developed world population and the prevalence rate is at 4.5 per 1000 population in India. The market potential is very high.

National/Societal relevance

Chronic non healing wounds are one of the commonest entity posing great challenges for caregivers and affects quality of life. Wounds impact patients physical, mental, and social well-being, and adversely affect families and care providers. In India and other developing countries, the problem of wounds is compounded by other factors such as low literacy rates, poor access to health care, inadequate health infrastructure, imported medical equipments, affordability, and quality of healthcare along with hot and humid environment. About 70% of India's population live in rural areas, where, despite of various efforts, hospitals lack basic equipment and facilities. The advance wound care systems to facilitate the wound healing process like Negative Pressure Wound Therapy NPWT, oxygenation are available only at tertiary healthcare facilities and cost of treatment is very high.

Project achievements

a. **Progress vis-a vis objectives-** Design and system architecture has been finalized. Prototype development is in progress.

b. **Technology/Product (to be) developed-** A multi therapeutic wound healing device that provide multiple advance wound care therapies is being developed.

c. **IP generated/ Potential for IP generation-** A Patent has been filed via BCIL and was licensed to M/s Inochi Care Private Limited for future development and commercialization. The IP is owned by DBT. International Application no: PCT/IB2018/051505.

d. **Resources Generated-** The Company was incorporated in 2017 and there is a team of product designer, electronic engineer, Biomedical engineer, mechatronics engineer and Biotechnology researcher in the organization. An in house engineering and development facility has been created to develop the prototype.

Plans to take innovation further

The technology is expected to enter the market in December 2020 after clinical validations and necessary regulatory approvals.

Risks envisaged

Regulatory approval and huge financial requirement to set up manufacturing facility and getting it licensed.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : Inochi Care Pvt. Ltd., [illegible]

Janitri Innovations Pvt. Ltd.

Title of the Proposal

Affordable, easy to use and portable uterine contraction monitoring device for low resources healthcare settings

Brief description

KEYAR is an affordable, easy to use and wearable device for continuous monitoring of fetal heart rate and uterine contraction during intra-partum period for low resources healthcare settings. The device monitors both the parameters, analyses the pattern and further gives colour coded/sound alert if fetus is in distress.

Current stage of development

Validation

Innovative Element(s)

KEYAR uses multiple surface electrodes to detect the uterine electromyography EMG for uterine contraction & fetal ECG for fetal heart rate. The device can be placed on the abdomen of a pregnant woman without knowing the fetus position for FHR and uterine contraction monitoring.

Market Potential

Global fetal monitoring market was valued at $2,206 million in 2015, and is expected to reach $3,584 million in 2022, registering a CAGR of 7.1 from 2016 to 2022. In India, every year 27 million deliveries take place across 1,50,000 sub-centers, 27000 PHCs Primary healthcare centers , 5000 CHCs Community healthcare centers , 700 District hospitals and 1,00,000 private maternity hospitals. Serviceable Available Market SAM will be $ 2 million by 2021 and $5 million by 2023 in India

National/Societal relevance

Every year, an estimated 1.02 million intrapartum stillbirths, 904000 intrapartum neonatal deaths & 250000 maternal deaths occur globally. More than 99% of those deaths occur in developing countries like India and Africa.

Project achievements

a. **Progress vis-a vis objectives-** 1. Development of uterine contraction algorithm, 2. Development of FHR algorithm, 3. Development of patch, 4. Development of embedded platform.

b. **Technology/Product (to be) developed-** Expected time need to enter the market is 6 months.

c. **IP generated/ Potential for IP generation-** One Indian patent is filed.

d. **Resources Generated-** 6 full time manpower employed

Plans to take innovation further

Pilot testing is going on in partnership with St. Johns Medical College Hospital Bangalore , Rangadore Memorial Hospital Bangalore & Jubilee Mission Hospital Thrissur.

Risks envisaged

The major risk with the development of medical device is safety and efficacy.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : [illegible]

JC OrthoHeal Pvt. Ltd.

Title of the Proposal

POC to market of FlexiOH: Breathable, Washable and light weight cast immobilization for fractured bone/ joint injuries

Brief description

After successful validation of FlexiOH under BIG project, We have moved for next milestone of making this technology to Market.

Current stage of development

Validation

Innovative Element(s)

FlexiOH is breathable, Washable and light weight orthopedic cast immobilization unlike conventional casts i.e Plaster of Paris and Glass Fiber

Market Potential

FlexiOH technology can address 60% of different fractures.

National/Societal relevance

FlexiOH is superior in terms of wash-ability and breath-ability. Evaluating FlexiOH under clinical set-up to prove superiority to conventional casts.

Project achievements

a. **Progress vis-a vis objectives-** Establishment of pilot scale production plant, buying raw material and equipment for raw-material development and anthropometric data collection.

b. **Technology/Product (to be) developed-** FlexiOH is being produced at Lab scale level, validation in product in private clinical set-up has been done. Product is good to go for launching tentatively in December 2018.

c. **IP generated/ Potential for IP generation-** IP has been filed in Canada, USA, Brazil, Vietnam, Malaysia, Singapore, Australia.

d. **Resources Generated-** Team of 18 people. Also trained 7 B. Pharm + MBA interns in this summer.

Plans to take innovation further

To scale up manufacturing and explore Indian followed by USA, Europe market.

Risks envisaged

Price sensitivity of Indian Market, Counterfeiting of IP.

Project Coordinator:
Pandit Deendayal Petroleum University

Team Members :
Tridib Chakravarty, Chirayu Sapovadiya, Subash Kumar, Sachin Mittal, Ritu Singh, Ankit Tiwari

Contact :
Dr. Pramudit Swami Nagar, Sola road, Gandhinagar, Gujarat 382330

Jeevtronics Pvt. Ltd.

Title of the Proposal

Development of Advanced Prototype of a very affordable Bi-Phasic Defibrillator with a built-in power generator for low resource settings

Brief description

Jeevtronics has developed the world's first hand cranked defibrillator SanMitra 1000 HC, which works even in areas without electricity. No battery changes are required ever. Thus, the total cost of ownership is the lowest in the world.

Current Stage of development

Validation

Innovative Element(s)

SanMitra 1000 HCT includes a hand cranked generator which can charge up the HV capacitor to 2000V in 5 to 9 seconds. The battery has been eliminated thereby increasing the reliability of the system.

Market potential

Indian defibrillator market is about 70,000 defibrillator per year. 80-90% of these are refurbished or low cost imports priced between Rs 60,000 to Rs 1,20,000. There is an opportunity for Jeevtronics SanMitra 1000 HCT to take large market share by virtue of the new technology and low price- Rs 85,000.

National/Societal relevance

India's death rate due to sudden cardiac arrest is 3-4x higher than that of developed countries and the number of defibrillators available in hospitals, ambulances is significantly low. A hand cranked and affordable defibrillator will help save those lives. India loses Rs 500 to 650 crores of foreign exchange annually due to import of defibrillators. This loss can be replaced using the "Invented and Made in India" defibrillator from Jeevtronics.

Project achievements

a. **Progress vis-a vis objectives-** Product is deployment ready. Production tools are being procured. Assembly process defined. Supply chain set up. Dealers being appointed. Field validation partners identified. Pilot study to start soon.

b. **Technology/ Product (to be) developed-** The product development is complete. Validation ongoing. Commercial launch shortly.

c. **IP generated/ Potential for IP generation-** Granted US patent US6597949 B1, 3367/MUM/2015 Filed., 3368/MUM/2015 Filed., Design Patent 289404 Granted. More patents likely.

d. **Resources Generated-** Moved into a manufacturing facility already. Manpower employed: Team: 1 M.Tech Hardware Engineer, 1 M.Tech Software Engineer, 1 Quality & Purchase Engineer, 1 Test Engineers, 1 Technician full time, 1 ISO consultant part time, 1 CE +Software consultant part time. Marketing: 2 contract.

Plans to take innovation further

Manufacture the product in-house and sales in India through distributor tie ups.

Risks envisaged

In India, distribution is always a risk. As a single product or very products medical device company, scaling up profitably can be a challenge especially globally. Hence, tie up with global players will be important.

Project Coordinator:
Aniruddha Jere

Team Members :
Ashish Lawania, Prerak D. Nanavati, Sandeep G.

Contact :
Jeevtronics Pvt. Ltd., 90C, NCL Innovation Center, Dr. Homi Bhabha Road, Pashan, Pune, Maharashtra- 411008

Kalyani Ramachandran (C-CAMP)

Title of the Proposal

Development of a novel medical device for early detection of Liver disease

Brief description

Development of a device to directly detect miRNA in blood for early, comprehensive and affordable detection of liver disease.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Direct detection of miRNA in blood early, comprehensive and accurate detection of liver disease.

Market Potential

Liver disease affects a huge proportion of the world. Approx 30% of the world and 20 crores of Indians are affected by NAFLD Non alcoholic fatty liver disease alone.

National/Societal relevance

Liver diseases are often underdiagnosed/ignored till symptoms force patients to be hospitalised. This places a huge burden on the medical system to treat high risk patients effectively increases demand for organs for liver transplant and forces individuals and society to absorb the financial costs of such late-stage disease treatment. This device will mitigate all of these effects, and will give patients and doctors agency to prevent/slow down progression of liver disease. This decreases the burden on caregivers and economic system and increases productivity of the society as a whole.

Project achievements

a. **Progress vis-a vis objectives-** All specifications of device development have been determined. Prototype of device is under construction.

b. **Technology/Product (to be) developed-** Device will enter the market in the next 5 years.

c. **IP generated/ Potential for IP generation-** Patent filling is in process.

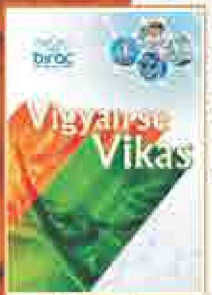
d. **Resources Generated-** Three Manpower hired and trained.

Plans to take innovation further

Through public and private funding opportunities.

Risks envisaged

None



Project Coordinator: Kalyani Ramachandran

Team Members : NA

Contact : [illegible]

Kornerstone Devices Pvt. Ltd.

Title of the Proposal

CT Guided Needle Navigation Device

Brief description

HighNoon is a light and shadow based instrument positioning device intended to perform CT guided percutaneous interventions. It relies on a central camera with four light source, oriented at 90 degree to each other around the camera. It is mounted on an overhead rail mounted on pillars, in front of the CT gantry. The camera/light unit has an axial, carino-cadual angular mobility with an X axis & Y axis linear mobility, providing angular guidance aiding precise needle placement with minimal trauma to tissues resulting in reduced patient-discomfort, radiation, complications and shorter procedures.

Current stage of development

Validation

Innovative Element(s)

Needle-free for quick check fluoroscopy, Easier to align the needle with liner shadows than with a laser light flashing at the needle hub, Patient movement/ respiratory movement can be detected and corrected.

Market Potential

There are approx. 6000 CT scanners installed in India with 400 units getting added year on year. Globally the numbers are 75000 & 4000 units respectively.

National/Societal relevance

HighNoon angular guidance assists Radiologists to strike smaller lesions which are key to early diagnosis of cancers enhancing chances of complete cure. It also increases the confidence of the radiologists which will be a boon to beginners.

Project achievements

a. **Progress vis-a vis objectives-** Prototype V2 built, Reduction in workflow time, BOM and dimensions Device to be placed at CMC Vellore for clinical validation, Demonstrated and tried by over 20 senior interventional radiologist.

b. **Technology/Product (to be) developed-** Final prototypes with all modifications under construction. Testing and certification to be carried out. Clinical trials in CMC Vellore is initiated. Time to launch is after 12 months.

c. **IP generated/ Potential for IP generation-** An Indian patent & PCT application id filed.

d. **Resources Generated-** Currently design & development of prototype/production is outsourced.

Plans to take innovation further

Partnership/ licensing discussions with CT manufactures has been initiated and likely to be firmed up in the next 9-12 months. Fund raising initiatives have been started with potential angel investors.

Risks envisaged

Newer imaging technologies that could potential disrupt this market, eventually outdating.

Project Coordinator: Roy Santosham

Team Members : Shanthakumar, [illegible]

Contact : [illegible]

Kozhnosys Pvt. Ltd.

Title of the Proposal

Rapid breath based screening device for breast cancer

Brief description

CanScan is a breath analyser for screening of breast cancer. It can detect breast cancer at early stage, even before symptoms appear. CanScan analyses exhaled breath of a person and gives indication on presence and absence of breast cancer.

Current stage of development

Proof-of-Concept

Innovative Element(s)

CanScan has a novel sensor that can detect the exhaled breath markers that are present at very less concentration in exhaled breath. This sensor can detect concentrations in parts per million and is very sensitive and specific.

Market Potential

Market for breast cancer screening in Asia is expected to reach $4 billion by 2022. This technique will be affordable and sensitive. Currently there are no competitors in this field. Kozhnosys is planning to capture 30% of the breast cancer screening market within 5 years from launch of product.

National/Societal relevance

Breast cancer is the most common cancer in India. Early stage breast cancer is difficult to diagnose as it has no distinguishable symptoms. When breast cancer patients become symptomatic, the disease has already reached a stage where the tumour is relatively large, and in most cases has already metastasized to the lymph nodes and other organs.

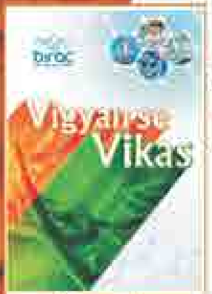
Project achievements

a. **Progress vis-a vis objectives-** Prototype development is currently under development.

b. **Technology/Product (to be) developed-** Product-CanScan: breath analyser for breast cancer screening.

c. **IP generated/ Potential for IP generation-** An Indian patent is filed on "System for detection of volatile organic compounds VOC in exhaled breath for health monitoring".

d. **Resources Generated-** Manpower employed & Enterprise created: Kozhnosys Pvt Ltd. Fund mobilization from other sources: BIRAC BIG Rs. 50 lakhs , DST NIDHI PRAYAS Rs. 10 lakhs



Plans to take innovation further

Other funding

Risks envisaged

Acceptance of new technology by doctors. Competition from existing breast cancer detection techniques.

Project Coordinator: [illegible]

Team Members: [illegible]

Contact: [illegible]

Kumudha Health Tech Pvt. Ltd.

Title of the Proposal

3D diagnostic and treatment planning tool for the spinal disorders

Brief description

It is a low cost 3D diagnostic tool for quantifying spinal deformities using stereo-radiographic reconstruction from bi planar x-rays thereby enabling specialists to track the disease like scoliosis and provide better treatment. The registered users like doctors, surgeons, clinicians, biomechanics experts, have to upload two orthogonal x-rays frontal and lateral to the cloud. The stereo-radiographic reconstruction and deformity quantification algorithms serve as a Software as a service on the cloud to support the users. The algorithm computes the 3D spine model and the deformity quantification report contains spinal indices like spinal curvature and axial vertebral rotation that quantifies the spinal deformities.

Current stage of development

Validation

Innovative Element(s)

1. Only two x-rays are used to produce 3D Spine.

2. Deformity quantification report is produced.

3. Can be accessed anywhere-anytime.

Market Potential

Estimated 5000 hospitals and clinics in India provide an immediate market. Nearly 200 patient visits x 5000 hospitals x Rs. 1000 per diagnosis = Rs. 100 Crore. If at least 2% of people opt, Rs. 2 Crore business/year.

National/Societal relevance

This product can be used for

1. Diagnosis - Scoliosis, Herniated disc, Spinal trauma etc.
2. Surgical planning - reduced risk, surgical and recovery time.

Project achievements

a. **Progress vis-a vis objectives-** 3D spine modeling - executed, Quantification of spinal deformities- executed, Laboratory Validation - going on

b. **Technology/Product (to be) developed-** Technology is developed. Only validation is remaining. Expected time needed to enter the market - 8 months

c. **IP generated/ Potential for IP generation-** Patent filed

d. **Resources Generated-** Employed - 6 & Trained - 9

Plans to take innovation further

Out-Licensing

Risks envisaged

New product

Project Coordinator: [illegible]

Team Members: [illegible]

Contact: Dept. of ECE, Manipal Institute of Technology, Manipal, Karnataka-[illegible]

Lattice Innovations Pvt. Ltd.

Title of the Proposal

Use of virtual reality VR goggles to aid in exercising vestibular disorders in elderly patients

Brief description

A virtual reality platform which allows for a broader range of therapies to be created which allow the patient to regularly do these exercises at home and improve their condition.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Virtual reality world allows us to keep the patient seated in a safe place so they do not have any adverse reactions as a result of the attacks.

Market Potential

Over 60% of patients over the age of 65 years have forms of vestibular degeneration. Most people try and treat symptoms with medication, but the another way to reduce the imbalance caused is through VRT.

National/Societal relevance

Virtual reality content along with patient EMR for tracking therapy sessions.

Project achievements

a. **Progress vis-a vis objectives-** 6 Virtual reality exercises have been created in the form of games. Currently preparing for clinical validation study.

b. **Technology/Product (to be) developed-** Virtual reality content along with patient EMR for tracking therapy sessions.

c. **IP generated/ Potential for IP generation-** No IP generated

d. **Resources Generated-** Engineers have been hired as resources as a result of this project.

Plans to take innovation further

Once the clinical validation is completed, B2B sales model will be adopted. Out- licensing.

Risks envisaged

The clinical validation is necessary to prove the efficacy of Virtual Reality in VRT. Although there is evidence to support the benefits of virtual reality it is yet to be clinically proven.

Project Coordinator: Sahil Monga

Team Members : Binay Yadav, Sourav Bhattacharyya, Priyanka Chawla, Vikrant Rai, Sagar Kumar

Contact : C-25, Okhla Industrial Area Phase I, New Delhi-110020

Lumisoft Technologies Pvt. Ltd.

Title of the Proposal

Affordable portable digital slit lamp

Brief description

Easy to use, affordable, yet of good quality portable slit lamp that captures, stores and shares the images instantly.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Affordable and novel method of illumination and viewing.

Market potential

Cost of existing technology for photo slit lamp: Rs. 4,50,000 + Laptop: Rs. 30,000 = 4,80,000 over 10 times the cost of the proposed portable digital slit lamp. Target is to sell 2,000 units /year in India, where available market is 60,000 units/year.

Global available market is 400,000/ year. Can be sold at 2X price abroad.

National/Societal relevance

There is a shortage and uneven distribution of eye doctors in India.

Eye Care reaches only 7% of needy. 1% of Indians have blindness which is 3 times more than world average.

This device helps in deskilling manpower as it is user friendly, reaching remote corners of the country as it is portable and helps in getting affordable and quality care as images can be shared with specialists to get opinion. It helps in detecting up to 80% of causes of blindness.

Project achievements

a. **Progress vis-a vis objectives-** 30% of objectives in prototyping are done.

b. **Technology/ Product (to be) developed-** Expected to enter the market by the end of financial year 2019-20.

c. **IP generated/ Potential for IP generation-** Potential for IP generation based on affordable illumination technique, affordable observation system, using an app in a slit lamp and 3D imaging.

d. **Resources Generated-** Created 3 jobs, created a facility of optical designing and ray tracing, 3D printing by FDM technology and flatbed printer. Obtained funding from KBITS, Karnataka.

Plans to take innovation further

Ethics committee registration for clinical trials, doing multi centric clinical trials, Filing complete patent and PCT and Licensing.

Risks envisaged

Competitor entering the market earlier than us. Not finding a suitable licensee.

Project Coordinator: H V Sridhar

Team Members : Mani Bharathi, Sreevatsa B K, Divya

Contact : Lumisoft Technologies Pvt Ltd, 1115, 8th Cross, Ashirwad, Banashankari 1st Stage, Bangalore, Karnataka-560050

MediAsha Technologies Pvt. Ltd.

Title of the Proposal

Instasplint-The first-aid kit which we can use to immobilize the affected limb instantly

Brief description

InstaSplint a first-aid device to provide instant immobilization to fractured limb until reach to the hospital. InstaSplint helps in providing rest to the injured area, preventing further displacement of bone fragments and thus protecting underlying vessels and nerves from the fracture fragments. It helps to reduce muscle spasms, muscle pain.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The USP for InstaSplint is early immobilization, quick setting time 3 minutes, lightweight (300 grams), yet strong.

Market Potential

The target market is Academic Institutes, Sports-Academies, Trekkers-Association, Defence-training Centres, NGOs, Transport system, Hospitals, Paramedics, First aid box, Disaster management team.

National/Societal relevance

InstaSplint a first aid device instantly immobilizes the fractured limb thus preventing further Second Injury/ Surgery or possible amputation.

Project achievements

a. **Progress vis-a vis objectives-** Through Survey, data concerning most occurring fracture, frequency of use of InstaSplint on daily base, existing products and their drawbacks, test to be done for the product, recommendation of different shapes is documented.
b. **Technology/Product (to be) developed-** Developing splint with increased stiffness of the splint so that it will remain in desired position for required duration.
c. **IP generated/ Potential for IP generation-** The patent is filed. Trademark for Company logo and Product name and logo is in process. Technology licensing of the patent has been done on 21st June 2018.
d. **Resources Generated-** One product designer is hired for the product development related work.

Plans to take innovation further

Three 3D CAD model using ergonomic and anthropometric data is being designed for different age groups.

Risks envisaged

The main competition will be from foreign multinational companies, who have the advantage of imported tag and established brand image. This will be countered by providing better features and higher value addition at a cost less than half that of imported splints.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : [illegible]

MFP Medical Devices LLP.

Title of the Proposal

Development of a multiplex microfluidic paper device for the rapid screening of donor blood for transfusion transmitted infections

Brief description

The proposed rapid and simple molecular diagnostic prototype based on paper-based microfluidic technology will be used for the screening of donor blood for TTIs - HIV, HBV, HCV, CMV and MP. This is a multi-test paper based integrated molecular prototype from extraction to analysis of NA on a single platform. There is not a single paper-based microfluidic device available currently for multiplex RT-LAMP assay for infectious diseases.

Stage of development

Proof of Concept

Unique furtures of the product/technology

The screening methods, currently used, by all the blood banks involves Immunoassays IAs for viral infection and microscopy for the Mycoplasma. However, the IAs often fail to detect infections in the window phase which may lead to transfusion of infected blood. WHO recommends, NAATs, for use in donor screenings, with a potential to detect the RNA or DNA, in the very early viremia/parasitemia phase. However, a PCR-based method requires state-of-art facilities and skilled manpower that is mostly unavailable in India. The current unmet need in the area of TTI screening is an "ASSURED" device, a term coined by World Health Organization WHO .

Market potential

In India, approximately 3 Crore units of blood donations take place in a year.

The commercial potential of the kit has been estimated based on the following assumptions:

The size of the "eligible donor population" is estimated to be 3 crores per annum or even more.

- Estimated cost of the paper-based device is Rs 600/-.
- Even if 50% of the donors are screened for the infections, estimated requirement for the screening devices is approximately 1.5 crores /year.
- Thus, the commercial potential of paper-based multiplex screening device would be around Rs 900 crores per annum/ 1.5 crores or 1800 crores for 3 crore donors.

National/Societal relevance

There is not a single paper-based microfluidic device available for multiplex RT-LAMP assay for infectious diseases. The current unmet need in the area of TTI screening is an "ASSURED" device, a term coined by World Health Organization WHO . In other words, an ideal multiplex NAAT tool is needed which is Affordable, Sensitive, Specific, User-friendly, Rapid/robust, Equipment free and Deliverable ASSURED to end-users.

Project achievements

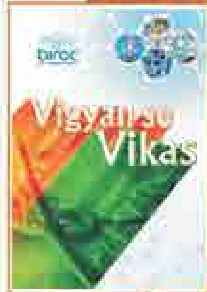
a. **Progress vis-a vis objectives-** The device is under development. The molecular process and multilayered Paper microfluidic device to test single parameter on paper has been developed. This needs optimization. Once the single test is robust and ready, multiplexing will be attempted.
b. **Technology/ Product developed-** The prototype will be ready by December 2018.
c. **IP generated/ Potential for IP generation-** IP will be filed for the validated prototype.
d. **Resources Generated-** 2 Research Assistants have been appointed for the product development.

Plans to take innovation further

Pilot batch manufacturing and validation & Application for marketing approval to the DCGI.

Risks envisaged:

None



Project Coordinator: [illegible]

Team Members : [illegible]

Contact : [illegible]

Mohammad Samheel (Manipal-TBI)

Title of the Proposal

A Hand in Need - A Self Driven Rehabilitation Device for Stroke and Neuro-Muscular Deficit Patients

Brief description

A Self-Driven Hand Rehabilitation device for patients with neuromuscular deficit of the hand which consists of two gloves. The patient can use his / her healthy hand wearing a Sensor glove to mirror similar movement on the affected hand wearing a Motorized glove. This allows the patient to do functional exercises with independent movement of each finger and the gloves provide good visual feedback. The device can also support Passive Mobilization Therapy. Therapy can serve for better recovery and to keep the joints of the affected hand mobilized and supple. This wearable device is highly portable, cost-effective and can be used at home.

Current stage of development

Proof-of-Concept

Innovative Element(s)

It is self-driven, allowing smooth, realistic movements and real-time mirroring for better visual feedback than currently used passive mobilization therapy. It is automatic, highly portable, customizable, compact & wearable all in one unit. It uses wireless transmission and is powered by a Power Bank.

Market Potential

India has more than 100,000 new patients per year who suffer from neuromuscular deficit. The device also has a huge potential abroad to offer cost-effective rehabilitation for patients. Current hand rehabilitation devices are very expensive and exclusively available in High End Rehabilitation Clinics and Hospitals which is not affordable for everyone.

National/Societal relevance

More than 2.5 Million people suffer from neuromuscular deficit in India. These patients need long term rehabilitation which is expensive and time consuming. Frequent visits to the hospital are a financial and social burden on the family. As a result, the therapy is often discontinued which leads to joint stiffness and reduced surgical options. This device will overcome these challenges by providing a self-driven, cost-effective, highly portable device available for therapy at home.

Project achievements:

a. **Progress vis-a vis objectives-** Currently the device is undergoing usability testing. Soon, early validation in a limited number of patients will follow for feedback to make the device more user friendly and marketable.
b. **Technology/Product (to be) developed-** A Self Driven Rehabilitation Device
c. **IP generated/ Potential for IP generation-** IP is under consideration for new design.
d. **Resources Generated-** A Startup Company named Osind Medi Tech Pvt Ltd has been created through this support. A Team of 5 including 1 Biomedical Engineer, 1 Biotechnical Engineer, 1 Fashion Designer, 1 Mechanical Engineer has been employed full time and 1 Intern part time. Also provided jobs for local Tailors for development of gloves.

Plans to take innovation further

Refining the Proof of Concept. Exploring collaborations to commercialize the device after full validation with hospitals and miniaturization of the device.

Risks envisaged

Implementation of the new Therapy device in current clinical practice will need training and time.

Project Coordinator: Mohammad Samheel

Team Members: Anil K Bhat, V S Venkatesan, Mohammed Tamseem Ahmed, Neha Shekat [illegible] Chaturvedi

Contact: Mohammed Samheel Sheikh, Near Jumma Masjid, Hoppaly Brahmavar Udupi, Karnataka-576213

Monitra Healthcare Pvt. Ltd.

Title of the Proposal

Compliance of the Smart MCT platform with IEC safety & radio-frequency standards

Brief description

Development of advanced non-invasive biosensing affordable adhesive band-aid like patches that record, analyze and transmit bio-physiological data in real-time. 7+ day's patient monitoring thereby enabling early diagnosis of diseases such as heart rhythm disorders.

Current stage of development

Validation

Innovative Element(s)

Adhesive Sensing device without any wires that automatically senses multiple bio-parameters, digitizes, encrypts, compresses and transmits data wirelessly. 7-day use and provides freedom of mobility to perform daily activities.

Market Potential

About 8+ million arrhythmia patients are estimated in India and 50+ million worldwide. Global cardiovascular monitoring and diagnostic devices market was valued at USD 3.7 billion in 2012 and is expected to reach USD 7.0 billion in 2019. The ECG telemetry market is expected to reach USD 1.25 billion by 2015.

National/Societal relevance

Early diagnosis of cardiac ailments, which allows diseases to be cured at initial stages before progression to chronic stage. It can help prevent morbidity, mortality and disability with rapid diagnosis and treatment of heart patients. Early diagnosis and pre-emptive treatment of cardiac anomalies also reduces the likelihood of catastrophic cardiac events.

Project achievements

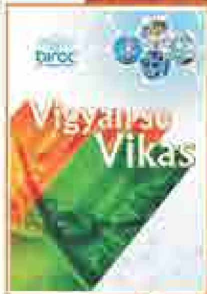
a. **Progress vis-a vis objectives-** Early validation of the technology done. The pre-clinical study showed that heart rate and rhythm data from the signals picked from this device is equivalent to current standard device.
b. **Technology/Product (to be) developed-** The technology is expected to undergo a few rounds of industrial design and compliance with world-wide medical device safety standards. The product is expected to be released within a year.
c. **IP generated/ Potential for IP generation-** IP is applied.
d. **Resources Generated-** Employment for 10 people. Awarded grant from United States India Science & Technology Endowment Fund.

Plans to take innovation further

Fund raising for conducting commercial pilots within next 12 months prior to release.

Risks envisaged

Currency exchange rate risks can drive costs high as some critical components are imported. Rely on third party distributor field force for primary touchpoints to both physicians and patients in the first phase.



Project Coordinator: [illegible] Bhogi

Team Members: Archana Gollapudi, Shruti Priya, Aparna Bhogi, Sashank Bhogi

Contact: 102 Maid [illegible], Plot 495, Defence Colony, Hyderabad Telangana-500094

Mukul Sarkar (FITT)

Title of the Proposal

Non-contact, non-invasive SpO2 measurement device using polarization based imaging

Brief description

Blood oxygen saturation SpO2 measurement is critical in the diagnosis of health-related problems. The most popular device, oximeter, suffers from the problem of inefficient body contact and motion artifacts. This project aims to use the polarization state of the reflected light to develop a non-contact device for the measurement of SpO2. The reflected component of the incident polarized light is depolarized by the blood molecules. The ratio of the intensities of light reflected from deep and superficial layers of the skin are measured and found to have a correlation with SpO2. This ratio is used for SpO2 measurement.

Stage of development

Proof-of-Concept

Innovative Element (s)

The use of phase information of the transmitted or reflected light allows for a development of complete non-contact based biomedical sensors. The project demonstrates a polarized imaging based non-contact, non-invasive SpO2 measurement portable device.

Market potential

The expected outcome of the project is the small portable real-time device which would replace the currently available oximeters, thus have a great market potential. Further, the successful testing and implementation of the proposed hypothesis will establish the foundation for polarized imaging based bio-signal analysis.

National/Societal relevance: The proposed device falls under the category of diagnostic equipment which represents a major part of a medical electronics. It would have a direct impact on health care and monitoring considering the fact that the blood oxygen saturation and pulsation analysis are the routinely performed diagnostic procedures.

Project achievements

a. **Progress vis-a vis objectives-** The first milestone of developing the prototype is complete. The first version, a test die to work on the feasibility has been fabricated and tested for polarization sensitivity.

b. **Technology/ Product developed-** A non-contact non-invasive Spo2 measurement device is being developed.

c. **IP generated/ Potential for IP generation-** No commercial device with polarized imaging based non-contact, non-invasive SpO2 measurement ability exists, thus the project has the potential for IP generation.

d. **Resources Generated-** Two project staff were employed.

Plans to take innovation further

The design is still in the proof of concept stage.

Risks envisaged

The pulse oximeter is a very established device. Challenging the existing popular device will be the risk in terms of immediate acceptability.

Project Coordinator: Mukul Sarkar

Team Members : Deepak Mahra

Contact : Electrical Engineering Department, Hauz Khas New Delhi-110016

Newndra Innovations Pvt. Ltd.

Title of the Proposal

IndoKnee: A device for knee Support

Brief description

IndoKneeTM is an efficient, unpowered, configurable knee supporting device that supports the knee and lower foot during range of mobility tasks including kneeling, walking, climbing the stairs and flexion extension movement of knee. It provides physical support to knee and share the load from knee and ankle. It is based on fundamentals of Mechanics and patent protected single point torque adjusting mechanism. The single point mechanism enables a user to adjust the support for flexion, extension. It has another adjustment mean to adjust the extent of knee load that user needs to share and minimize with the device.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The core innovation of the project, invention of hinge mechanism, characterizes with single point torque and angle adjustment mechanism. The available methods do not have any assistive mechanism that help in flection and extension movement of knee whereas the IndusKnee has an efficient, active mechanism which helps flection and extension.

Market Potential

Orthopaedic braces market size was valued at $3.3 billion in 2016 with expectation reaching $4.9 billion by 2022 growing at a CAGR of 6.8 during forecast period by MRC. CDC estimated around 30 million U.S. adults affected with arthritis in 2016.

National/Societal relevance

India has the second largest population of Knee Osteoarthritis sufferers in the world which is getting further severe as the population ages. 901 Million Indian people aged above 60 years and that accounts for 12 percent of the total global population. Osteoarthritis is the most prevalent joint disease and a leading source of chronic pain and disability in the United States and other developed nations. IndoKnee helps the Knee Osteoarthritis patients live better while allowing all mobility.

Project achievements

a. **Progress vis-a vis objectives-** Product Design freezing and prototyping has been done.

b. **Technology/Product (to be) developed-** To develop and test an efficient, unpowered, configurable knee supporting device that supports the knee and lower foot during range of mobility tasks.

c. **IP generated/ Potential for IP generation-** IndoKnee is based on our Indian Granted Patent No. 268302 and newly filed patent 201711003199. The PCT No. PCT/IB2015/059722. ISR is published and is fully positive. US patent Filed number: 15/107914.

d. **Resources Generated-** 4 persons employed. Design and development lab and prototyping facility developed.

Plans to take innovation further

Post development of IndoKnee, a small pilot cum validation in collaboration with the hospitals is planned.

Risks envisaged

Manufacturing challenge in ensuring ample supply of raw materials and components from our suppliers.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : [illegible]

Orthocrafts Innovations Pvt. Ltd.

Title of the Proposal

Bioabsorbable implants based on polylactic acid

Brief description

Orthocrafts is engaged in development of implants that will be absorbed inside body. Developed know-how for synthesis of high molecular weight biomedical grade polylactic acid materials and its co-polymers and will use these materials to make implants that will be used to repair soft tissue in knee, shoulder and for hernia repair.

Current Stage of development

Validation

Innovative Element(s)

Expertise in the field of polymer synthesis, processing. Tailoring the properties of materials to create affordable and impactful healthcare solution based on bioabsorbable materials. No Indian manufacturer is making bioabsorbable materials and implants based on Poly lactic acid.

Market potential

There are more than 10 million surgical procedures performed annually that requires the products targeted by Orthocrafts. In India this number will reach 1 million by 2025. Global bioresorbable materials market is pegged at USD 1400 million with healthcare as leading application area.

National/Societal relevance

There is no Indian manufacturer who is making high molecular weight biomedical grade PLA material required for development of implants despite the clear need. It is one of the crucial areas of technology and product development for upliftment of Indian medical device manufacturing sector. Raw material and products are made available by few MNCs creating monopolistic scenario. By creating safe to use, tailored biomedical grade polylactic acid Orthocrafts has created an option for Indian surgeons and medical device designers to develop India specific designs. This will further enable the indigenous manufacture of core technology and will provide the safer and cost effective replacement of current choices.

Project achievements

a. **Progress vis-a vis objectives-** Performed biocompatibility testing of the first product and finalized design for two more products.
b. **Technology/ Product (to be) developed-** Expect to launch the first product in the market by end of 2019.
c. **IP generated/ Potential for IP generation-** Orthocrafts has secured trademarks viz- Orthocrafts, Orthoscrew, Osteoanchor and Lactomeros
d. **Resources Generated-** Generted a Team at Orthocrafts including Ph.D and B.Tech degree holders from reputed institutes. Orthocrafts so far has raised around half a million dollars in funding.

Plans to take innovation further

Orthocrafts will develop the partnership to bring its products in the market. Already in talks with angel investors and venture capital firms to raise more funds.

Risks envisaged

Stringent regulatory pathway associated with implantable devices and materials could pose early barrier. Risk mitigation however by collaborating with experts in the field.

Project Coordinator: Piyush Joshi

Team Members : Ashish Lele, V Premnath, Manjusha Pensalkar

Contact : Orthocrafts Innovations Pvt. Ltd., Flat No 0/12, Montvert, S. no. 140/4, Baner Sus road, Pune, Maharashtra-411021

Persistent Systems

Collaborator: Maharashtra Institute of Medical Education and Research, Talegaon, Pune

Title of the Proposal

I-Doctor: An intelligent diagnosis and drug dispensing platform

Brief description

The proposed i-Doctor platform is an intelligent disease diagnosing and automated drug dispensing kiosk. i-Doctor kiosk will have seamlessly integrated multiple portable point-of-care devices like thermometer, Plus Oximeter, BP apparatus, ECG, weighing machine, camera, etc. working in sync with an intelligent disease diagnosing algorithm powered by statistics and artificial intelligent algorithms. The objective of i-Doctor is to provide basic health care services to Indian citizens.

Current stage of development

Proof-of-Concept

Innovative Element(s)

i-Doctor will be capable of diagnosing 50+ commonly occurring clinical conditions. There will be no dependency on real-time presence of doctor over the network to examine the patient. I-Doctor will measure body vitals using portable point-of-care IOT devices and the patient would be expected to answer set of predefined questionnaires for diagnosis. The intelligent disease diagnosing algorithm will be designed using advances in artificial intelligence protocols with clinical inputs from panel of very experienced medical practitioner. There will be an inbuilt SOS Mechanism for immediately calling Ambulance, medical support and connecting to the nearby hospital in case of emergency. Inbuilt secure biometry based patient identity system linked to Aadhar database to store medical history and also avoid drug abuse and Cloud based patient data collection system for sharing data in an anonymized fashion for healthcare authorities and policy makers. Inbuilt battery backup will ensure functioning of i-Doctor system in power shortage areas.

Market Potential

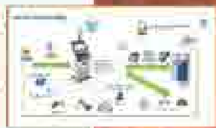
i-Doctor has huge market potential not only in India but also internationally.

National/Societal relevance

India has scarcity of quality doctors, especially in rural settings. As a result, large section of population visit local Pharmacies and rely on Over the Counter drugs for getting relief from commonly occurring illnesses like vomiting, diarrhoea, stomach ache. This practice is dangerous as Pharmacists are not trained in disease diagnosis and this leads to unscrupulous use of medication, drug abuse and development of drug resistance. Moreover, telemedicine models for offer better healthcare have failed due infrastructure problems like power shortage and poor network bandwidth connectivity. Hence, the proposed i-Doctor platform has potential to offer sustainable and scalable solution in current Indian scenario.

Project achievements

a. **Progress vis-a vis objectives-** The project has started and working on first objective.
b. **Technology/Product (to be) developed-** Technology is currently under development, development shall be completed by March, 2020.
c. **IP generated/ Potential for IP generation-** Prior-Art Search is in progress.
d. **Resources Generated-** 13 Manpower hired by Persistent Systems and Medicine Experts hired by MIMER



Plans to take innovation further

Development shall be completed by March, 2020 and would be taken to market in next 2-3 years.

Risks envisaged

Market acceptance and regulatory approvals.

Project Coordinator: Abhay Jere

Team Members : Vivek Kulkarni, Arun Jamkar, Pratap Sanap from Persistent Systems, Sushma Sharma, Ramchandra Bhalsing from MIMER

Contact : Persistent Systems, Pingala - Aryabhata, 20A/12 Karve Road, Erandwane, Pune, Maharashtra 411004

PetaVista Healthcare and IT Solutions Pvt. Ltd.

Title of the Proposal

Design and Development of Sensor Based Insole for Early Detection of Abnormal Plantar Pressure Distribution in Type 2 Diabetes Mellitus with Peripheral Neuropathy

Brief description

To build, test and calibrate a wireless wearable smart sole which is capable of analysing the pressures applied at different section of the foot and provides this data to the end users. This is a non-invasive procedure where system is measuring a plantar pressure of diabetic patient to understand the pressure variations in real life.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The proposed system is a cost effective wearable smart insole independent of footwear which will be used to measure plantar pressure distribution of a patient/subject as compared to existing systems Pedar Shoes, MAR or In-shoe Tekscan. The real time data can be captured by the Doctor from remote locations of the subject/patient. The major portion of the product is the strong analytics based on realtime mapping of temperature and pressure of plantar unique to the product with other medical parameter captured during customization of the sole one time.

Market Potential

The potential is high in India

National/Societal relevance

Individuals with diabetes are generally prone to ulcer formations under their foot. Increase in plantar pressures and increase in temperature appear to be the most important determinants of foot ulceration regardless of the duration of diabetes. There is no cost effective solution for this problem in the market for the population except for the top of the pyramid. The existing system available in the hospitals detect the plantar pressure in the closed environment under the observation of doctors/nurses and temperature is captured separately and this is not integrated with other parameters such as diabetes and neuropathy. The proposed system addresses these concerns.

Project achievements

a. **Progress vis-a vis objectives**- Proof of Concept generated.
b. **Technology/Product (to be) developed**- Prototype is ready.
c. **IP generated/ Potential for IP generation**- Provisional Patent filed
d. **Resources Generated**- 4600 man hours of Employment generated.

Plans to take innovation further

1 year is required for commercialization. The Company's first product/service offering shall be to manufacture Wearable Smart sole with decision support system for foot characterization in diabetes for Normal arch, Indian foot size for both male and female. Agreement has been signed with Manipal Technologies Ltd., Manipal for the Production of Insole with printed sensors and requested for marketing the product post pilot study. The potential kiosk of the Diabetic Foot Clinics in the Hospital has been identified to capture the clinical data of all diabetic patients and distribution of insoles to the patients. The system will be improvised to build the insole for subjects with various types of abnormalities.

Risks envisaged

Delay in sensor printing and calibration of the insole due to external factors and product stabilization by improving the parameters of sensors and electronic circuit.

Project Coordinator: Manohara Pai M.M.

Team Members : [illegible]

Contact : Dept. of Information and Communication Technology, University of Manipal, Manipal, Karnataka- 576104

Piscium Health Sciences Pvt. Ltd.

Title of the Proposal

Nano-engineered dental burs with better durability, efficiency, heat conduction, and reduced vibrations

Brief description

Pisciums Nano-engineered dental burs last longer, cut with finesse and reduce procedural time. By growing synthetic diamond on tungsten carbide burs, Piscium has combined classical cutting tooling with nanotechnology, thus delivering a product superior to the existing burs, almost all of which are imported.

Current stage of development

Validation

Innovative Element(s)

Currently available sintered diamond burs cut through abrasion provided by diamond grit and do not have cutting edges. On the other side Tungsten carbide burs have cutting edges, but are not able to harness the hardness and thus cutting ability of Diamond. By synthetically growing nano-sized diamond crystals onto carbide burs, Piscium combines classical cutting tool principles with the hardness and penetrability of diamond.

Market Potential

The market potential is high and is driven by fast increasing awareness about dental hygiene, a huge diabetic population and increasing rural incomes. India in the next 5 years will be the worlds largest market for dental care. Currently it is among the most underserviced sectors.

National/Societal relevance

80 percent Indians have a dental problem and less than 50 percent have ever visited a dentist. Fear of a painful dental procedure is a huge deterrent. A major cause for dental pain is inefficient burs. They increase procedural time and risk of infection apart from causing patient discomfort. Developed and made in India, the Piscium Bur stays sharp longer, saves procedural time and delivers more patients per bur.

Project achievements

a. **Progress vis-a vis objectives**- SP3 deposition validated; IP filed, validation trials commenced.
b. **Technology/Product (to be) developed**- Nano-engineered dental burs.
c. **IP generated/ Potential for IP generation**- Complete patent specification for "Chemical vapour deposition process, equipment for implementing the same and surface-modified articles resultant thereof" (No. 201721036636) filed in May 2018.
d. **Resources Generated**- Assets and pilot scale set up for manufacture of the nano coated burs ready and operational. One Apprentice hired.

Plans to take innovation further

Validation on extracted human teeth commence in August 2018. Commercialisation planned by June 2019.

Risks envisaged

Delays in regulatory approvals, funding, fabrication of equipment could lead to delay in Go to market post test launch.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : Piscium Health Sciences Pvt. Ltd., [illegible]

Prantae Solutions Pvt. Ltd.

Title of the Proposal

Development of novel and ultra-sensitive method for amplification less measurement of miRNA to enable early diagnosis of Pregnancy disorder- Preeclampsia at affordable cost

Brief description

A platform technology to detect sparse biomarkers for the early diagnosis of Pregnancy disorder-Preeclampsia. It is an amalgamtion of two independent components, nanoparticle based biosensor and highly sensitive optical device unit, with a capability to detect analyte at a Femtomolar concentration.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The innovation lies in Plasmonic nanosensor operating in the near-IR zone, energy acceptor enhanced response to detect bioanalyte present at a very low concentration and modular optical detection device to detect analytes at close to single molecule level.

Market Potential

The proposed platform translates the literature established biomarker micro-RNA, for the disorder Preeclampsia, but it can be translated to other disorders/diseases as well. Early diagnostics has a huge market demand for pregnancy disorder and other disorders/diseases like cancer, diabetes etc. microRNA is one of the most potential early biomarkers. Thus, the platform technology is expected to have huge market potential in India and globally.

National/Societal relevance

In India the prevalence rate of preeclampsia is very high. The clinical onset of preeclampsia is sudden, providing negligible time for management. It is one of the primary cause for maternal mortality, stillbirth and pre-term birth. Early diagnosis will help in early identification of the pregnancies that could develop preeclampsia so that management can be initiated to prevent or reduce the impact of preeclampsia on mother and child.

Project achievements

a. **Progress vis-a vis objectives-** Biosensor synthesized and first-prototype device developed.

b. **Technology/Product (to be) developed-** Platform technology for detection of microRNA.

c. **IP generated/ Potential for IP generation-** Patent has been applied.

d. **Resources Generated-** Manpower has been trained for gold chip, nanoparticle synthesis and device design. Odisha Start-up financial support has been utilized in part of this project.

Plans to take innovation further

The company has partnered with an academic collaborator for further clinical validation post lab based validation of the device and biosensors.

Risks envisaged

Awareness among different stakeholders and extensive clinical validation which is time and capital intesive.

Project Coordinator: [illegible]

Team Members: [illegible]

Contact: Prantae Solutions Pvt. Ltd., [illegible] Bhubaneswar, Odisha [illegible]

Raghavendra Rao PV (SINE)

Title of the Proposal

Developing a real-time cervical cancer screening device by redesigning existing medical tools combined with advancement in electronics for operation in Indian healthcare settings

Brief description

Project aims to develop an integrated tool that combines advances in electronics and optical technology across devices/platforms and acts as an accurate real-time cervical screening device, while also being an efficient operating tool during surgical and other invasive/non-invasive procedures. Smart ColpoSpec utilizes the miniaturization of low-cost high resolution cameras and the availability of powerful micro controllers that can execute complex machine learning algorithms.

Stage of development

Proof-of-Concept

Innovative Element (s)

Combining high resolution colposcopic imaging system into one single device that can be reusable. Incorporates resident on the mobile computing device a morphological feature extraction, anatomical mapping and a spectral analysis profile of the whole cervix with indices for triaging and recommendations for follow on procedure. The significant benefits offered by this device would be:

1. A single easy to deploy and use device
2. A continuous clear non-obstructed access to the cervix
3. Tele-medicine enabled distant specialist can supervise the procedure during a see and treat
4. Provides access to users including guided robotic surgery

Market potential

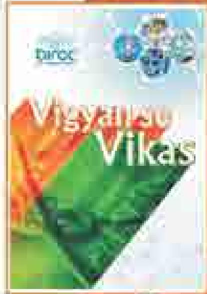
The cervical cancer colposcopic market potential is more than 50 million procedures per annum, with BRIC countries alone having the potential for 30 million plus procedures every year. A significant population doesnt have access to accurate cervical cancer screening procedures, which Smart ColpoSpec aims to change through this innovation

National/Societal relevance

India has around 453.02 million women who stand the risk of developing cervical cancer, with around 70,000 deaths due to cervical cancer every year. 1 out of 4 women that die globally due to cervical cancer is Indian

Project achievements

a. **Progress vis-a vis objectives-** Initial version of the head-mounted prototype has been developed to capture a high-definition image of the cervix and are in the process of developing the image processing algorithm using deep neural networks.



b. **Technology/ Product developed-** Applicants are developing a proof-of-concept stage device that captures high-resolution images which can then be analyzed by an image-analysis algorithm to identify cervical cancer accurately.

c. **IP generated/ Potential for IP generation-** Design provides an unobstructed view of the cervix with high-definition imaging combined with an intelligent algorithm to detect cervical cancer with accuracy.

d. **Resources Generated-** In the process of hiring manpower.

Plans to take innovation further

Following development of the PoC device, next step would be to develop an industrial prototype to undergo regulatory approval process, following which it will be incorporated it into the Cervical Cancer screening workflow through large scale pilots conducted at oncology centers.

Risks envisaged

Since this is a novel idea in terms of design and functionality, time taken for product to reach market is crucial. The accuracy of image analysis would further enhance its use as a standalone screening tool. Its important sensitivity/specificity levels are ensured to be accurate throughout product development.

Raghavendra Rao PV | [illegible] | [illegible] Bangalore, Karnataka [illegible]

Raja Aditya Kadambi (C-CAMP)

Title of the Proposal

An accurate, automated, accessible and affordable solution for seizure diagnosis

Brief description

360eve is a patent-pending innovation in the field of Video-Electroencephalography (Video-EEG) which makes seizure diagnosis more accurate, automated, affordable and accessible to the lacs of seizure and epilepsy sufferers in India and worldwide. The system integrates the latest technologies in video capture, motion tracking, software analytics and cloud-based data sharing, into a home-based epilepsy diagnosis system.

Current stage of development

Validation

Innovative Element(s)

The technology is a proprietary combination of hardware, firmware and software for seizure diagnosis. The innovative elements are automated detection and tracking of patient for up to 170 hours, automatic seizure event detection and tagging, proprietary algorithms for extraction, presentation and analysis of seizure video, sensor and EEG data for physician review and anonymized Video-EEG event snippets.

Market Potential

Total addressable market in India is USD 400 Million annually and total addressable market in USA is USD 1.5 Billion annually.

National/Societal relevance

In India there are 22-25 million epilepsy sufferers and 400,000 new incidences are added. Only 25 percent hospitals in Tier I cities across India currently offer video EEG. In other locations, most substitute with lower grade EEG due to costs and no at-home monitoring is available. The innovation can bring down the costs by 80 percent for Indian patients, allow lot more hospitals to offer video EEG services for accurate and quicker diagnosis. At-home monitoring can be offered for the first time in India

Project achievements

a. **Progress vis-a vis objectives-** Hospital partnerships formed in India and the USA. Prototype device ready for patient studies in hospital settings. Partnerships formed with a global EEG player for licensing and distribution.

b. **Technology/Product (to be) developed-** Video-EEG device for seizure diagnosis

c. **IP generated/ Potential for IP generation-** Patents for proprietary combination of hardware, firmware and software have been filed in 2017. Additional patents will be filed.

d. **Resources Generated-** The company has been incorporated in the US and India. Partnership with 2 hospitals in India and 2 in the US has been established for patient studies. One of the biggest EEG manufacturers in the world, have expressed interested in partnering and integrating the solution as part of improving their Video-EEG product. The company has received recognition in various innovation forums such as American Association of Neurology Brainstorm 2018, IIM Calcutta Smart Fifty 2017, Tata Trusts - Design Impact for Social Change, IIM Bangalore Launchpad 2017.

Plans to take innovation further

The company expects to be in the Indian and US markets in 12-18 months.

Risks envisaged

Effort by market players to either work around or replicate the technology

Project Coordinator:
Raja Aditya Kadambi

Team Members :
Ankita Kumari, Scott Pearn, Kamal Sharma

Contact :
Raja Aditya Kadambi C-CAMP Program Manager, Whitefield Road, Mahadevapura Bangalore, Karnataka 560048

Rajamadhangi Medical Technologies Pvt. Ltd.

Title of the Proposal

Development and validation of Indigenous Dialysis Cartridge

Brief description

With increasing number of Acute and Chronic Kidney failure cases, the demand for dialysis is increasing worldwide. Lifelong dependence on dialysis and the need to repeat thrice a week makes the treatment expensive. At present, India lacks the technology to produce dialysis cartridges. Almost all the devices are being imported and no indigenous device is close to clinical trials. The aim of the project is to develop of a cost effective cartridge which will fulfil the huge demand for dialysis.

Current stage of development

Proof of Concept

Innovative Element(s)

Although the technology behind haemodialysis is at least 40 years old, it has not been able to get a breakthrough in this field in India. The project team has full access to indigenous technology that is producing hollow fibres for the development of dialysis cartridges.

Market Potential

The size of the market is huge and is of the order of 500 Crores. Further, the technology is in the hands of a few foreign companies which exclusively supply the product in India. With no indigenous player in the market, market entry is feasible.

National/Societal relevance

Dialysis Cartridge, an essential component of the dialysis process, is almost exclusively imported. The underlying hollow fibre technology is three decades old and yet, India is unable to master the technology. Current demand for haemodialysis cartridges is estimated to be 60,000 per week and with the introduction of the National Dialysis Scheme, this estimate is likely to go up several fold. Thus, there is an urgent and nationally important need to indigenously develop and produce the cartridges.

Project achievements

a. **Progress vis-a vis objectives-** Initial toxicity and performance tests completed.

b. **Technology/Product (to be) developed-** Ingenuously development of dialysis cartridge.

c. **IP generated/ Potential for IP generation-** Nil.

d. **Resources Generated-** 2 biomedical engineers employed.

Plans to take innovation further

Protyping followed by clinical validation.

Risks envisaged

Individual variation in the cartridge and market penetration.

Project Coordinator:
Vikram Prasad

Team Members :
V.S. Venkatasubramanian, Ravindra Prabhu, Raghu Chandrashekar, Nitesh Kumar, Nikhilesh Shetty, Naveen Prakash

Contact :
Rajamadhangi Medical Technologies Pvt. Ltd. A1-11, New A1 Flat, MIT Campus Manipal, Karnataka 576104

Rishi Shanker (Biotech Park-Lucknow)

Title of the Proposal

Internet of Things IoT -based Platform for Rapid Quantification of Antimicrobial Resistance and Susceptibility

Brief description

To establish a validated and networkable limited resource settings platform, for rapid and simultaneous quantification of antimicrobial resistance and susceptibility. The rapid availability of information and analysis can provide useful guidance to physicians to write targeted antibiotic prescriptions. The integration of a low cost multiplexed DNA biochip with the ability to rapidly (1 hr) measure nucleic acids markers of antibiotic resistance without DNA extraction, assess antibiotic susceptibility and connect the overall platform with Internet of Things IoT Dashboards for data collection, display, and analytics. It will be networked and simple to operate making it suitable for deployment at 25,000 primary health care centres PHCs and 15,000 public and private hospitals in India.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Novelty lies in simultaneous measurement of AMR with AST and direct amplification using an IoT-based genetic analysis platform.

Market potential

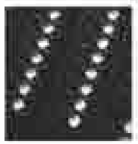
The system when fully implemented will have an IoT-based AMR and AST platform for India that could be used by physicians and healthcare policymakers to help prescribe antibiotics judiciously. There is no other platform currently that integrates both isothermal amplification and growth-based AST assays.

National/Societal relevance

The platform proposed is expected to be high impact because the estimates of deaths and productivity losses due to the emergence of AMR are staggering. The problem is especially overwhelming in countries like India due to its large population with poor access to rapid and accurate diagnostics resulting in imprudent use of antibiotics.

Project achievements

a. **Progress vis-a vis objectives-** Chip/cartridge design developed.
b. **Technology/ Product (to be) developed-** IoT-based AMR and AST platform. Manufacturing ready stage in late 2019 to early 2020
c. **IP generated/ Potential for IP generation-** Potential for IP generation both in wet lab analysis area, hardware and integration of AMR & AST.
d. **Resources Generated-** Manpower trained, Chip fabrication facility.



The Chip

Plans to take innovation further

Compete for Phase II funding to extend the network nationally. Plan to fully utilize the technical and business strategy advice, access to synergistic networks of DBT, BIRAC, BMGF, IKP & their partners for the success of this idea.

Risks envisaged

The challenges to be solved include regulatory, manufacturing and deployment. It is well known that low costs devices face greater challenges in establishing a sustainable business due to meagre revenue generation rather than technical development.

Project Coordinator: Rishi Shanker

Team Members : [illegible]

Contact : [illegible]

Sensivision Health Technologies Pvt. Ltd.

Title of the Proposal

Effective, Accessible and Affordable Device to Diagnose, Treat and Prognosticate HIE in Neonates

Brief description

This is the First of its kind integrated device to treat, monitor and prognosticate Hypoxic Ischemic Encephalopathy in Newborns.

Current stage of development

Validation

Innovative Element(s)

Servo-Controlled, for maximum effectiveness with temperature control at least within +/- 0.5oC. Fully Automated, Cerebral Function Monitoring for early Diagnosis and continuous monitoring of the Treatment, Transport enabled, providing Portability to treat during transport.

Market Potential

Huge market potential.

National/Societal relevance

Under the National Health Mission of Health Ministry of India, newborn health is a key pillar of the Reproductive, Maternal, Newborn, Child Health strategy. Reducing Neonatal Mortality Rate is also a key Millennium Development Goal of India. HIE, which is targeted through this device, is one of the top 3 causes of Neonatal Mortality.

Project achievements

a. **Progress vis-a vis objectives-** The product is being readied for Safety testing.
b. **Technology/Product (to be) developed-** Whole Body cooling device to treat a Birth Asphyxia complication called Hypoxic Ischemic Encephalopathy in Neonates.
c. **IP generated/ Potential for IP generation-** Indian Patent granted.
d. **Resources Generated-** 5 full time employees.Infrastructure in terms of Office space, Lab facilities, Due diligence for Investment from 3 Investors in progress.

Plans to take innovation further

Fund raising to take the device through Clinical Investigations, CE marking and market launch.

Risks envisaged

Will require time and effort to convince Doctors to start using this treatment.

Project Coordinator: [illegible]

Team Members : [illegible]

Contact : [illegible]

Shapecrunch Technology Pvt. Ltd.

Collaborator: AIIMS, Delhi

Title of the Proposal

Development and Testing of custom 3D printed foot orthosis using foot images from smartphone for various foot problems

Brief description

The current process of generation of custom insoles from foot images involves three steps: Point cloud generation from images in 3D environment. Designing of insoles based on diagnosis and manufacturing of insoles using 3D printing. The first step has been automated. The work is now focussed on automating the second step of designing of insoles based on diagnosis. Currently, manual designing is done for generating the 3D model. Data of more than 1000 patients is being collected and a machine learning algorithm is being designed for predicting 3D model of the insole based on diagnosis of the patient.

Current stage of development

Validation

Innovative Element(s)

The innovation lies in conversion of images into point cloud of 3D model of insole, automatic designing of insoles based on diagnosis and automatic variation in hardness of insole based on diagnosis and weight of the patient.

Market Potential

The alpha release of app saw a great amount of traction not only from India but also from Singapore, Malaysia and Sweden. With further automation, insole designing will be just one click away and can be done by podiatrists, orthopaedics, physiotherapists without any knowledge of 3D designing.

National/Societal relevance

The product has been designed keeping remote evaluation as its core. Where medical facilities are not readily available, most of the time, people have to travel far off places to get diagnosed and then treated. In India, more than 58% of people have some kind of foot problem and the product is intended to give them a solution in their hand which is accessible at any hour of the day.

Project achievements

a. **Progress vis-a vis objectives**- The Company is working towards completion of the second milestone which is prediction of the curves of the insole which will be the last step in the automation of designing of insoles.

b. **Technology/Product (to be) developed**- Automation of process for designing of insoles.

c. **IP generated/ Potential for IP generation**- IP will be filed in India and abroad for the software package and copyrights in India and patents in abroad.

d. **Resources Generated**- A small designing and manufacturing facility at AIIMS, New Delhi was set-up, wherein two 3D printers with high configuration desktop was placed. Two human resources were also employed for collection of pressure data at gait lab and manufacturing of insoles and were trained to use 3D printers.

Plans to take innovation further

A complete software suite along with inexpensive mobile foot pressure measurement device will be licensed to the doctors. The Company will also be providing insoles manufacturing services to the doctors who do not want software package.

Risks envisaged

Lack of basic medical education in general public, which makes them doubtful about the benefits of the product.

Project Coordinator: Nitin Gandhi

Team Members: Jitin Saini, Jatin Sharma, Sukhmandeep Singh and Krishna Murari

Contact: 253-E, 4th Floor, Shahpur Jat, New Delhi 110049

Smartify Health Pvt. Ltd.

Title of the Proposal

Smart IV, a biomedical device for efficient surveillance of inpatients on IV line.

Brief description

Smart IV, is a smart biomedical device for efficient surveillance & point of care of inpatients who are on IV line. The nurses have to ensure the bags are changed on time to prevent reverse flow of blood, phlebitis and air embolism. There is no auto-monitoring system present in market to monitor the IV bags related information such as the current level of IV in bottle, flow rate of the IV, time to finish IV dosage.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Novelty in SmartIV is that it gives time to finish TTF for remaining IV present in the IV bag, it gives flow rate of the drip which is presently calculated by manually observing the initial number of drops per minute, it generates notification when the critical condition set by the user is met, it is designed as such so that it can be used without changing any current hospital environment and with the powerful battery backup, it does not need external power supply hence it is deemed suitable to deploy in rural regions also.

Market Potential

India has about 0.87 million inpatient beds where IV monitoring would be manual today. The Company plans to launch the product in MEA, Srilanka & Bangladesh which have a bed capacity of 4 million beds.

National/Societal relevance

The product will help IV administration to be done remotely which can not only bring transparency in drug administration but also assist in new treatment models like remote monitoring of Chemotherapy.

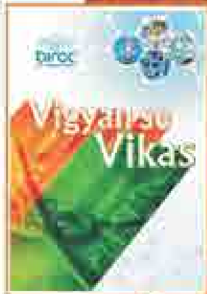
Project achievements

a. **Progress vis-a vis objectives**- The initial prototype has been tested for one week at a BETA site.

b. **Technology/Product (to be) developed**- Smart IV, a device for efficient surveillance of inpatients on IV line is being developed.

c. **IP generated/ Potential for IP generation**- Patent for Smart IV from US PTO has been granted. Patent application is done in India also.

d. **Resources Generated**- 4 full time employees and 2 Consultants are working on the project. The Company has received Angel funding of Rs. 1.2 Crores, which will help to get the product on ground.



Plans to take innovation further

After successful Prototype development and validation, the market ready product will be manufactured from outsourced partner and launched in India. After about 6 months of launching in India, the Company intends to build a strong partner / dealer network for national level sales & distribution and in the 2nd year after product launch it would be taken to MEA, Srilanka & Bangladesh.

Risks envisaged

Delay in launching the product increases the chances of competition.

Project Coordinator: [illegible]

Team Members: [illegible]

Contact: Smartify Health Pvt. Ltd., Mulund W (E), Dr. R.P. Road, Mumbai, Maharashtra- 400080

Smruti Rekha Priyadarshini (KIIT)

Title of the Proposal

TiMiS Tissue fluid microbiology screening tool - A novel screening tool for rapid detection of ocular pathogens

Brief description

TiMiS will be designed as a small, easy to carry kit with different compartments where various reagents would be present. The kit will be exposed directly /indirectly to tissue fluid like tear fluid, cornea scraping, vitreous and lacrimal fluid. The specific chemical reagents present in the different compartments will then react with the specific pathogen with the help of microfluidics and lead to a macroscopically visible colorimetric change which can be detected with the help of a low cost device.

Current stage of development

Proof of Concept

Innovative Element(s)

Till date there is no such product available commercially in market which is in the form of a kit which can rapidly differentiate between pathogens without the help of microbiology setup or trained personnels. TiMiS will be designed to be used as a single, ready to use, rapid and low cost kit.

Market Potential

Initially the kit is being designed for ocular samples, however the usage can further be extended to other tissue fluids like serum, CSF and urine. Hence Ophthalmologist as well as general practitioner will be benefited from this product.

National/Societal relevance

Corneal ulceration is a major cause of monocular blindness in developing countries. The common causes are bacteria and fungi. Currently microbiological diagnosis is dependent on a microbiology laboratory and trained microbiologist and such facilities are not available everywhere particularly in rural areas and in resource-constrained countries. Till date there is no kit commercially available that can rapidly differentiate between pathogens without the help of microbiology setup or trained personnel. The proposed device will help in changing the practice pattern of treatment of ocular infections .Once the detection of organism is made at the grass root level, specific treatment can be initiated and the outcome is expected to be much better than the currently practised regimen of nonspecific combination therapy.

Project achievements

a. **Progress vis-a vis objectives-** Dye selection completed and testing with ocular samples is in progress.
b. **Technology/Product (to be) developed-** Tissue fluid microbiology screening tool.
c. **IP generated/ Potential for IP generation-** Nil.
d. **Resources Generated-** Junior research fellow hired for microbiology work and soon Senior research fellow will be hired for micro fluidics work and designing.

Plans to take innovation further

After adequate validation, the grantee would approach device making companies for the final product which can be made commercially available in market.

Risks envisaged

Stability of the dyes since all the dyes are fluorescent based and designing a low cost equipment for detection of the colorimetric change.

Project Coordinator: Smruti Rekha Priyadarshini

Team Members : Sujata Das, Sanchita Mitra, Soumyava Basu, Himansu Sekhar Seal

Contact : Smruti Rekha Priyadarshini, L V Prasad Eye Institute, Patia, Bhubaneswar, Odisha 751024

StellarGene Technologies Pvt. Ltd.

Title of the Proposal

A novel, cost-effective diagnostic test for Non-Invasive Prenatal Testing

Brief description

Prenatal Testing to diagnose chromosomal trisomies in the fetus is an integral part of maternal and fetal healthcare. Non-invasive prenatal tests- NIPT, act as a screening test, sampling the mothers blood which contains both the maternal and fetal DNA in a cell free state. A major deterrent for current NIPT has been the cost which ranges from 25-60,000. The aim is to develop a NIPT test using a novel approach and Genomics platform to study fetal copy number variation including trisomies, microdeletions and duplications. The use of this technology carries the potential to make NIPT a cost-effective prenatal screening approach.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The test being developed utilizes unique molecular biology reagents and process for sample processing, making the fragmented cell free DNA amenable for utilization in an established genomics workflow used to identify chromosomal aneuploidies, microdeletions and duplications. Compared to current tests, the proposed test is not only economical but also technically superior as it also reports on chromosomal microaberrations.

Market Potential

According to RNCOS, 2014 market research report on NIPT in India, it is the quickest growing segment of Molecular Diagnostics. In the US, where the test was initially launched, the market is expected to grow at a CAGR of 49 percent during 2013-2018. Current NIPT tests in the market, India and International, assess chromosomal aneuploidies only and in India sell at ~ INR 25,000. The proposed test would be more economical ~ INR 10,000 and technically superior as it reports on chromosomal microaberrations.

National/Societal relevance

With increasing age of conception and growing burden of genetic disorders, prenatal test of the developing fetus for common genetic disorders such as Downs syndrome, Edwards syndrome etc, carries a lot of socio-economic value. Safe and highly dependent NIPT screening tests are currently out of reach of most Indians. The proposed test aims to bring down the cost of these tests by more than half and also make them technically superior ensuring a higher diagnostic yield.

Project achievements

a. **Progress vis-a vis objectives-** The project has completed 4 milestones and aims at achieving the proof-of-concept by the end of the project time. One test for gene specific genetic disorder-Hyperoxaluria - has been developed in parallel and validated.
b. **Technology/Product (to be) developed-** POC for Non-Invasive Prenatal Testing.
c. **IP generated/ Potential for IP generation-** Will be filed.
d. **Resources Generated-** Two employees were trained in the process- a PhD. and a MSc. The PhD candidate is trained in all concerned genomics workflow. A second round of funding has also been secured to ensure further progress of the product so as to reach the market.

Plans to take innovation further

Second round of fund have been raised which would be sufficient to reach clinical validation, following which the product would be ready for market.

Risks envisaged

Clinical validation and market penetration.

Project Coordinator: Aparna K. Sajan

Team Members : Bahadur Singh Gurjar and Kapil Rao

Contact : StellarGene Technologies Pvt. Ltd., ZTBI-BTIC, IARI PUSA Campus, New Delhi 110012

Tarun Gupta (FITT)

Title of the Proposal

Developing affordable "Intelligent Self Care" product for multimorbid patients providing personalized preventive care using predictive analytics from historical/real-time using IOT/ Mobile based app

Brief description

IOT devices especially wearable smart trackers which are use for continuous monitoring of patients activity and physical parameters. This solution will be based on 3- key fundamental, Capturing of Patients current and available historical data than Scientific assessment of the data using advanced analytics in monitoring and optimizing the management of the disease & Generating personalized communication with the patients for assurance. The proposed mobile based app will help treating doctor to take more rational decision on drug like its dose, duration, and effects of multiple medications.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Use of time series data over a long period to analyse trends rather than single points. Analysing incremental drivers for change in patient's conditions rather than baseline health conditions. App analysis go deeper to identify which condition causes which disease over time & identifying the root cause of the issue & what should be done next, forecasting & planning.

Market Potential

The current market opportunity is probably under $ 100 million. Rising incomes, greater health awareness, rise in lifestyle diseases and increasing access to insurance are major growth drivers.

National/Societal relevance

Connected healthcare: .With continuous remote monitoring through IOT devices, patients can get treated proactively. Personalized communication: Generating personalized communication with the patients for assurance, help seeking, better compliance, and preventing medication errors Reducing hospital visits: Help in reducing unnecessary hospitalization and emergency visits of patients.

Project achievements:

a. **Progress vis-a vis objectives**- 1. Development of an IOT based system and mobile app is completed. Development of a Data Analytical Engine is in Progress.

b. **Technology/Product (to be) developed**- Product is currently in research and development phase. Expected time required to hit the market is 6-8 months.

c. **IP generated/ Potential for IP generation-** it has potential for IP generation.

d. **Resources Generated**- 4 Man power hired.

Plans to take innovation further

Fund raising and our product licensing is under process.

Risks envisaged

Major challenges will be adoption by customers, customers might be skeptical for sharing data.

Project Coordinator:
Tarun Gupta

Team Members :
T.M. Team, Ravi Krishnan, Vishnu V. R, Pooja Tanwar

Contact :
C1/24, Aman Nagar, A3MS, New Delhi, India - 110029

The University of Burdwan

Title of the Proposal

Development of field based rapid hemoglobinopathy - Thalassemia carrier screening kit.

Brief description

This is a rapid and low cost field based kit Thalassemia/hemglobinopathy carrier screening by a single reagent solution from the normal population. An easy to perform at the home of the common people without involving any instrument by semi-skilled personnel. The detection time is very less, only 10-20 minutes. Visual interpretation of screening results without any instruments. It will help to eliminate the Thalassemia mutant alleles from the population and ultimately lower the disease burden. This is the most common recessive genetic disease in India. Carrier frequency almost 10% in normal population and spread by silent carrier in the normal population.

Stage of development

Proof-of-Concept

Innovative Element (s)

1. Development of rapid field based Thalassemia/hemglobinopathy carrier screening kit. As such type a of kit is not available in world wide.
2. Current method to detect carrier is robust laboratory test using HPLC based technique.
3. Formulation of a single reagent solution to screen for all common types of pathological hemoglobin or thalassaemia carrier in a single test with Visual interpretation of screening results without any instruments.

Market potential

This carrier screening kit will be most cost-effective screening tool for thalassaemia and common haemoglobinopathies, not only in this sub-continent but also abroad, as the disorders mentioned above are a menace in the entire south-east Asia, Africa, middle east and South America. There is an existing gap between population screening and final diagnosis HPLC with CBC . There is no single kit is available to screen carrier for different type of Hemoglobinopathies like . Sickle cell Anemia, Beta Thalassemia, Hemoglobin -E, HBFH and others. Thus this kit will be hot cake for the huge market potential in India, and south eastern countries.

National/Societal relevance

Hemoglobinopthy/Thalassemia is the number one genetic disease in India. Every year there is huge loss of life from this diseases. The annual birth of subjects suffering from transfusion dependent haemoglobinopathies in India is almost 10,000. The cost of maintaining these children to socially and economically able adult is about Rs 15,000 / month, so about Rs 2 Lakh per person per year.

Project achievements

a. **Progress vis-a vis objectives-** Analysis of the performance of developed Haemoglobinipathy carrier screening kit to determine the sensitivity, specificity for different types of quantitative hemoglobinopathy carriers.

b. **Technology/ Product developed**-Principal of the test: Normal individual bears normal RBC with stable Hemoglobin. On the other hand Hemoglobinopathy carriers having two different types of RBC based on their hemoglobin status. Thus blood sample from the normal individual to the matrix will form the single circular band . On the hand in case of carrier individual another inside band will also appear in the matrix. Thus the single or double circular band to the matrix is the visual interpretation criteria for normal and carrier individual respectively.

c. **IP generated/ Potential for IP generation-** IP will be generated in due time.

d. **Resources Generated**-One project fellow and a laboratory technician are engaged in this project.

Plans to take innovation further

Technology may be transferred to the industry in the appropriate stage or commercial production of the kit.

Risks envisaged

There is no market competition, need to develop sensitive and specific kit.

Project Coordinator:
Anupam Basu

Team Members :
Prosenjit Kumar Chowdhury, Mouhumi Das, Debashis Saha, Sudeb Majhi

Contact :
The University Of Burdwan, Chandrasekhar Bidhanchandrapur, Burdwan, Khandaghosh, West Bengal-713360

Urvogelbio Pvt. Ltd.

Title of the Proposal

Development of non-invasive Alzheimer disease diagnostics

Brief description

The technology uses combined exosome and ocular biomarker technology to detect, diagnose and conduct real-time monitoring of CNS diseases, currently Dementia. The exosomal cargo mimics the cell of their origin with respect to host proteins, nucleic acids, lipids and metabolites. Harping on the existing exosome platform, the Company is developing a combined neuronal exosome profiling and combining it with an ocular biomarkers technology to detect amyloid plaques - the signature molecules of AD disease. Exosome profiling forms the basis of companion diagnostics for amyloid and tau therapies and Retinal amyloid imaging forms the basis of companion image diagnostics.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The current gold standard for testing Alzheimers is radioactive, non-repetitive, time taking, costly and invasive. The proposed exosomal-profiling and ocular biomarkers has the potential to move towards early, non-invasive, repetitive, real-time monitoring of disease. Early diagnosis of preclinical-AD will help in pushing up the clinical-disease expression by 15 years.

Market Potential

AD-diagnostics and imaging market is growing at a CAGR of 19.6/18.7. Urvogelbio projects an annual sales approaching $103 million by 2023 and revenue is projected through three streams i.e. sale of the panel, licensing fees and CDX/CDb services for clinical trials.

National/Societal relevance

India has the third largest community of people suffering from Dementia in the world. Alzheimers Disease is the most common type of Dementia. The diagnosis has been poor with only 10 percent getting privilege of right diagnosis. Thus there is substantial unmet clinical need in Indian context. Though degenerative diseases of the brain cannot be reversed, however, with some measures such as symptomatic treatment and effective intervention, it is possible to somewhat delay the progress of the disease, if diagnosed early. This could be possible through the proposed technology.

Project achievements

a. **Progress vis-a vis objectives-** The Company has standardized Exosomal RNA and protein biomarkers from blood using multiplex PCR and ELISA and are developing ocular biomarkers for detection.

b. **Technology/Product (to be) developed-** Platform technology.

c. **IP generated/ Potential for IP generation-** Development of product-patent: "Retinal-amyloid-imaging with different amyloid analogs and test-procedure for neuronal exosome profiling". Development of design-patent: "Miniaturization of the test format, handheld devices, and lab on a chip format".

d. **Resources Generated-** One manpower recruited, trained and another shortlisted, a network of doctors and hospitals identified for clinical material and future market.

Plans to take innovation further

The innovation will be extended to other CNS diseases and clinical samples are being accumulated. Another two years are required to enter into the market.

Risks envisaged

Market acceptability and lack of brain biobank with AD samples.

Project Coordinator: Manoj Vinkare Sasidhar

Team Members : Subhashini Prabhakar, Jay Chaudhari, C. Krishnaveni

Contact : Urvogelbio Pvt. Ltd., AHERF, AMDR building, 2nd floor, Apollo Hospitals, Hyderabad, Telangana - 500033

VMP Ortho Innovations LLP.

Title of the Proposal

System for Accurate Guide-wire Positioning in Orthopedic Surgery

Brief description

Purely image based Trackerless, Non Invasive, Real time, Affordable, Universal, Navigation system predicting future position of Guide wire, Screws and Plates in 2D and 3D for hip fracture fixation to eliminate trial and error, thus improving accuracy, reduce complications, reduce surgery time, reduce radiation and reduce bone loss.

Current stage of development

Validation

Innovative Element(s)

The innovation lies in trackerless navigation for hip fracture surgery, predicting future position of bone implants, predicting future position of guide wire and drill bits, navigation without using invasive tracking sensors, 3D bone image representation with only 2 shoots from Anteroposterior view and Lateral view as compared to other systems of multiple more than 100 shoots, Universality - the system can be used on any bone fracture, with any implant from any manufacturer and on any C arm system unlike other navigation systems.

Market Potential

The market potential is high.

National/Societal relevance

It is a Make in India system which has a potential for worldwide export of technology, software, hardware and manpower. Radiation to OT staff over a period of years can be significant. Use of the system will significantly reduce the radiation thereby reducing the risk of cancer and other medical issues. The initial tests results have shown upto 80 percent reduction in radiation.

Project achievements

a. **Progress vis-a vis objectives-** Project Completed.

b. **Technology/Product (to be) developed-** Technology for trackerless navigation in orthopaedic and trauma surgery for hip module developed.

c. **IP generated/ Potential for IP generation-** Indian patent filed 3571/MUM/2011, United states patent granted for "System for accurate Guide wire positioning" 9808265 B2 and Copyright for software, L31080/2008, SW-3653/2007 in India.

d. **Resources Generated-** The Company VMP Ortho Innovations LLP has been registered and a project manager/ Engineer has been hired.

Plans to take innovation further

In talks with various companies for licencing and commercialization of the system in India and worldwide.

Risks envisaged

Regulatory approvals may take time.

Project Coordinator: Vijay Pandiarajan

Team Members : Ruchi Jog, Rupali Sampgaonkar and Kedar Panchmatkar

Contact : B-1/8, Amitmod Society, Near Krishna Mandir Road, Model Colony, Pune, Maharashtra - 411016

Healthcare - Devices and Diagnostics / SPARSH

Yostra Labs Pvt. Ltd.

Title of the Proposal

Affordable diagnostic device for screening Diabetic Peripheral Neuropathy

Brief description

Neuro Touch Sparsh is a portable, battery powered, multi-parameter diagnostic device for professional doctors to screen diabetic patients for symptoms of Peripheral Neuropathy.

Current stage of development

Validation

Innovative Element(s)

Conventional Diabetic Peripheral Neuropathy screening devices available in the market are bulky, not portable, expensive and need trained healthcare workers to operate the device. Compared to them, Neuro Touch has been developed specifically to enable mass screening of diabetic patients at primary and secondary healthcare centres and resource poor settings.

Market Potential

An addressable market size of approximately USD 150 Million.

National/Societal relevance

Reduce the diabetic peripheral neuropathy screening cost due to low capital investment and need for moderately skilled healthcare workers. NeuroTouch Sparsh is highly portable and can be easily operated in resource poor settings.

Project achievements

a. **Progress vis-a vis objectives-** Completed the product design, ISO 13485 certification and are currently in the clinical validation phase of the project.

b. **Technology/Product (to be) developed-** Post the clinical validation, and DFM verification the product will be manufactured in pilot batches. Market entry by end of the year.

c. **IP generated/ Potential for IP generation-** An Indian IP & PCT has been filed.

d. **Resources Generated-** 7 full time employees and 2 part-time employees. ISO 13485 certified manufacturing facility.

Plans to take Innovation further

Planning to enter the market by end of the year. Fund raising for commercialization and scale up.

Risks envisaged

Being a start up, geographical reach for sales and service is one of the key risk factors.

Project Coordinator:
Vinayak Ponnikas

Team Members :
Ram Mohan Rao, Sanjay Sharma, Manohar K N, Pravin Kumar, Neeta Vinaik, Srividya

Contact :
200, 2nd Cross, 3rd Block, Koramangala, Bangalore, Karnataka-560034

IIPME / Healthcare - Devices and Diagnostics

4S Medical Research Pvt. Ltd.

Title of the Proposal

See Sound- A novel speech visualization tool for improving auditory perception and speech performance of hearing impaired children and adults using their visual cortex

Brief description

See sound live is a software application for Android phones. The application empowers a hearing and speech impaired child or adult to learn speaking English / Hindi. It can be programmed to learn any language.

Current stage of development

Proof-of-Concept

Innovative Element(s)

See Sound Live is the only App of its type in the world that empowers the user to speak by themselves unlike other technologies that aim to speak via computers. The technology takes advantage of a hearing impaired persons overactive Visual Cortex to process sound signals.

Market Potential

Expected users to be about 51 million. Out of these, 15 Million are in India.

National/Societal relevance

This App would give an unprecedented improvement in the quality of lives of these people socially and economically.

Project achievements

a. **Progress vis-a vis objectives-** Prototype has been developed completely and is currently undergoing trials with potential users to establish proof of concept.

b. **Technology/Product (to be) developed-** Clinical trials to complete in 6 - 12 months, at which time we will begin to consider entry into market.

c. **IP generated/ Potential for IP generation-** Copyright of the concept of SeeSoundLive has been granted. Patent applications are planned for US markets.

d. **Resources Generated-** The Application has improved a speech therapists / teacher of deaf's ability to impart speech to deaf children and adults.

Plans to take Innovation further

SeeSoundLive will be expanded to cover all the languages in the world, opening centers in non English / Hindi speaking countries.

Risks envisaged

Learning speech is a time intensive exercise, focus on ways of maintaining the users interest until results start to speak for themselves. Penetration into rural India can be a challenge.

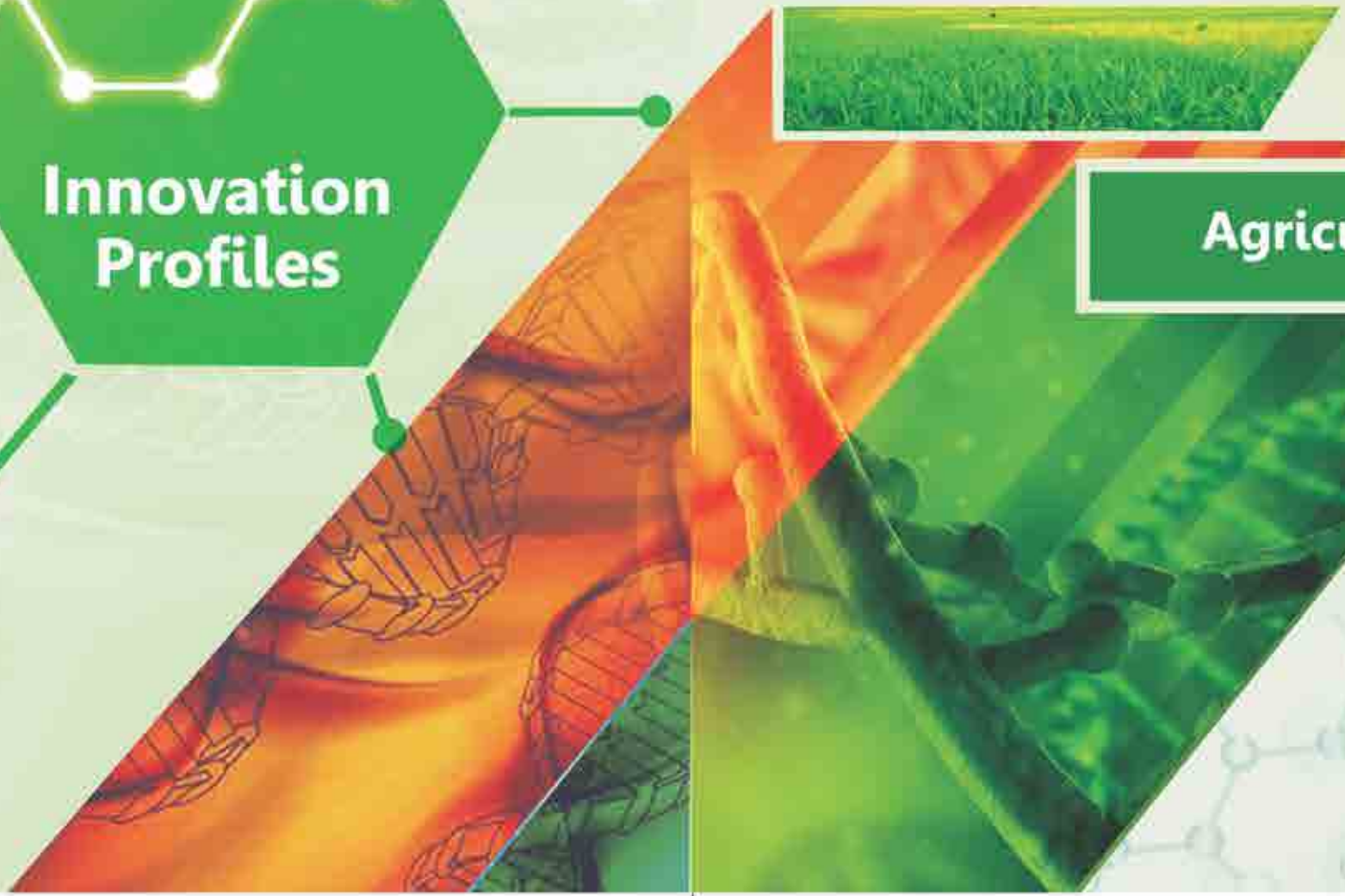
Project Coordinator:
Gurmeet Singh

Team Members :
Rajagiri Chandan, Krishna Nagargoje, Ritu Harit, Sonu Sanjam, Deepak Sehgal

Contact :
A-7, Nehru Nagar, New Delhi-110065

Innovation Profiles

Agriculture



Anitha Peter (C-CAMP)

Title of the Proposal

Development of biosensor for the detection of papaya ringspot virus infecting *Carica papaya*

Brief Description

Highly destructive disease caused by papaya ringspot virus (PRSV) results in heavy yield loss. Early diagnosis is the best strategy to supply disease free planting material for a healthy productive crop. The project aims at assembling the prototype into a hand held device like a glucometer for use in nurseries and tissue culture facilities for this purpose. The proposed concept is a platform technology and can be taken forward for detection of other important plant pathogens.

Current Stage of Development

Proof-of-Concept

Innovative Element(s)

Innovation lies in the hand held Impedance based electrochemical Biosensor that allows field detection of pathogen at early stage of infection

Market Potential

Since the crop is being cultivated globally, this device will be useful to farmers within India as well as outside worldwide

National/Societal Relevance

Innovation will lead to the development of a cost effective hand held device that can be used by the farmer themselves without any training which aids in the selection of disease free plating material thus boosting the production of papaya leading to improved socio-economic status of farmers.

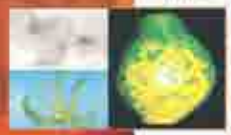
Project Achievements

a. **Progress vis-a vis objectives**- The team has produced and purified recombinant Papaya Ring Spot Virus Coat Protein (rec PRSV CP) from *E.coli* BL 21

b. **Technology/Product (to be) developed**- Hand held, Impedance based electrochemical biosensor like glucometer

c. **IP generated/ Potential for IP generation**- IP will be filed on completion of work

d. **Resources Generated**- Employment of a Senior Research Fellow and Administrative Assistant. Addition of new equipment to support the existing facilities of the lab



Plans to take innovation further

Exploring suitable collaborators for improving, and moving the product towards large scale production for commercialisation

Risks Envisaged

Finding partners for marketing can be challenging

Project Coordinator: Anitha Peter

Team Members : Anand Benjamin Mirajkar, Vinay Nigam, Nimmia K. S, Mukesha Arun

Contact : Department Plant Biotechnology, IIAS @ GKVK Bangalore, Karnataka - 560065

Arsh Biotech Pvt. Ltd.

Title of the Proposal

Development and validation of an economic, rapid, on-site, sensitive, high throughput and convenient molecular diagnostic assay based on recombinase polymerase amplification for detection of key viruses affecting diverse crops in India.

Brief description

The Company proposes a rapid, on-site, high throughput, economic and efficient molecular diagnostic assay for Plant Viruses based on a recombinase polymerase amplification RPA reaction, which allows for pathogen detection using a rapid isothermal amplification without requirement of any laboratory equipment using crude plant extract instead of purified RNA/DNA. Under this they will develop and validate rapid on-site molecular diagnostic kits for two key viruses namely CMV and GBNV affecting cucurbits in India.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The diagnostic kits proposed to be developed and validated in this project shall detect two RNA viruses affecting cucurbits in India namely Cucumber Mosaic Virus and Groundnut Bud Necrosis Virus, for which there are no rapid on-site molecular assays available in India

Market Potential

The gap in the Indian market of economic, rapid and on-site molecular assays for plant pathogens shall be thus met using this approach, and once validated, this approach can be vertically expanded to include other pathogens including bacteria and fungi which are important for cucurbits, and horizontally expanded to include other important crops.

National/Societal relevance

Food losses due to infections by crop pathogens are a persistent issue in Agriculture. Rapid on-site and efficient disease detection is essential to take the necessary steps in time to maximize agricultural productivity. Presently, the most commonly used methods for plant pathogen diagnostics are ELISA and PCR, both of which lack features of rapid on-site detection. The proposed solution can give answers to above problems.

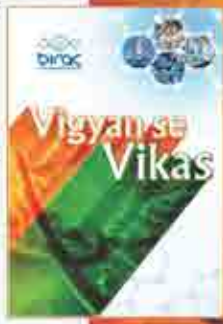
Project Achievements

a. **Progress vis-a vis objectives**- Examination of conserved regions of both CMV and GBNV viruses has been done in order to arrive at stretches in their genome suitable for targeting to develop an on-site molecular test.

b. **Technology/Product (to be) developed**- A rapid, on-site, high throughput, economic and efficient molecular diagnostic assay for Plant Viruses.

c. **IP generated/ Potential for IP generation**- None

d. **Resources Generated**- Being a novel technology, the project has created valuable human resource trained to develop assays based on recombinase polymerase amplification for rapid molecular testing.



Plans to take innovation further

Commercialisation of the product

Risks envisaged

Accuracy of the kit

Project Coordinator: Hemant Sahni

Team Members : Vignesh Kumar, Atinder Chadha, Rajan Sahni, Virendra Bhanwal, Sarita RK, Baweng

Contact : 308, Agarwal City Mall, Road 44, Pitampura, Delhi - 110034

ATGC Biotech Pvt. Ltd.

Title of the Proposal

Development of Novel Technologies for Integrated Pest Management through Mating disruption using Patented SPLAT formulation

Brief Description

An innovative tool to achieve insect pest family planning in agriculture through mating disruption. The technology confuses adult males by luring them to the product which has 10x concentration of female sex pheromone. This false plume of female is emitted by at least 400 source points per acre and adult males always confuse and do not mate with their female counterpart. This prevents further generations of the insect population and protects the crop damage.

Current Stage of Development

Validation

Innovative Element(s)

The product works on life cycle of the pest by disrupting mating prior to egg laying hence no issue of pest developing resistance or genetic modifications.

Market Potential

ATGC Biotech has products which have a market size of $ 14 billion globally and $ 3 Billion in India alone.

National/Societal Relevance

The present research program leads to the final SPLAT Mating disruption and A&K formulations which significantly aides in providing a new revolutionary tool for a farmer.

Project Achievements

a. **Progress vis-a vis objectives-** Project is progressing well, and final season large scale demonstrations trials are ongoing.
b. **Technology/Product (to be) developed-** Testing of product under various ICAR Institutes/SAU was completed and is currently under regulations review. The product is expected to release into market by next year.
c. **IP generated/ Potential for IP generation-** The IP of synthesis is protected as a trade secrets and the formulation is covered under various patents worldwide.
d. **Resources Generated-** Manpower employed/trained: More than 20 academic project investigators, 60 doctoral and post-doctoral fellows, field assistants were trained, and workshops/field days were organized

Plans to take innovation further

MoU has been signed with NACL industries limited for licensing and marketing and exploring collaborations with multinational seed/pesticide companies apart from our own brand to bring the products into market.

Risks Envisaged

All possible risks have been evaluated and addressed with appropriate solutions.

Project Coordinator: Markandeya Gorantla

Team Members : Burla Sashidhar, Ravindra Babu Perem, B V Reddy, K M Sharadraj, Raghavendar Nagoti

Contact : ATGC Biotech Pvt. Ltd. Plot No. 1, Maa Lakshmi Residency, Kompally, Secunderabad, Andhra Pradesh - 500014

Barefeet Analytics Pvt. Ltd.

Title of the Proposal

Cost efficient and rapid residue testing for grape farmers

Brief description

Agrochemicals ensure farm productivity towards worldwide food security. However, residue levels above permissible limits can have severe economic implications including food losses due to rejection, loss of livelihood for marginal farmers and brand devaluation for the FMCG sector. Currently used analysis methods have inherent limitations - low analysis throughput, long test report turnaround durations, high infrastructure and recurring costs. Secondary losses due to inclement weather while awaiting reports and erroneous results also pose challenge. Barefeet Analytics has developed an innovative analysis alternative that increases the analytical throughput by 10-fold 500-800 samples/day, overnight reports and reduced capex and recurring costs.

Current stage of development

Innovative Element(s)

The innovative elements include (a) 2 minute / sample analysis time (b) 10 fold increase in sample throughput (c) Reports within 24 hours (d) Screening of 200+ multiclass chemical residues and pesticides (e) Lower capex and operational costs (f) Potential for field deployment.

Market Potential

Food exports from India~19 Billion USD where testing for residues is mandatory across the product categories. Worldwide MS-based analytical testing ~2.1 billion USD and growing significantly. Issues and unmet needs being addressed with Barefeets innovation are universal for both the developed and emerging markets with a significant potential for market penetration

National/Societal relevance

Testing laboratories need infrastructure and process knowhow, both currently being imported. These involve significant capital investment that leads to prohibitive costs for end users. Even for those who can afford, rejections due to the detection of residues beyond permissible limits often low parts per million or billion are substantial resulting in losses of valuable produce and food. Rejected grapes that do not cross the border are also offloaded in the domestic or unregulated markets incurring significant losses. Developing cost-efficient and affordable residue analysis methods for the domestic and international market without compromising the regulatory accepted methods is of utmost societal importance.

Project Achievements

a. **Progress vis-a vis objectives-** Implementation of developed AP MALDI MS methodology for large scale grape analysis and validation with the existing method
b. **Technology/Product (to be) developed-** Analysis service products method and process SOPs to cater the food testing
c. **IP generated/ Potential for IP generation-** None
d. **Resources Generated-** Manpower employed-4, trained-7 Food testing laboratory with infrastructure and systems towards ISO17025 was created

Plans to take innovation further

Partnerships and key collaborations towards market penetration are in place. Plans are afoot for raising funding for operational expenses and support further growth

Risks envisaged

Competition from existing companies could potentially impact the success. Resistance to change could be a challenge with existing testing laboratories/users. Regulatory acceptance of methods is a challenge.

Project Coordinator: Vishal Mahale

Team Members : VenkateswarluPanchagnula; RekhaSolanki; Madhuri Gupta; MadhuriSagare; Vishal Mahale

Contact : Barefeet Analytics Pvt Ltd., 100 NCL Innovation Park, Pashan, Pune, Maharashtra- 411008

Barrix Agro Sciences Pvt. Ltd.

Title of the Proposal

To develop sustained release pheromone dispersion formulation and trap for the in house synthesised, patented, commercially affordable pheromones used by the farmers to control agricultural pests enabling organic cultivation.

Brief description

Economical synthesis of pheromone using in- house procedures by commercially available materials.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Pheromone molecules synthesised in gram level with high purity of more than 95 percent and 80-90 percent of yield.

Market Potential

Groundnut leaf miner Gt.M- Ground nut-7.5 million hectares cultivation area - 20-30 percent damage- Recommendation of traps- 12 traps/hectare, @80 Rs per trap 7,200 million rupees market potential. Yellow stem Borer YSB Paddy 44.0 million hectares cultivation area- 20 - 80 percent damage -Recommendation of traps-12 traps/hectare @70 Rs per trap 36,960 million rupees market potential. Early shoot Borer ESB Sugar Cane 4.61 million hectares cultivation area- 40-50 percent damage - Recommendation of traps, 20 traps/hectare@70 Rs per trap 6,451 rupees million market potential.

National/Societal relevance

The world is adversely affected due to high usage of chemical pesticides which causes various diseases to mankind and destroys the ecological balance. Indiscriminate spraying of pesticides has affected the fertility of soil, which has resulted in lesser yield of agriculture products. High chemical residue levels in the consumables have reduced exports and hampered foreign exchange. This has resulted in inflation with respect to prices of such products.

Project Achievements

a. **Progress vis-a vis objectives-** Developed commercially viable method for the synthesis of yellow stem borer rice and early shoot borer sugar cane pheromones from 1 gram level to 30 gram level and established the purity and impurity profiling by GC FID, same has been elucidated and evaluated by GC-MS and NMR.

b. **Technology/Product (to be) developed-** To develop sustained release pheromone dispersion formulation and trap for the in house synthesised, patented, commercially affordable pheromones used by the farmers to control agricultural pests enabling organic cultivation

c. **IP generated/ Potential for IP generation-** Patent has been filed for various processes.

d. **Resources Generated-** Manpower and Laboratory

Plans to take innovation further

The Company will be seeking fund raising from any of the Govt. organisations or Technology development board or soft loan for creating facility and to establish the factory for mass production and commercialization of pheromones.

Risks envisaged

Creating awareness to the farmers to introduce the Integrated Pest Management IPM Products. Creating space for pheromone-based product in the market. To develop quality control strategy for pheromone-based products.

Project Coordinator: Kannan S

Team Members : Raghavendra Reddy, Vinoth Kumar D, Priyanka G, N K Sarathchandra Prakash, S P Venkatesh Prasad, Mallikarjun, Remya Kolaveli

Contact : 68 A, Ground Floor, 6th Main, 3rd Phase, Peenya Industrial Area, Bangalore, Karnataka - 560058

Centre for DNA Fingerprinting and Diagnostics

Collaborator: Central Silk Board & Andhra Pradesh State Sericulture Research & Development Institute

Title of the Proposal

To conduct multilocational field trials on transgenic BmNPV resistant silkworm strains to establish their efficacy and generate data for their regulatory approval

Brief Description

Simultaneous targeting of several BmNPV essential genes in transgenic silkworm would elicit a stable defence against virus. The vectors carrying short sequences of four essential BmNPV genes ie1, lef1, lef3 and p74 were introduced into the silkworm germline. The transgenic silkworm was developed using the Piggymultigene flip-flop-3XP3-DsRed2, that is efficient in inducing RNAi based silencing of four essential viral genes, ensuring high degree of resistance to BmNPV infection

Current Stage of Development

Validation

Innovative Element(s)

RNAi mediated inhibition of baculovirus proliferation in transgenic silkworms by targeting multiple viral genes simultaneously was devised at CDFD and the transgenic lines generated under *Bombyx mori Nistari* genetic background showed resistance against virus and this antiviral property was transferred to CSR2 silkworm through marker assisted backcross breeding at APSSRDI.

Market Potential

To meet the Global demand for Bivoltine Silk in tropical countries like India, BmNPV resistant transgenic Bivoltine hybrids could be reared without crop loss throughout the year by the farmers and aid in enhancing their income over time.

National/Societal Relevance

The transgenic silkworm hybrids have the potential to contribute towards increased bivoltine silk production in the country which would attract young Entrepreneurs to take up Sericulture for their livelihood.

Project Achievements

a. **Progress vis-a vis objectives-** The developed transgenic silkworm hybrids were taken to Phase I Multi-location field trials at Institutional level to establish efficacy across the major silk producing areas and the data were generated.

b. **Technology/Product (to be) developed-** BmNPV resistant transgenic silkworms were developed and validated at Institutional level under Phase I of contained field trials.

c. **IP generated/ Potential for IP generation-** An IP was filed: WO2012104876A1

d. **Resources Generated-** Under Manpower, four project personnel were recruited and trained for the project period. A World class Silkworm rearing facility and Biotechnology Lab was established at APSSRDI.

Plans to take innovation further

The Emerging Technology of Transgenic Silkworms would be tested at farmer's level with the approval of GEAC

Risks Envisaged

Technology has been discussed at Institutional Bio-safety Committee meetings of CDFD, APSSRDI and three R&D institutes of Central Silk Board.

Project Coordinator: P J Raju

Team Members : S J Raju, Devaiah Mitra, V V Satyavathi, K Bindhu Sadhu, Rohit Joshi

Contact : Centre for DNA Fingerprinting and Diagnostics, Gruhakalpa, 5-4-399/B, Nampally, Hyderabad, Andhra Pradesh -500001

Dtronics Technology Pvt. Ltd.

Title of the Proposal

Proof of Concept on development of field portable Arsenic testing kit

Brief description

Colorimetric based image processing technology will be used for onsite detection of Arsenic in water using Smart Phone

Current stage of development

Proof-of-Concept

Innovative Element(s)

Sensor has been developed which gives unique color when it comes in contact with Arsenic present in water. Uniform illumination based image analysis technique will be developed for identification of concentration of Arsenic in water.

Market Potential

Test strips are colorimetric and the results depend on matching colors by eye. One shortcoming of a colorimetric test like this is the limited number of preselected levels present on a color chart. This early detection of arsenic in ground water will surely have a great market potential.

National/Societal relevance:

Arsenic contamination in groundwater in the Ganga-Brahmaputra fluvial plains in India and Padma-Meghna fluvial plains in Bangladesh and its consequences to the human health have been reported as one of the world's biggest natural groundwater calamities to the mankind. With widespread Arsenic contamination and lack of laboratory facilities, usually, the field detection kits are preferred to detect arsenic in tubewells. However, these kits produce a significant number of false positives/negatives due to human errors in matching the detection test-strip colors to the reference color chart. This proof of concept proposal introduces digital image processing methods and a smart phone application, which allow fast and inexpensive improvement in the test-strip classification of field detection kits.

Project Achievements

a. **Progress vis-a vis objectives-** 1.Detection of Arsenic in water using biotechnology based receptor 2. Detection of Arsenic in water using chemical-receptor 3.Development of uniform illumination arrangement & prototype system

b. **Technology/Product (to be) developed-** Sensing of Arsenic contamination through colorimetric technique based on smart phone enabled uniform illumination system.

c. **IP generated/ Potential for IP generation-** New IPR is expected as it is a novel concept

d. **Resources Generated-** Equipped laboratory has been created and manpower has been recruited and trained.

Plans to take innovation further

The system will be deployed in multiple locations after field trial.

Risks envisaged

Developed sensors may not reach the required detection limit necessary to control for a specific parameter

Project Coordinator: Chinmay Sarkar

Team Members : Amit Sarkar, Chinmay Sarkar, S Pal, Purusottam Das, Souptik Bera, R. Bandyopadhyay

Contact : Dtronics Technology Pvt. Ltd., 35 Sarat Bose Lane, Near Chayanika Math Para, Kolkata - West Bengal - 700083

Ganga Kaveri Seeds Pvt. Ltd.

Title of the Proposal

Development of brown plant hopper (BPH) resistant rice hybrids by marker-assisted breeding

Brief Description

The proposed objective is to impart disease resistance to GK rice hybrids by introgression of BPH resistant genes viz., Bph 18 Donor : IR 65482-7-216-1-2-B derived from *O. australiensis*, Bph 20 and Bph 21 Donor:IR 71033-121-15 derived from *O.minuta* utilizing marker assisted breeding and involvement of di-haploid breeding.

Current Stage of Development

Validation

Innovative Element(s)

Improvement of restorer lines of GK rice hybrids introgressed with bacterial blight resistance genes through introgression of three dominant Bph resistance genes (Bph18, Bph20 and Bph21) for achieving durable resistance to Brown plant hopper (BPH)

Market Potential

GK 5028 is an early maturing hybrid and can be an effective replacement for the traditional early duration varieties. GK 5003 is a mid-early maturing hybrid and suited for major rice growing areas in India. GK 5017 is a medium duration hybrid and suited for major rice growing areas in India.

National/Societal Relevance

Resistant varieties would prevent the pest damage effectively and avoid the BPH outbreaks while saving costs of pesticides, application and drudgery as well. Rice hybrids insulated with resistance will thus be more advantageous.

Project Achievements

a. **Progress vis-a vis objectives-** Evaluation of agronomic and yield related traits and multi-location testing and phenotypic observations will be done during Kharif 2018

b. **Technology/Product (to be) developed:** Product could be tested in the market during Kharif 2020

c. **IP generated/ Potential for IP generation-** Multiplex PCR for screening 5 genes simultaneously

d. **Resources Generated-** Manpower employed/Trained - 1 2 BITP trainees have been trained on various aspects of the MAS during the tenure of this project

Plans to take innovation further

Further validation & marketing strategy to be done

Risks Envisaged

Evolution of different virulent biotypes of BPH

Project Coordinator: Sai Mohan Raj Pasupuleti

Team Members : Lalitha Shanti, M. Raghavendra Rao, S. Vidyadhara, R. Ajay Kumar, M. Ramanaiah Chennala

Contact : Ganga Kaveri Seeds Pvt. Ltd., Subu Gan Estate, Bhavani Nagar, Hyderabad, Andhra Pradesh- 500053

Indo American Hybrid Seeds

Title of the Proposal

Marker assisted gene pyramiding of blast and bacterial blight resistance genes into CMS & maintainer lines of rice

Brief Description

Marker Assisted gene pyramiding through backcross breeding is being employed to introgress bacterial blight Xa21, xa13 and blast genes Pi1, Pi2 and pi54 into commercially released high yielding cytoplasmic male sterile (CMS) based rice hybrids.

Current Stage of Development

Proof-of-Concept

Innovative Element(s)

Innovation lies in the introgression of multiple genes to pyramid bacterial blight resistance genes and blast genes into elite hybrid female background of cytoplasmic male sterile and its cognate lines

Market Potential

The market potential of present hybrids is 300 metric tonnes however, with the newly developed resistance hybrid will have a market of 800-1000 metric tonnes.

National/Societal Relevance

Suitable to disease endemic areas and requires least plant protection sprays; also minimizes the cost of cultivation and gives great returns

Project Achievements

a. **Progress vis-a vis objectives-** The disease resistant genes introgressed female parent lines CMS and maintainer have been advanced up to double cross F4 generation and field evaluation at disease hotspot areas is in progress.

b. **Technology/Product (to be) developed-** The product development is under progress and would enter the market by 2021-22 after the multi location trial.

c. **IP generated/ Potential for IP generation-** IP is not generated

d. **Resources Generated-** Manpower has been employed and trained very well in genotyping, phenotyping, crossing and evaluation of introgressed lines in hotspots.

Plans to take innovation further

It can be licensed to others for use

Risks Envisaged

There may be great threat of new virulent recombinant pathogens strain evolution which may cause damage. There may be competition from competitor who might have greater advantage of improved resistance.

Project Coordinator: Devaraja Achar A.M

Team Members : Vikram Kumar Yadav, S. N. Rabbo

Contact : Indo American Hybrid Seeds, Channasandra Near RNS IT College, Rajarajeshwari Nagar, Bangalore, Karnataka 560098

Jiva Sciences Pvt. Ltd.

Title of the Proposal

Development of MLBSS chip for Bovine sperms sorting

Brief Description

Microfluidic based Laser assisted Bovine Sperm Separation MLBSS machine prototype is proposed to be built around the prototype bovine sperm sorter built in Phase 1 of the project. At present 2nd phase of the proposal is under consideration at BIRAC. Overall system design will include pressurized flow and control, coupled opto-electronic system, specific lasers for fluorescence and ablation, advanced photodetectors for high-sensitivity detection, and a microscope objective for ablation. The system will have electronics which detects and process data in nanoseconds for real time detection and ablation of undesired Y sperms.

Current Stage of Development

Validation

Innovative Element(s)

The approach is based on developing a novel fully integrated, a high-throughput optofluidics machine for bovine sperm cell detection and separation. At the heart of this platform is the custom designed microfluidic device, which is capable of aligning cells in 2D and 3D flow using hydrodynamic focusing

Market Potential

India is the largest producer of milk, and dairy products which are a primary source of nutrition in country. Only female calves ensures next generation of cows for dairy operations. The bovine sperm sex sorting machine will be sold to semen stations and the cattle breeders in India, to counter the non-availability of the same in India.

National/Societal Relevance

Important for Dairy industries. Only female calves ensures next generation of cows for dairy operations. Non-productive male cattle is of no use these days. Bovine sperm sexing for female sperms is a very good approach which is focussed on utilization of Biotechnology for socio-economic welfare of farmers and to restrict unwanted bulls being born.

Project Achievements

a. **Progress vis-a vis objectives-** Prototype development with laser device interface & functional analysis of the device.

b. **Technology/Product (to be) developed-** Technology for Proof of Concept is established. Commercial machine is needed to be developed.

c. **IP generated/ Potential for IP generation-** One patent filed in India, three more patents would be filed by end of 2018.

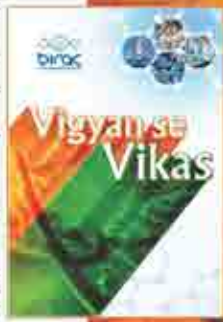
d. **Resources Generated-** Created infrastructure with Microfluidics, Optics, Applied biotechnology and sperm sexing state of art technologies, IVF and Embryo preservation.

Plans to take innovation further

Jiva Sciences Pvt. Ltd. is the R&D division of Tropical Animal Genetics Pvt Ltd which has state of art technologies for improving food availability across the globe with specific focus on India

Risks Envisaged

Unforeseen time delays in machine development and high expenditure in R&D can cause the product to become expensive. Also, the capital expenditure to set up high-production facilities for manufacturing, machines required for 100 million doses of sperms in our country per year is quite substantial. However, Jiva Sciences already has a forward contract with the NDDB to reduce risk and financial requirement.



Project Coordinator: Srinivasan Sridhar

Team Members : Puneet Kumar Gupta, Jonathan Pillai, Anushekaloth, Pravasi Rathi, Jobin Vijayan, Pravin Kini, Sasishly Shenoy

Contact : Jiva Sciences Pvt Ltd., 3004, HAL Third Stage, Bengaluru, Karnataka - 560038

Kaveri Seed Company Ltd.

Title of the Proposal

Marker-assisted dissection of genetic basis of yield and improving yield potential under drought stress in Maize

Brief Description

Maize genetic enhancement under drought conditions through traditional breeding has not been realized to the full extent due to complexity of genetic mechanisms involved in controlling the trait. Alternatively, molecular marker technology complementing traditional breeding offers a promising solution for improving maize productivity under drought conditions.

Current Stage of Development

Discovery

Innovative Element(s)

Improving maize productivity under drought conditions through molecular marker technology offers a promising future

Market Potential

Since maize being primarily cultivated under rain fed situations, improved hybrids and inbreds with high yield will have a very high market potential.

National/Societal Relevance

In India, maize is cultivated over 8.17 M Ha with an annual production of 19.73 MT Maize productivity in India is about 2.4 MT/Ha, whereas the global average is 5 MT/ha. If the country manages to push maize yields anywhere close to global average, India would have sustained maize production and also scope for maize export from the country.

Project Achievements

a. **Progress vis-a vis objectives-** Marker assisted dissection of genetic basis of yield and drought tolerance and improvement of parental lines using marker-assisted recurrent selection has been completed. Multi-location trial of the developed hybrid is under progress.

b. **Technology/Product (to be) developed-** The project would lead to the development of high yielding drougrit tolerant Maize hybrids

c. **IP generated/ Potential for IP generation-** Nil

d. **Resources Generated-**The project has created infrastructure facility, marker technology facility and manpower resource for the company.

Plans to take innovation further

The project helped to understand the genetic basis of high yield potential in maize under drought stress which will be used to develop superior maize hybrids in future.

Risks Envisaged

The maize hybrids developed in the project need to be tested in multi location trials across the country's major maize growing areas before entering the market

Project Coordinator:
G. Srinivas

Team Members :
Ramesh Kumar Chakrala,
Bheemaiah Chitte, CH. Veeraiah,
S. Sammaiah

Contact :
Kaveri Seed Company Ltd.
Minerva Complex, Sarojini Devi Road,
Secunderabad, Andhra Pradesh- 500003

Krimmi Biotech LLP.

Title of the Proposal

Validation and bench-scale production of beneficial nematodes on waste silkworm pupae against agricultural pests like root grubs, shoot borers, root weevils, fungus gnat etc., to protect crops like arecanut, sugarcane, banana and other vegetative crops.

Brief description

Biocontrol agents are used as an alternative to deal with the negative impact of the chemical pesticides being used in the agriculture sector. One of them being Entomopathogenic nematodes EPNs. This technology comprises of an improved and novel in vivo method of EPN production which would drastically reduce the production cost of rearing *Galleria mellonella* which is a commonly used host for EPN multiplication. As a better alternative, they have identified pupae as the novel surrogate host for the mass cultivation of EPN.

Current stage of development

Validation

Innovative Element(s)

The innovative step in this project is the mass multiplication of Entomopathogenic Nematodes, by using discarded pupa from reeling units

Market Potential

The global market is projected to reach USD 10.05 Billion by 2020, growing at a CAGR of 14.5 percent from 2015 to 2020. Indian Scenario: The Indian biopesticide market is projected to grow at a CAGR of 20.2 from 2010 to 2020 with the market of USD 23.92 million in 2015.

National/Societal relevance

In India, out of all the agricultural production 2,80,792 million tons, 26% of total crop losses is due to insect pest infestation. Agriculture sector face severe loss of about 1,300 crores for the crop failure due to infestation by insects. Through this technology, discarded pupa can be used as an replacement or alternative to *Galleria mellonella* model organism to mass multiply EPN. It would drastically reduce the health hazard caused by discarded pupa from reeling industries, as there is 26,000 MT of annual discharge of waste pupa to the environment. This pupa is a rich source of lipids and protein enriched with essential amino acids which would enable effective EPN multiplication.

Project achievements

a. **Progress vis-a vis objectives-** Established a proof of concept in mass multiplying EPN s on waste pupa.

b. **Technology/Product (to be) developed-** Biocontrol agent in the form of EPN formulation

c. **IP generated/ Potential for IP generation-** One Indian provisional patent has been filed

d. **Resources Generated-** Support received from Government of Karnataka under the Idea to PoC schema.

Plans to take innovation further

Further plans of scale up and commercialization by seeking support in the form of grants in aid, loan etc.

Risks envisaged

Market Penetration

Project Coordinator:
Manoharan.S

Team Members:
Gaurav Bharadwaj Deopak
Rajesh

Contact :
No 63, EWS Colony, Devaraj URS Layout,
B Block, Near Yellamma Temple, Davangere,
Karnataka- 577006

Kwaklei & Khonggunmelei Orchids Pvt. Ltd.

Title of the Proposal

Commercial orchid breeding and production of clones of elite hybrids

Brief Description

Utilization of the rich orchid resource of India can be achieved through breeding of the potential species either for pot plant or cut flower. Elite genotypes of the already developed hybrids have been selected and propagated clonally and so far, more than 50 primary as well as secondary orchid hybrids have been developed.

Current Stage of Development

Discovery

Innovative Element(s)

The project focuses on development of novel hybrid orchids using the resources available in India. This breeding effort shall result in production of hybrid orchids suitable for commercial cultivation in different parts of India.

Market Potential

Orchids are very sought after horticultural items worldwide. India has been importing from other heavyweight orchid producing countries. Hence, there is high market potential.

National/Societal Relevance

Despite having rich orchid resources India has been importing orchids from other orchid producing countries in SE Asia for commercial purposes. Those orchids developed in tropical Asia may not perform well in sub-tropical or temperate climates. Hence, there is a need for development of specific commercial breeds for providing to the growers in different climatic regimes in India.

Project Achievements

a. **Progress vis-a vis objectives-** Clonal propagation of the primary hybrids is being carried forward and more than 50 primary as well as secondary hybrids have been germinated in vivo and maintained in the laboratory.

b. **Technology/Product (to be) developed-** New hybrid orchids are the product of this project and at present there are more than 30 new hybrid orchids being developed.

c. **IP generated/ Potential for IP generation-** Registration of the hybrid under plant variety protection shall be done once the plants flower.

d. **Resources Generated-** Manpower employed/trained- 1 project fellow and 1 field assistant have been appointed. Facility created: Equipment including a laminar flow cabinet, an autoclave and a pH meter has been purchased.

Plans to take innovation further

Venture fund for further scale up and commercialization shall be sought from NE Ventrue fund of NEDFI.

Risks Envisaged

Long maturity period is the only problem to the orchid breeder.

Project Coordinator: Rajkumar Kaleo

Team Members : Jina Heikrujam, K. Rohit

Contact : Kwaklei & Khonggunmelei Orchids Pvt. Ltd Segolband Vijay govind Leimbal Manipur-795001

Maharashtra Hybrid Seeds Company Ltd.

Title of the Proposal

Improvement of line yield per se and efficiency of hybrid seed production in rice using genome editing technologies.

Brief description

Genome editing (GE) is a precise method using modified molecular nucleases, which act as scissors, to edit any crop genome at specific loci. The genome editing technique, CRISPR-Cas9, is used in this present project to modify various yield genes to increase production of paddy and one sigma exertion gene to increase hybrid seed producibility.

Current stage of development

Lines with intended genome edits have being generated.

Innovative Element(s)

The convergence of new breeding technologies NBT like CRISPR/Cas9 with traditional breeding will have a significant impact on the rapid advancement in yield and mitigating food shortage.

Market Potential

New, better performing, high yielding paddy varieties and hybrids over the existing ones are the need of the hour. Genome edited paddy products could fill the gap, increasing farm income.

National/Societal relevance

For decades, plant breeders have used various tools to accelerate crop improvement efforts to reduce the time required to develop new improved crop varieties. The convergence of new breeding technologies (NBT) like CRISPR/Cas9 with traditional breeding will have a significant impact on the rapid advancement in yield and mitigating food shortage. The genome edited high yielding rice lines will be ready in about three years.

Project achievements

a. **Progress vis-a vis objectives-** The project is progressing as per plan. Lines with intended genome edits have being generated.

b. **Technology/Product (to be) developed-** The genome edited high yielding rice lines will be ready in about three years.

c. **IP generated/ Potential for IP generation-** Genome edited hybrid lines can be protected via PVP-FRA.

d. **Resources Generated -** Greenhouse, equipment and trained human resource.

Plans to take innovation further

Deregulation of CRISPR Cas 9 generated transgenic plants for moving towards commercialization

Risks envisaged

Regulatory guidelines for Genome edited crops are not in place in India.

Project Coordinator: Bharat Chair

Team Members : Aniruddha Bhattacharya, Vilas Parkhe, Venugopal Mekkilaveet

Contact : Maharashtra Hybrid Seeds Company Ltd. Hybrid Research Centre, Jalna-Aurangabad Road, Maharastra-431203

One Acre Venture Pvt. Ltd.

Title of the Proposal

Nutri Plant Health Application for Farmers

Brief description

Agri nurture is a digital ICT based application for the soil nutrient management system to improve agricultural productivity and improve the farmers livelihoods. It uses a mobile front-end to capture the soil quality and on the basis of the crop to provide the right recommendation with the right dosages of those nutrients which are locally available. This platform triggers the development of an ecosystem, which uses AI to drive decision-making for small farmers and in the process incentivizes the user [Agri retailer] to maintain continuous and reliable engagement with the farming community. The data is consistently and constantly updated through transactions, enabling the creation of digitized knowledge, which maps the framers cropping journey and his nutrient engagement behaviour. A personalized soil health card/portfolio is maintained on a continuous basis and the farmers are alerted on the soil health to ensure their crop productivity.

Current stage of development

Validation

Innovative Element(s)

The innovation lies in designing human digital technology platform to improve the soil nutrient management and farmer engagement.

Market Potential

The smart agriculture market will grow from US$ 5.18 Billion in 2016 to US$ 11.23 Billion by 2022, at a CAGR of 13.27 between 2017 and 2022. In India, there are 15 agents per sub-district engaging an average of 100 farmers. This puts the addressable market at 1.35M agents working with 120M farmers. 80 are small holders thus putting the farmer market size at 96M. Globally this market size is 450M i.e. 2.2 billion people depend on agriculture for their livelihoods. Globally with ~ 500 million smallholder farmers, The Total Addressable Impact [TAI if no competitor exists in the market] is 268 million farmers and Shared Addressable Impact [SAI describes the portion of TAI that is realistic for the enterprise to accomplish within a specific timeframe] is 5 million farmers.

National/Societal relevance

The eKutir model aims at integrating the ecosystem and making the communities evolve as active and responsible participants. Through this model, they are practising a theory of change model anchored into the convergence of efforts among different collaborators with proven efficacy in managing nutrition interventions and impact-based evaluation for agriculture and farmer development.

Project achievements

a. **Progress vis-a vis objectives-** The objective of the project is to design and re-engineer the AgriNurture software for the beta version with the enhanced User interface, smart data repository system and enhanced security is ongoing.

b. **Technology/Product (to be) developed-** The Agri-Nurture is an ICT and AI-based intelligent software for soil nutrient management.

c. **IP generated/ Potential for IP generation-** NIL

d. **Resources Generated-** Multiple resources have been generated throughout the project management phase. 7 manpower are being employed, 2 facilities are created.

Plans to take innovation further

To approach multiple partnerships & collaborations.

Risks envisaged

None

Project Coordinator: Sivankar Mishra

Team Members : Pulak Dash, Yash Jagtiani, Kiran R S, Sudhansha Sahoo, Bhanoj Kumaran Nalini, Sambit Mahapatra

Contact : One Acre venture Pvt. Ltd. Flat No: H3-01, Plot No N2/43 Nayapalli, Bhubaneswar, Orissa- 751015

Proximal Soilsens Technologies Pvt. Ltd.

Title of the Proposal

An affordable soil monitoring system for precise irrigation

Brief description

In India, around 50 percent of employment is in the agricultural sector. The lack of technology being used in the agricultural sector makes it non-profitable and the depleting groundwater levels make it unsustainable. This sector uses 80 % of the available water, out of which 40 % is wasted. Proper irrigation will improve the crop yield by 15-20 %. This calls for an affordable custom solution for precise irrigation management. With this motivation, they have developed an affordable in-field soil monitoring system which helps the farmers irrigate their fields by measuring multiple soil parameters like soil moisture, soil temperature, atmospheric temperature and relative humidity.

Current stage of development

Validation

Innovative Element(s)

Including the sensors, the complete system is in-house developed which makes this different from others and thus making the solution affordable to the Indian farmers.

Market Potential

Agricultural Institutes and KrishiVigyanKendras KVK -There are more than 80 Agricultural universities and more than 600 KVKs in India having their own farms. These Universities and KVKs are funded by Central or State governments. To all above-mentioned customers, the revenue can be generated by selling the systems or renting the systems.

National/Societal relevance

The system can predict the water requirement for the agricultural field, based on the type of soil, and the growth stage of the crop. For the farmer, the information will be a simple color code on the display or mobile phone, and at the same time for the analysis, the information will be sent via a wireless link.

Project achievements

a. **Progress vis-a vis objectives-** Already built 35 systems

b. **Technology/Product (to be) developed-** Technology

c. **IP generated/ Potential for IP generation-** Already patented through IITB

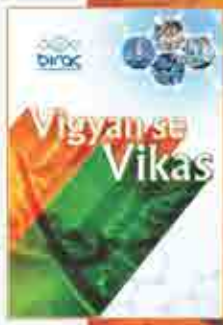
d. **Resources Generated-** Employed 4 people; made a workshop to build and test the system

Plans to take innovation further

Arrangement of additional funds

Risks envisaged

As the technology enters the market, copying of product is one concern. Also educating marginal farmers to adopt the technology is another challenge.



Project Coordinator: Sujit Patkar

Team Members : Mangesh Gurav, Vinay Palaparthy, Jobish John, Swanand Zanpure, Mayur Mankar, Siraj, Mohammed

Contact : SINE, IIT Bombay, Mumbai, Maharashtra - 400076

Rishi Shanker (Biotech Park, Lucknow)

Title of the Proposal

AGRO-Dx - A smartphone-operated multi-analyte platform for precision farming in India

Brief description

AGRO-Dx - a Tablet or Smartphone-operated multi-analyte platform for on-site and simultaneous quantification of protozoans, bacteria, viruses and fungi in plant tissue or soils. Miniaturized multiplexed test including direct amplification of nucleic acids markers on DNA biochips with time to result for most assays is around 30 minutes. The platform will possess the capability to set the geo-coordinates and enable submission of data to a central database using Smartphone-based GPS operation. Platform will be similar in size to a Tablet and serve as one node of an Internet of Things IoT network developed for the more than 2.2 million agricultural farms in India.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The novel platform will facilitates molecular analysis that is generally carried out in centralized facilities using complex protocols and instrumentation. The automated inclusion of geo-coordinates and submission to a centralized database is also novel especially for the agriculture sector in India. When fully implemented, AGRO-Dx will serve as a field instrument critically needed by both farmers and government personnel involved in crop management

Market Potential

AGRO-Dx will be validated for select pathogens to demonstrate its capabilities to investors, licensures, and buyers. The projected cost for the Indian market may be in the range of Rs 250 per panel of 8 tests. Assuming 4 tests per year and 2 million customers, the total addressable market may be roughly 200 crores

National/Societal relevance

Commonly identified gaps or weaknesses in the Indian agricultural industry include lack of technological input and poor infrastructure. An early warning system as preventive measure combined with treatment and control options is one of the most important steps that can be taken to benefit from the energy and resources that are already spent on agricultural productivity. The answer is yes but the approach must be based on prioritization of risk. With more than 51 crops and use of more than 90,000 ton of pesticides and fungicides, the focus on disease detection must begin by identification of the pathogens causing maximum economic losses and most effective measurements to deal with them. With the ability to identify pathogens in all categories, the proposed IoT platform is expected to serve as a key resource in providing such early warnings

Project achievements

a. **Progress vis-a vis objectives-** Chip design developed

b. **Technology/Product (to be) developed-** AGRO-Dx platform is expected to reach the manufacturing ready stage in 2020.

c. **IP generated/ Potential for IP generation-** The patent search indicates that the overall concept of such a device has not yet been patented by anyone and may be open for exploration.

d. **Resources Generated-** Manpower trained. Capability for designing and fabricating chips.

Plans to take innovation further

Interested in partners willing to sponsor manufacturing of the device at a scale that is beyond beta testing and validation

Risks envisaged

The challenges to be solved include regulatory, manufacturing and deployment. It is well known that low costs devices face greater challenges in establishing a sustainable business due to meagre revenue generation rather than technical development

Project Coordinator: Rishi Shanker

Team Members : Somesh Mishra, Surinder Pal Singh, Shikha Yadnwar

Contact : C-1/413, Sector-G, Janipuram, Kursi Road, Lucknow Uttar Pradesh-226021

Saveer Biotech

Title of the Proposal

Towards Smart and Efficient Nanopesticides for Indian-Agro Industry

Brief description

Saveer Biotech Ltd (SBL) has developed a complete protocol for the synthesis of Zinc Oxide nano particles (nZnO) and silica nano particles (nSiO2) using world-leading Induction plasma synthesis (IPS) technology. They have synthesized the nano particles by IPS method with high purity, and without any organic contaminants. Further, they have developed a novel nanoinsecticide by combining the IPS synthesized nSiO2 and nZnO in US€PA approved carrier through proper physical mixing. In the developed product, nSiO2 has potential insecticide activity through physical abrasion of insect cuticle, while nZnO has fungi stat property as well as potent nutrient zinc source.

Current stage of development

Validation

Innovative Element(s)

The company has synthesized nanoparticles through physical process which ensures the synthesis of high purity nanoparticles compared to wet chemistry methods, where there is lot chances of organic contaminants. Further, insects tend to exhibit resistance after long term exposure to organic pesticanedes, while several publications suggest that insect resistance to silica nanoparticles does not occur. Also, the developed product has fungistat and plant germination acceleration capabilities due to nZnO in the final product.

Market Potential

Several nano-products of agricultural sector have been launched in the market by technology-oriented mid-sized companies that produce soil-enhancement products to promote water distribution, storage, and consequently water saving (Transparency Market Research) . However, nano products for storage pest management are not available in market. Also, use of inorganic inert dusts is considered as one of the environment friendly alternative to chemical pesticides in stored pest management. Hence, deployment of these inert dust nano insecticides has huge potential in market outreach.

National/Societal relevance

Based on the research output, engineered and functionalized silica nano particles could be a better possible and cost effective alternatives to the existing pesticides for seed storage in India. The product will be user friendly and not having any problem of insect resurgence, resistance, residues and environmental hazards as compared to the chemical pesticides. Further, farmer need not to reapply the product once applied which is a usual practice with chemical pesticides, this saves the money of farmer.

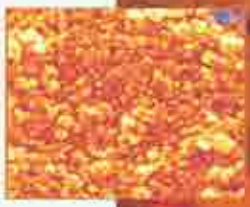
Project achievements

a. **Progress vis-a vis objectives-** Silica and zinc oxide nanoparticles synthesized and formulated with suitable carriec have proved to be nontoxic in nature and exhibited both insecticidal and fungistat properties.

b. **Technology/Product (to be) developed-** Bioefficacy studies revealed that the developed product has potential insecticide property without resurgence even after one year. The final data has been submitted to central insecticides board CIB , India for approval.

c. **IP generated/ Potential for IP generation-** Nil.

d. **Resources Generated-** Manpower and Equipments



Plans to take innovation further

Saveer Nano Division facility is well suited for translational research industry synthesis of nano material by induction plasma of high purity and productions of nano particles of desired sizes.

Risks envisaged

Emergence of nanotechnology applications in consumer products has increased the number of ethical and societal concerns in some countries, which include health and environmental safety, consumer perception, and intellectual property rights. There are no proper set of guidelines for conducting environment safety and other risk associated parameters for nanopesticides from CIB, India.

Project Coordinator: G. S. Reddy

Team Members : Sanjay Sudan, Virendra Patel, Pinky Singh, Anna

Contact : Saveer Biotech 1442, Vikas Nagar, New Delhi - 110 059 & D-54, Sec- 4, Industrial Area, Greater Noida, Uttar Pradesh - 201306

SM Plant Production Technologies Pvt Ltd

Collaborator: Sir M.Vishveshwarayya Institute of Technology

Title of the Proposal

Development of Fusarium resistant banana cv Elakki bale through chemical mutagenesis of embryogenic cells and mass screening for resistance

Brief description

Project proposes to induce mutation in the embryogenic suspensions ECS of the cultivar using chemical mutagens and develop resistant cultivar without changing its favourable qualities by large scale screening of the plants. SM Plant Production Technologies Pvt Ltd. has developed protocols for total regeneration of the plants through Embryogenic Cell Suspensions in bioreactors. Treating the ECS with chemical mutagens would be more efficient in regeneration of chimera free plants.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The company has developed protocols for complete regeneration of the plants through Embryogenic Cell Suspensions in bioreactors. Large number of plants developed through cell suspensions in bioreactors will be available for screening for resistance at seedling stage itself and thereafter for commercialising

Market Potential

A Fusarium resistant cultivar hold high commercial potential.

National/Societal relevance

Development of resistant cultivar of Elakki Bale with its original qualities -flavour and aroma retained would be a boon to the society as a favoured cultivar would be prevented from devastation Utilisation of EMS will be a non-transgenic approach for induction of resistance and this will not be subjected to intensive biosafety evaluation.

Project achievements

a. Progress vis-a vis objectives- Embryogenic cell suspensions of Variety Elakki Bale have been treated with mutagenic agents and mutants have been developed which are being screened for resistance against Fusarium.

b. Technology/Product (to be) developed- Fusarium resistant Banana cultivar Elakki Bale. The plants after initial screening have to be screened in pots and in the field for resistance.

c. IP generated/ Potential for IP generation- NIL

d. Resources Generated- Employed and Trained man power, Created facility

Plans to take innovation further

Not yet decided

Risks envisaged

None at this stage

Project Coordinator: Sukhada Mohandas

Team Members : S.Poovarasan, Anshi Shruti

Contact : 138, Madiure Hobli, Kodi Halli, Doddaballapur Taluk, Karnataka- 562103

Sowbhagya Biotech Pvt. Ltd.

Title of the Proposal

Production of plant growth promoting factors by *Bacillus subtilis* SR1 under the influence of feather protein hydrolysate with control of plant pathogens

Brief description

The aim of the present investigation is to assess the influence of feather protein hydrolysate FPH on plant growth promotion activity of keratinolytic bacterial strain *Bacillus subtilis* SR1. Keratinases, as they are proteinases, show proteolytic activity on various proteins other than Keratin protein, mainly on their disulfide bonds, which are also present between amino acids and is the components of various toxins. An attempt will be made to use Keratinases to degrade the proteins of the pathogens, which inhibit them to grow and infect and thus we may control various plant diseases

Current stage of development

Proof-of-Concept

Innovative Element(s)

The use of chicken feather as a substrate to produce biofungicide

Market Potential

High

National/Societal relevance

Few reports have emphasized the potential role of degraded feathers in 277 plant growth promoters as the end products of keratin degradation are rich source of nitrogen. Feather degradation potential of Bacillus spp. has been widely described in various reports. The time course study of feather degradation by strain PF1 reveals its potential to utilize feather keratin as sole source of carbon and nitrogen

Project achievements

a. Progress vis-a vis objectives- Optimization of media for feather degradation & keratinase enzyme production has been completed

b. Technology/Product (to be) developed- A foliar spray from chicken feather protein hydrolysate amino acids.

c. IP generated/ Potential for IP generation- NIL

d. Resources Generated- Manpower and equipments

Plans to take innovation further

Looking for Partnership and Fund raising

Risks envisaged

None

Project Coordinator: P. Narendra Kumar

Team Members : Sunil Kumar Gupta, Malini N.S, Sai Kishore Kurras, Madhusudan Reddy

Contact : Plot No. 79, Phase II, IDA Cherlapally, Hyderabad, Andhra Pradesh-500051

T. Stanes & Company Ltd.

Collaborator: CAS in Marine Biology, Annamalai University

Title of the Proposal

Development of an integrated product with plant growth & defense potential through end to end utilization of marine biological resources.

Brief description

Development of an integrated product with plant growth & defense potential through end to end utilization of marine biological resources in collaboration with CASMB, by utilizing the ubiquitously available marine resources seaweed and seaweed associated microbes to provide nutrients & mobilize nutrients and stimulate natural resistance against biotic and abiotic stress.

Current stage of development

Pre-Commercialization

Innovative Element(s)

The present project investigated the efficacy and benefits of using the mixture of seaweed and seaweed associated microbes for agricultural application by evolving an efficient process for extraction, cost effective method of culturing seaweed associated microbes, developing a suitable formulation with seaweed associated microbes SWAM.

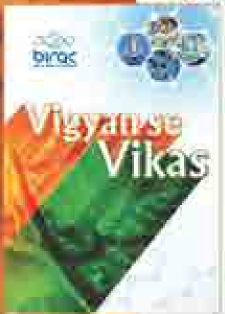
Market Potential

The applications of chemical fertilizers have adversely affected crop yield and soil fertility. But, the use of natural and biological fertilizers on crops will enhance the plant growth and yield without any adverse effect on soil fertility. Hence, developing a product with seaweed and SWAM will significantly improve the utilization of nutrients, produce growth stimulants for plants and provide biological control. Additionally, the use of combo pack of seaweed and SWAM can improve productivity per area in a relatively short time, consume smaller amounts of energy, and promote antagonism and biological control of phyto pathogenic organisms. The aforementioned aspects will be translated into profitable benefits for farmers as a result improved fertilization and higher crop yields.

National/Societal relevance

One million tonnes of seaweed could be produced in a year and around 10, 000 families earn their livelihood. In addition, it is well known that chemical fertilizers degrade the fertility of the soil by making it acidic, rendering it unsuitable for raising crops, however, seaweed and microbial fertilizer besides increasing the soil fertility increases, the moisture holding capacity and supplies adequate trace metals improving the soil structure.

Project achievements



a. **Progress vis-a vis objectives**- Formulation of seaweed microbial fertilizer SMF - consisting of aqueous extracts of the macroalgae and associated microbes & coded as WAKS-16. The products WAKS-16 SMF, KP-18 & RP-17 SLF showed significant effect on the growth of the treated plants, with foliar application.

b. **Technology/Product (to be) developed**- Multiplication media designed, process parameters & co-culturing of the microbes with seaweed extracts. Consortia of Microbes with macro algal extracts as biostimulant and biofertilizer Development of active inoculum CDS consortia suitable for generation of biogas from spent seaweeds.

c. **IP generated/Potential for IP generation**- Isolation and screening of seaweed associated microbes for development of marine based agri inputs. Seaweed Research and Utilization, 39 2: 3946, 2017

d. **Resources Generated** - Two Pilot scale production facilities for seaweed associated microbes & large scale production facilities for commercialization of product has been planned

Risks envisaged

a. Acceptance of the product in terms of the cost and quality
b. Lack of awareness among the farmers to distinguish dubious and good quality seaweed extracts/saps
c. Regulatory guideline & registration of the product in a specified category

Project Coordinator:
K. Latha

Team Members :
V. Karuppiah, K. Sempali Ragunath, P. Srinivasan, Radhesh Krishnan, Keerthana Priya, Manivadan, M. Gracy

Contact :
T.Stanes & Company Ltd., 8/23-24 Race Course Road, Coimbatore, Tamilnadu - 641018

Theevanam Additives and Nutraceuts Pvt. Ltd.

Title of the Proposal

Development of improved glucan based natural immunity booster for shrimp aquaculture with enhanced absorption and potency.

Brief description

TAN ISTIM is a novel formulation of natural polysaccharide immunity booster for booming Shrimp aqua industry. The formulation is made from yeast effluent of brewery industry. Years of research indicated the active component to be ideal for immunity boosting. Use of nanotechnology to control particle size and prevent aggregation on biological fluid leads to efficient absorption and higher potency to bind immunity cell receptors. The introduced formulation is standardized for dosage amount and frequency through statically designed lab trials as well as field trials. The formulation is expected to efficiently eliminate major infections and stress/morbidity usually encountered in shrimp cultivation at hatcheries as well as open ponds/farms and thereby improving the productivity.

Current stage of development

Validation

Innovative Element(s)

30-110 nm size particles leads to increased absorption and potency by efficient binding to immunity cells receptors. Physico-Chemically characterized - defined product - water-insoluble branched polysaccharides Statistical dosage optimization. Process suitability for large scale and affordable production.

Market potential

Shrimp industry is having the huge export opportunity. MPEDA data in 2015 - production of 4.34lakh tons - 1.30 lakh hectare. 70 crop worth Rs. 20045.5 crores were sold in export market. In 2013, 48.000tons of crop destroyed due to infection only and 2.70lakhs tons of crop was achieved.

National/Societal relevance

Growth of aqua industry can provide substantial employment opportunity in rural area. It will bring down Shrimp mortality significantly due to various infections.

Project achievements

a. **Progress vis-a vis objectives**- Glucan extraction from yeast cell wall and processing to nano-particles. Physico-chemical characterization. Lab-trials on shrimps for immunity boosting. Vius/bacterial challenge study. Field-trials for enhanced growth and immunity in shrimp.

b. **Technology/Product (to be) developed**- TAN-ISTIM is a potent immunity modulator nano-particles derived from yeast with 85% carbohydrate purity. Product is under safety testing and certification.

c. **IP generated/ Potential for IP generation**- Process patent will be applied on completion of field validation.

d. **Resources Generated**- 2 PhD and 2 intern employed under the project

Plans to take innovation further

Fund raising for wide scale field validation and pilot-production set-up

Risks envisaged

Lack of unified body for quality certification of the aquaculture feed product in India, lead to extra efforts in convincing farmers for benefits and efficacy of the product. Severe lack of awareness of scientific practices in aquaculture farmers in India

Project Coordinator:
Pati PK

Team Members :
Champa Iswariyan, Minari Patel, Mukesh Dubla, T. Lashadri, Anvasorai Kumar, D.Thyagaraja

Contact :
Department of Biotechnology IIT Madras, Chennai - 600036

Agriculture

BIG

Utpal Tatu (IKP)

Title of the Proposal

Animal Disease Diagnosis and Treatment

Brief description

Development of molecular diagnostic methods as well as software for data storage and analysis for diagnostics and surveillance of infectious in agriculturally important animals. The technology is developed in-house to detect infections in animals. The technology is continuously being upgraded to enhance the sensitivity of the disease diagnostics. The technology provides accurate disease diagnostics and the test can detect infections at an early stage and can thus help in faster recovery and accurate treatment.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Project will lead to the creation of a fourth generation point-of-care, hand held kit which can be used directly in the field, hence saving time.

Market Potential

These services are valuable for dairy, poultry, meat as well as horse industry

National/Societal relevance

This technology will help create healthy animals which would in turn benefit the nation's economy

Project achievements

a. **Progress vis-a vis objectives-** Collected over 4000 field samples and carried out tests for Trypanosomiasis. This has resulted in a successful ELSIA reading to be used by potential clients.

b. **Technology/ Product (to be) developed-** A point-of-care kit will be produced that can be directly used on the field to provide fast and accurate diagnostics.

c. **IP generated/ Potential for IP generation-** Exploring potential IP generation

d. **Resources Generated-** Human resources developed

Plans to take innovation further

In touch with investors to raise funds

Risks envisaged

Government recognition & acceptance.

Project Coordinator:
Utpal Tatu

Team Members :
Sajith S. Nath, Derek Pinto
Shakti Rathore, Ranga Rao, Sweta T

Contact :
Dept. of Biochemistry, Indian Institute of Science, Bangalore-560012

Innovation Profiles

Industrial

Biotechnology

Aspartika Biotech Pvt. Ltd.

Collaborator: Sir M Visvesvaraya Institute of Technology

Title of the Proposal

Establishment of pilot-scale Supercritical Fluid Extraction unit for nutraceutical and cosmeceutical products development

Brief description

The technology developed by the company is to convert the silkworm pupae waste discarded from silk reeling industries into high value nutraceutical like Omega 3 Fatty Acids. The novel solvent free process of extraction ensures an infestation and odour free silkworm pupae oil with not less than 35% omega 3 fatty acid. Poultry feed supplement YeggMore Omega enriched with Calcium linolenate from silkworm pupa oil, enhances the omega 3 fatty acid content in Eggs from 40mg to 250mg. The leftover cake is rich in protein not less than 65 percent protein which is superior to soya protein and used in poultry & aqua feed supplements.

Current stage of development

commercialization

Commercialized in the name of (Product/Technology Name)

Poultry feed supplement: YeggMore Omega and Aqua feed supplement: Growthmin Aqua

Date of commercial Launch : 2018-02-01

Number of units sold : 40000 kg

Number of end users : 30

Innovative Element(s)

A novel and abundant source of omega 3 fatty acid that is 50 % cheaper and 20 % higher in concentration compared to existing sources like fish, trout, krill, flax seed etc.

Market Potential

The estimated global market for omega-3 fatty acid is growing by a healthy rate of 13.8% CAGR from 2015-2020 with an estimated value of USD 9.94 billion. The Indian market for omega-3 fatty is growing at a rate of 11.4% CAGR from 2013 through 2020.

National/Societal relevance

India is the second largest producer of silk in the world with an annual production of 33000 MT. 80% of this comprises of silkworm pupae which is discarded cheaply as waste and causes environmental hazards. Silkworm pupae is rich in omega-3 fatty acids and protein. The amino acid profile of silkworm pupae comprises of essential amino acids that satisfies the FAO/WHO/UNU recommendation. The complete reclamation of this waste can meet omega-3 fatty acid requirement of 78 lakhs children or 26 lakh pregnant women/lactating mothers.

Project achievements

a. **Progress vis-a vis objectives**- The silkworm pupa oil extraction is in pilot scale and its utilization for manufacture of poultry, aqua, swine and cattle feed supplement has been completed.

b. **Technology/Product (to be) developed –** For Human Nutrition: With certifications and other compliances, expected time to hit the market is within 1 year. For Animal Nutrition: Due to lesser compliance, already in market.

c. **IP generated/ Potential for IP generation** - India patent filed for the omega 3 fatty acid production from pupa oil. Other product formulations etc are a combination of patent and trade secret

d. **Resources Generated –** A DSIR recognized R&D unit has been created which is located in Sir MVIT, Bangalore. A production unit in the Dodballapura region of Bangalore has also been created. The company has around 15 employees and a scientific advisory panel comprising of scientists, veterinary doctors etc. Funding has been received from BIG, BIPP, Idea2PoC grant from KBITS, Loan from SBI, Peenya under CGTMSE scheme

Plans to take innovation further

Raised term loan from SBI under CGTMSE scheme. They are in discussion with Ministry of Sericulture GoK , Ramnagara District Zilla panchayat, and MNREGA team for the implementation of a similar project in Ramanagara through a joint venture

Risks envisaged

There is a need for additional funding support for marketing, competent manpower and certifications like FSSAI, ISO, GMP, GLP etc to enter into the human nutrition market.

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : [illegible]

Bactreat Environmental Solutions LLP.

Title of the Proposal

Resource Recovery from Septage

Brief description

The present proposal aims at recovering sanitised soil and fertilizers from septic tanks while adequately abating pathogens and organics. Soil production will be done with Terra Preta composting, while fertiliser recovery from septic effluent will be pursued for struvite recovery by mixing with other wastewater like cow urine whose pH increases when ages.

Current stage of development:

Validation

Innovative Element(s)

The combination of Lactic acid fermentation for hygienization and odour control followed by Vermicomposting for producing the compost from faecal matter / septage.

Market Potential

With centralized sewerage system covering only 35% in India, and most of the others relying on septic tank, nutrient recovery from septage has a huge potential.

National/Societal relevance

Even the major treatment systems which relies on conventional activated sludge, which reaches sufficiently low carbon, nitrogen and phosphorus effluent levels, but is not cost-effective, hardly achieves recovery, requires electricity equivalent to a fossil fuel consumption of 85 kWh per inhabitant equivalent per year. Projected water and phosphorus shortages and the need to lower greenhouse gas emissions force us to rethink wastewater treatment for sustainable cities of the future.

Project achievements

a. **Progress vis-a vis objectives -** One septic tanker solids per day can be processed and 10 tons of Terra preta compost per month can be produced

b. **Technology/Product (to be) developed -** The product has been developed and is currently under cost optimization which will be completed by December 2018

c. **IP generated/ Potential for IP generation** - There is no IP generated although we have the technical know how

d. **Resources Generated** - Two manpower trained, Complete set up for making Terra preta i.e to process one septic tanker has been set up at Baina Sewage treatment plant.

Plans to take innovation further

Plan to set up faecal sludge management plant based on this concept for 20000 people equivalent

Risks envisaged

Regulatory Approvals

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : Bactreat Environmental Solutions LLP, [illegible]

Baijnath Pharmaceuticals Pvt. Ltd.

Collaborator : Institute of Himalayan Bioresource Technology

Title of the Proposal

Development, adoption of green technology for commercial production of tea catechins and its formulations

Brief description

Catechins and theaflavins, the polyphenolic antioxidants of green and black tea, respectively are extracted from coarse shoots and other underutilized parts of the tea plant mainly flower, fruit and mature shoots which otherwise are not used for making orthodox tea. The company has deployed a green technology for extraction of catechins. The institute has a patent for the same.

Current stage of development

Validation

Innovative Element(s)

Green technology for extraction of catechins.

Market Potential

Global market for black tea polyphenols is expected to exceed USD 25 million by 2020 at an estimated CAGR of 6.3 from 2013 to 2020. Countries like Japan and China are exporting their catechin based products like capsules, sachets as nutraceuticals for oral consumption, creams, shampoos and other cosmetic products in to Europe and American markets.

National/Societal relevance

Tea is a crop of commerce. India is the world's second largest producer of tea. For processing tea, the apical bud and subtending two leaves are used. But due to labour shortage, there is difficulty in maintaining the flush and the shoots overgrow. During the rainy months the tea factories are not able to handle the flush which results in low manufacturing and poor quality. Therefore, this technology aims at utilizing these overgrown shoots and abundant flush for extracting catechins, which otherwise results in lower returns of the produce. These extracted catechins/polyphenols are high value, diversified tea products which will fetch many fold higher remunerations leading to upliftment of economic and social strata of tea growers of Himachal Pradesh.

Project achievements

a. **Progress vis-a vis objectives**- Baijnath Pharmaceuticals has successfully completed replicating the process parameters established at CSIR-IHBT campus with 20 Kg batches. Process optimization for purification of catechins at 100 Kg fresh tea leaves per batch 3 batches has been done at M/s. Baijnath Pharmaceuticals Pvt. Ltd.

b. **Technology/Product (to be) developed** – Development of suitable dosage form/formulations of catechin products (i) Tablets (ii) Capsules (iii) Sachets (iv) Cream/paste (v) Elixir Liquid syrup as nutraceuticals/ herbal product

c. **IP generated/ Potential for IP generation** - In-licenced from CSIR - IHBT

d. **Resources Generated** - Three scientists trained in the technology and Pilot scale facility is installed.

Plans to take innovation further

Phase II for the project is under consideration in which they are targeting nutraceuticals and cosmetic products for commercialisation.

Risks envisaged

Market Penetration

Project Coordinator :
S. K. Sharma

Team Members :
[illegible]
Mohit Sharma

Contact :
Baijnath Pharmaceuticals Pvt. Ltd
Paprola, HIMACHAL PRADESH
India 176115

Carot Labs Pvt. Ltd.

Title of the Proposal

Capillary Bioreactor: Bringing major reduction in water requirement for algal cultivation

Brief description

The algae biofuels were touted to revolutionize the world due to energy crisis and global climatic change. Unfortunately, the high production cost of algal cultivation led to its failure. About 40% of production cost is utilized mainly for separation of biomass and water. So, the algae industry resurgence is possible when there is a revolutionary technology which has negligible or no separation cost. An algae production system that reduces water utilization will invariably also reduce separation and handling costs. Thus, the proposed capillary bioreactor which leverages the capillary action across microporous growth surfaces, is a cutting edge technology for algal cultivation that comfortably sees a 5 fold reduction in water consumption compared to the conventional methods.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The proposed technology includes four different innovative elements like CL proprietary nutrient delivery system, CL proprietary gas exchange system, CL proprietary automated harvesting and CL proprietary growth system.

Market Potential

The algae industry is USD $5 billion industry currently at its worst and has the potential to grow in triple digits if the algae biofuel industry achieves financial viability. So, if a disruptive technology like this can add to increased viability in algae biofuels, the market for our technology can be pitted at ~ USD $50-100 billion in the years to come. In addition, there are several other industries that are now tapping into the algae production systems. For examples, astaxanthin and omega from algae is in itself a USD $2 billion market, combined and growing fast. The market trend in India is no different from the global scenario.

National/Societal relevance

A Revolutionary system with least water consumption for algae cultivation which has huge social impact. A cost-effective cultivation system for microalgae which can be utilized for various applications like human nutrition, animal nutrition, cosmetics, high value added molecules poly-unsaturated fatty acids, pigments, vitamins , pharmaceuticals, bioenergy, CO_2 capture and wastewater treatment. Environmental friendly and carbon +ve system with highest efficiency in terms of water, cost and eco friendliness- first of its kind in the world.

Project achievements

a. **Progress vis-a vis objectives**- The lab scale alpha pre-prototype of capillary bioreactor with reduced water consumption is achieved. However, a prototype with precision engineering and increased automation is being developed.

b. **Technology/Product (to be) developed** – An innovative bioreactor for algal cultivation with Carot Labs proprietary growth surface and harvesting technology. The reactor will reach its commercial entry within two years.

c. **IP generated/ Potential for IP generation** - The company is in the process of securing IP for several critical modules of the system.

d. **Resources Generated** - Six employees hired and trained under this project and they also established a sophisticated research facility with proprietary reactor system exclusively designed for algal cultivation.

Plans to take innovation further

Once the technology reaches the commercial level, they wish to collaborate with Petroleum industries to provide the algal raw material for oil production.

Risks envisaged

None

Project Coordinator :
Naveen Chandrasekaran

Team Members :
Ravi Kumar Singaraju, Karthick Sekar, [illegible]
[illegible]
[illegible]

Contact :
Carot Labs Pvt. Ltd
Plot No. 151, 1st Main Road,
Industrial Estate, Perungudi, CHENNAI
TAMIL NADU India-600096

Central Food Technology Research Institute

Title of the Proposal

A process for detoxification and production of high value, bio-based product for cosmetic and health care application from caffeine containing agricultural residues

Brief description

The project aims at the detoxification of agricultural residues containing caffeine and their value addition through microbial fermentation. The resulting "natural product" has cosmetic and healthcare applications especially in the treatment of melanoma. The project aims at scale up of technology for production of the product through microbial fermentation.

Current stage of development

Early stage validation

Innovative Element(s)

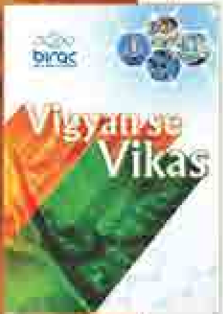
Decaffeination of agricultural residues makes it amenable to decomposition, use as animal feed, aids biogas production and hence alleviates disposal problems. This is a novel solution to the problem.

Market Potential

Skincare market is a growing market with an expected potential of crossing USD $17 billion by 2019. "Natural skincare" products are sought after by consumers due to the associated non-risk factors, unlike synthetic chemical ingredients. A premium natural skin care product today costs on an average not less than Rs. 3000 to 5000 per kg. The product envisaged to be developed under the project thus has a huge market potential with a profit margin of not less than 60-70% of manufacturing and maintenance investment.

National/Societal relevance

The presence of caffeine in wastes makes it unsuitable to be used as animal fodder and their disposable is related to several environmental hazards. If the wastes can be utilized for the generation of valuable methyxanthines, and a product of premium value, it would result in "wealth from waste". This activity could be taken up at community level resulting in increase of income, especially to local population where the raw material is available as well as result in employment for many.



Project achievements

a. **Progress vis-a vis objectives -** The project initiated 8 weeks back and the first objective has been initiated
b. **Technology/Product (to be) developed -** Technology for the disposal of caffeine containing agri residues.
c. **IP generated/ Potential for IP generation -** There is huge potential for generation of IP since no similar products are available in market.
d. **Resources Generated -** Since project is just funded, resource have not been generated

Plans to take innovation further

As a policy of the institute, CSIR-CFTRI, we develop the process know-how which is available for commercialization and transfer of technology. Once the product is ready, we will approach potential industrial partners to take it forward.

Risks envisaged

The risk envisaged include a sustainable availability of raw material for product manufacturing, micro scaling to community level operations, competition from skincare product manufacturers

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : CFTRI, Mysore [illegible] KARNATAKA India [illegible]

Cleanergis Biosciences Pvt. Ltd.

Title of the Proposal

Molasses Spent Wash Treatment Decolourization, Detoxification leading to algal biofuels.

Brief description

Cleanergis Biosciences has developed a technology to treat industrial wastewater using bioremediation. Molasses Spent Wash (MSW) effluent of the molasses based distillery industry is dark brown, has obnoxious smell, very high levels of BOD, COD and other toxic substances that are very detrimental to the environment. The technology uses myco, phyto and phycoremediation and other physical principles to breakdown and remove the substances present in the wastewater. The wastewater flows through the system and gets cleaned up.

Current stage of development

Validation.

Innovative Element(s)

Different principles have been combined to get the best benefit. Myco, phyto and phycoremediation and physical and electro-chemical principles have been combined in an unique way to find a sustainable solution that is cost effective and good for the environment. Pollution problem is solved and simultaneously value is created.

Market Potential

Treatment of MSW is a global issue. In India there are around 300 distilleries and they produce around 35-40 billion liters of spentwash each year. At 10 paise per litre, the total Indian market is 4 billion and 1% of this, if captured, can bring 4 crore annual revenue.

National/Societal relevance

Discharge of effluents in a river or lake can result in water that is unfit for human use and death of fish and other aquatic life. It can lead to excessive anaerobic activity leading to the production of methane and hydrogen sulphide that can cause fires and foul smell. Industries can also cause air pollution and global warming. This technology may provide answer to the above issues.

Project achievements

a. **Progress vis-a vis objectives-** Technology has been developed and pilot trials have been conducted
b. **Technology/Product (to be) developed –** Industrial wastewater treatment using bioremediation
c. **IP generated/ Potential for IP generation -** PCT patent application filed
d. **Resources Generated -** Six post/ graduates employed/trained, simple lab facility created, company registered with ROC

Plans to take innovation further

Thailand pilot trial in progress - partnership expected out of this effort

Risks envisaged

Distillery industry is not willing to accept the new technology. They have invested in evaporation and RO plants and do not wish to invest in new technologies. They are not willing to accept change/ take risks.

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : Cleanergis Biosciences Pvt. Ltd. [illegible] Bangalore [illegible]

Daurala Sugar Works

Collaborator: Shriram Institute for Industrial Research

Title of the Proposal

Removal of hydrogen sulphide from biogas by recovering sulphur from it

Brief description

The bio-gas produced at Daurala contains mainly methane, CO_2 and H_2S. Stripping of CO_2 and H_2S from bio-gas is called up-gradation of bio-gas to the quality of natural gas, which is suitable for automotive applications. Four scrubbers of 1200mm dia and 7 metre height were used in series for up-gradation of biogas upto 100 M^3/hr flow rate in batch process. H_2S is removed by reacting with chelated polyvalent metal ion using redox mechanism, which was regenerated by air and sulfur precipitated as elemental sulfur. CO_2 was removed by scrubbing the biogas with amine solution, which was regenerated by boiling.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Unlike other common processes used for the removal of hydrogen sulphide from bio-gas, it has advantage of recovery of sulphur as by product.

Market Potential

The upgraded biogas may be a good substitute of compressed natural gas, liquefied petroleum gas and piped natural gas and can be used as fuel in various applications where these gases are being presently used. Upgraded biogas would reduce carbon emission and help to earn carbon credit.

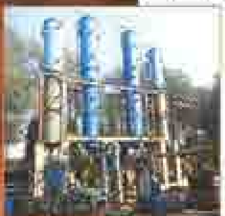
National/Societal relevance

The process developed will provide an opportunity to upgrade bio-gas available in the country to provide a clean and green alternative fuel in the form of upgraded bio-gas. Hence the technology has national importance and is relevant to our social requirement keeping the supply of a cheap and renewable fuel to rural India in mind.

Project achievements

a. **Progress vis-a vis objectives**- Bio-gas was up-graded by removing 87.5% H_2S & 100% Co_2 @ 1m^3/hr. 99% H_2S & 99.5% CO_2 @ 10m^3/hr. 99.9% H_2S & 60.3% CO_2 @ 100m^3/hr.

b. **Technology/Product (to be) developed** – Batch process for up-gradation of bio-gas at 100 m^3 /hr flow rate.



c. **IP generated/ Potential for IP generation** - Nil.

d. **Resources Generated** - Facility created by setting-up of pilot plant for up-gradation of bio-gas in batch process at 100 m^3/hr flow rate.

Plans to take innovation further

The technology has been established as batch process for up-gradation of bio-gas and need to be validated as continuous process.

Risks envisaged

None

Project Coordinator : Vinay Kumar Tyagi

Team Members : [illegible]

Contact : Daurala Sugar Works Daurala, District Meerut UTTAR PRADESH India-250221

Devlina Das (IKP)

Title of the Proposal

Flocco-A Biodegradable Flocculation Filter

Brief description

Flocco is an organic flocculation system comprising of three elements. This is an organo/mineral system which could treat a wide range of pollutants from wastewater with the phenomena of flocculation and adsorption. Unlike commercial flocculants which remove majorly suspended solids, this flocculation system could remove heavy metals mercury and arsenic as well reduce, BOD, COD and oil/grease.

Current stage of development

Validation

Innovative Element(s)

The innovative component of the proposed system is presence of biopolymers and mineral element. The major advantage is it can treat wastewater at a neutral pH.

Market Potential

Flocculants have a total market of 150 million USD worldwide. Even though, commercial PAM and PAC increases the COD of wastewater and are limited to suspended solid matter, they are commercially sold. This flocculant can not only be designed for the wastewater sector but also for pharmaceutical and food sector for their natural origin and this dieversifies their market. Hence the market potential is huge.

National/Societal relevance

This product being an organic/mineral formulation can be used for an instant application of water cleaning, specially muddy or unclean water, with a lot of suspended solids. Specialised filter pouches can be designed and water cleaned by flocculation can be filtered and used instantly for drinking. This technology can be applied for specially those areas where instant water cleaning is required such as disaster prone regions or drought.

Project achievements

a. **Progress vis-a vis objectives**- The stage of technology transfer to the metal polishing industry who wants to find an alternative to using alkali for wastewater treatment.

b. **Technology/Product (to be) developed** – Developed (a) flocculant for sewage and polishing wastewater treatment and (b) filter materials for Arsenic and Fluoride removal. We are in process of regulatory certifications.

c. **IP generated/ Potential for IP generation** - 201841016111 - Flocculant for Sewage Wastewater Treatment. 201841028681 - Ferric Activated Adsorbent for Removal of Arsenic

d. **Resources Generated** – Few manpower hired and equipment purchased.

Plans to take innovation further

Patent on the formulation is in process of getting licensed to a metal polishing company. Currently apart from flocculation, they are in process of developing a product line using biopolymers which would be specifically targeting pollutants like Arsenic, Fluoride, Heavy metals, TDS, suspended solids and oil/grease

Risks envisaged

Major Risk in commercialising the flocculant lies in procurement of the components.

Project Coordinator : Devlina Das

Team Members : [illegible]

Contact : Department of Biotechnology, PSG College of Technology Coimbatore, Coimbatore-641004

Enzibeta Biotech Pvt. Ltd.

Title of the Proposal

Enzymatic Production of Betaine

Brief description

The product "betaine" available in market is either natural, obtained from beet root, or it is chemically synthesized as betaine hydrochloride. EnziBeta Biotech has developed enzyme-based production technology for Betaine which is innovative and first of its kind. This enzymatically produced betaine has properties similar to that of natural betaine. This will be a "Made in India" product which is intended for supply to domestic & international market. Targeted market segment for betaine are - Feed manufacturers cattle & poultry, Energy drinks, Pharmaceuticals.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Currently Betaine is available from Natural or chemical source. Being synthesized enzymatically with similar properties that of Natural betaine, it will help create an intermediate segment. The process technology is protected and currently no such commercial technology is available.

Market Potential

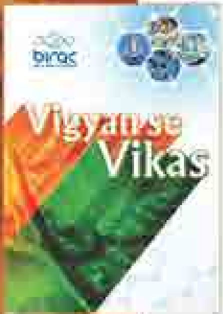
As per market analysis reports, the annual global market of betaine is expected to be 4 billion USD by year 2020. Out of this, the Indian feed market stands around 350-400 million USD.

National/Societal relevance

Currently, India imports betaine. Production within country will not only save forex but also safeguard users against varying prices due to fluctuation in US$.

Aligned with Make in India theme, proposed enzymatic betaine production will help meet the agriculture land available for food & the manufacturing unit setup will open up employment opportunities.

Project achievements



a. **Progress vis-a vis objectives**- The proof of concept is established and technology is under development at lab scale.

b. **Technology/ Product (to be) developed** – End product will be EnziB, which is betaine produced enzymatically and similar in profile to natural betaine. Time frame expected to enter market is 12-15 months

c. **IP generated/ Potential for IP generation** - Patent Title: "Modified gene sequences encoding choline oxidase and a method for preparing betaine using the same- Indian Patent office filing no 201741027084 and PCT filing no PCT/IB2018/055712 with priority date 31st July, 2017

d. **Resources Generated** - EnziBeta Biotech Pvt Ltd was founded to receive the funds. During the project tenure two members were hired and trained for carrying out specific lab activities. In April, 2018 we have received the seed fund from TDB for carrying out the further work.

Plans to take innovation further

The Company have identified 2 raw material manufacturers, whose raw material meets their process specifications. Talks have been initiated with one of these manufacturer for strategic partnership for ensuring raw material supply w.r.t specs and cost.

Risks envisaged

Success factor will depend on the *in-vivo* performance of EnziB in poultry trial. Other challenge is the increase in price of raw material, because this in turn will affect the pricing of the product.

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : [illegible]

Epygen Biotech Pvt. Ltd.

Collaborator : CSIR-Institute of Microbial Technology

Title of the Proposal

Phase 2 of Development of Recombinant Streptokinase in collaboration with CSIR IMTECH for Scaling up and optimization of large-scale production of this life-saving Thrombolytic protein at an affordable cost for the unmet need in Indian patients.

Brief description

Streptokinase (SK) is a ~47 kDa protein produced by beta-haemolytic streptococci used in the treatment of cardiovascular diseases as the most economic thrombolytic agent. EPYGEN BIOTECH intends to produce rSK drug substance using kanamycin clone, utilizing its state of the art facility and purify it, complying with all the compendial requirements of streptokinase drug substance as per biosimilar guidelines.

Current Stage of Development

Proof of Concept

Innovative Element(s)

Overexpression of rSK using *Kana* clone in *E. coli* BL21-DE3 by high cell density fermentation at 100 L scale and purification to homogeneity using modified chromatographic processes

Market Potential

As per the market figure on number of vials, 1.5 million IU are sold per year by the major brands. The current usage covers only 2% of the potential candidate. Considering this, the present Streptokinase market is estimated at about $40 million

National/Societal relevance

With a large portion of Indian society suffering from CVD, there is a serious need for economically viable thrombolytic drugs, especially where cath-lab treatments are rare for the underprivileged. Amongst all thrombolytic agents, streptokinase (SK) is widely used in the treatment of Acute Myocardial Infarction AMI due to its cost-effectiveness and relatively shorter period of hospital stay. A large number of clinical trials on patients with (AMI) clearly show that intravenous infusion of (SK) is associated with reductions in both short-term and long-term fatality

Project achievements

a. **Progress vis-a vis objectives** - Validation of HCD fermentation for rSK production at 19 L scale and lab scale purification showing high yield of purified protein with potency as specified in IP 2018

b. **Technology/ Product (to be) developed** - Validation of HCD fermentation and optimization of downstream process of rSK at 100L scale in Epygen facility at Patalganga

c. **IP generated/ Potential for IP generation** - Project is based on IP owned by CSIR-IMTECH

d. **Resources Generated** - **Manpower employed/trained** - Bioprocess Manager, 1 QC Manager, 1 Microbiologist. Technology incubation centre for 19 L demo and Therapeutic protein plant for 100 L fermentation and purification. Total investment generated from FDI by Foreign Promoters of Indian Origin, Private Investors, Term Loan is to the tune of Rs. 26.4 crore

Plans to take innovation further

EBPL had purchased and developed its MIDC-Patalganga site in Maharashtra, where it has set up a state of the art Therapeutic Protein plant. The timelines are currently set to complete the Animal Toxicity exercise with RCGM by 2018 and Phase 3 Clinical Trials with the DCGI by mid-2019. Commercial launch of EBPL rSK is aimed by late 2019

Risks envisaged

Attaining the targeted yield percentage, plasmid stability, Sensitivity of rSK kanamycin protein to high OD cell-lysis, Scaling up issues related to large quantity protein refolding, consistency of biologically active protein since the refolded protein often loses functionality in part leading to less-than-optimal specific activity and/or stability activity

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : [illegible]

Kabir Jairaj Udeshi (Flycatcher Technologies LLP.)

Title of the Proposal

The Rhino Digester: A novel, robust, versatile, modular, compact and cost effective appliance for decentralized waste processing

Brief description

The Rhino Digester System converts food waste into immediately usable fuel gas and organic fertilizer. It is compact, easy to use, odor and pest free and can be operated by kitchen staff.

Current Stage of development

Commercialization

Commercialized in the name of (Product/Technology Name)

The Rhino Digester System

Date of commercial Launch : 2018-03-01

Number of units sold : 4

Number of end users : 4

Innovative Element(s)

Patented method for circulation and gas generation measurement, eliminates expensive and high maintenance components and minimizes chances of a breakdown. Smallest footprint: 10x smaller than conventional systems; Completely sealed: Waste is crushed and pumped from point of generation directly to the digester through piping. This completely eliminates the need for transportation and handling; Fully automated micro-controller based control and monitoring system; Compact industrial gas storage.

Market Potential

The first target market is institutions in Mumbai and South Gujarat. However, as per the law and societal need, every apartment complex, hotel, industrial canteen, office, etc is a potential client. The overall market is a 1000 Cr. plus market.

National/Societal relevance

Processing food waste is a significant global challenge and one of the primary objectives of the Swatchh Bharat Mission.

Project achievements

a. **Progress vis-a vis objectives**- Project completed

b. **Technology/ Product (to be) developed** – The product has been launched in the market

c. **IP generated/ Potential for IP generation** - Patent Number: 295520; Title: System and method for liquid circulation and gas generation measurement; Date of Filing: 04/03/2017

d. **Resources Generated** – 6 trained manpower, Manufacturing process, Service SOPs, Business model

Plans to take innovation further

There is a huge market to serve. The company is working on the technology to make it possible to deploy a large number of machines with the highest quality of service at the lowest cost.

Risks envisaged

To scale in a systematic manner so that it caters to the market. This will need a combination of technical service expertize and sales efforts.

Project Coordinator : Kabir J Udeshi

Team Members : [illegible]

Contact : [illegible] Villa, Floor 1, [illegible] Mumbai MAHARASHTRA India-[illegible]

Kalam Biotech Pvt. Ltd.

Title of the Proposal

Production of Biofungicide Iturin from *Bacillus amyloliquefaciens* RHNK 22

Brief description

The product, a lipopeptide based cocktail bio fungicide, will have great societal impact directly on the farmers community by protecting their crops from fungal pathogens, giving them good yield and improving their economic status. Indirectly it will also benefit the larger society by providing healthy and safe food by the use of non toxic bioproducts.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

Product is a Lipopeptide based cocktail biofungicide formulation which is broad spectrum and protects plants from fungal pathogens. It is produced from non-pathogenic bacteria *Bacillus amyloliquefaciens* in fermentors. The production and downstream processing is simple and economic. It is being produced using agro industrial waste products like deoiled seed cake which is a cheap source of substrate which brings down the cost of production and makes the product economic.

Market Potential

The biofungicides available are made of live and whole cell formulations, which have problems like stability, cross contamination, and many times are not functional due to competition in the soil environment, and must be used in large quantities. The product even in crude form with 30-40% purity shows good activity *in vitro* and *in vivo* in green house and field tested plants. It acts at micro and milli gram level, hence the quantity needed to kill the pathogens is less.

National/Societal relevance

The product has great potential in the market and will help the farmers in saving their crops from disease and will increase the income by giving greater productivity and improve their livelihood and indirectly benefit the society by producing healthy and safe food.

Project achievements

a. **Progress vis-a vis objectives**- Isolates (more than 1000 *Bacillus* species) from different environments have been screened for lipopeptides production. The lipopeptides were further used and four types of biofungicide formulations prepared and are being tested at Directorate of Oil Research and Agri Business Foundation Hyderabad, in two crops for Fusarium wilt disease.

b. **Technology/ Product developed** – The technology is being developed at laboratory scale in flasks and 1-15 ltr fermentors,and the product produced is being evaluated for its toxicity and field efficacy.

Further the product has to be validated for large scale production and long term toxicity and efficacy studies. It will take 2 years to enter market.

c. **IP generated/ Potential for IP generation** - Patent filing is in process

d. **Resources Generated** - Laboratory facility has been established, four people are employed for the BIG project.

Plans to take innovation further

After the completion of the project, the company will take the innovation ahead by raising funds for validation of the product and taking it to market.

Risks envisaged

Market is large, big players are already there. The advantage with the company is that there are no such products in market. Acceptance by the farmers is also a challenge.

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : Kalam Biotech Pvt Ltd, Department of Microbiology, [illegible] Hyderabad [illegible]

Mallipathra Nutraceutical Pvt. Ltd.

Collaborator: Sir M Visvesvaraya Institute of Technology

Title of the Proposal

Bench scale production of snow flake Cordyceps and *Cordyceps militaris* through solid- state and sub-merged fermentation respectively for nutraceutical application.

Brief description

Snow flake Cordyceps are the medicinal mushroom known to have high Nutraceutical and Cosmeceutical value. It is naturally found in mountains of Korea, Japan and China. It is being consumed as functional health food in countries like Korea and China. It has properties like anti-cancer, anti-cholesterol, anti-diabetic, anti-hypertensive, immune boosting and energy boosting. It also has anti-aging, skin whitening, antioxidant properties. Hence, the project aims at Bench production of the medicinal mushroom on both non-veg host as well as vegetarian substrate for the development of Nutricosmetics.

Current stage of development

Validation

Innovative Element(s)

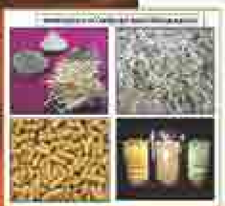
Development of novel and synergistic products comprising bioactives from specific breeds/bio-stages/sex of silkworm 1-DNJ, GABA and Cordycep species. Standardized parameters like temperature, humidity, intensity of light etc., which reduces the time required for fruiting body formation 45 days without compromising quality and quantity of mushroom. Enhancement of bioactives like Cordycepic acid, 4-ASD Acetoxyscripendiol by utilizing novel vegetarian and non-vegetarian substrates. Utilization of waste and discarded silkworm pupae for cultivation of Snow flake cordyceps.

Market Potential

Currently Snow flake Cordyceps are produced by countries like Japan and Korea which costs up to 137 dollars for 20 grams. There are no products related to Snow Flake Cordyceps in India. With abundant availability of low cost raw material, we intend to develop a low cost nutraceutical product.

National/Societal relevance

It is rare as it grows in only specific high altitude areas. It is seasonal as it grows once a year. It is highly expensive due to the non-availability and huge demand. Grows on un-identified hosts and hence highly inconsistent in the quality. Its high value and increasing demand has led to over exploitation of the natural resources. Hence there is a need for sustainable cultivation of mushroom on consistent host or substrate for the conservation of the natural species.



Project achievements

a. **Progress vis-a vis objectives-** Optimization of culture conditions for solid state Snow flake Cordyceps and sub-merged fermentation Cordyceps militaris at Bench Scale Quality assurance of the Products.
b. **Technology/Product (to be) developed** – Cordyceps fruiting body, Cordyceps capsules, Cordyceps mycelium powder
c. **IP generated/ Potential for IP generation -** IP applied
d. **Resources Generated** - Facility created for bench scale production of Cordyceps.

Plans to take innovation further

Seek funding support for marketing activities

Risks envisaged

None

Project Coordinator :
[illegible]

Team Members :
[illegible]

Contact :
Mallipathra Nutraceutical Pvt. Ltd.
[illegible]
KARNATAKA India-[illegible]

Nagarjuna Fertilizer & Chemicals Ltd.

Title of the Proposal

Development of technology Platform for Rare Sugar Production (Phase II)

Brief description

In-house products Honeytose, Caneose and Nectarose occur naturally in honey, cane and nectar. They are tastier than regular sugar and offer clean pleasant sweetness which consumers crave for. The products are free of chemical sweeteners, artificial colors and flavors and are soy free, gluten and dairy free and void of GMO. These products are made using proprietary process using enzyme which is designed to operate efficiently over broad temperature and pH range and maximize conversion rate. Furthermore, the long sustenance of the enzyme renders the overall process economical.

Current Stage of development

Commercialization

Commercialized in the name of (Product/Technology Name)

Honeytose, Caneose and Nectarose

Date of commercial Launch

To be launched in 2019

Innovative Element(s)

The process utilizes protected enzyme which is designed to operate efficiently over broad temperature and pH range and maximize conversion rate. Furthermore, the long sustenance of the enzyme renders the overall process economical. Other innovations are novel sugar separation and crystallization systems.

Market Potential

The company is directly targeting sugar market – 78 % of overall sweeteners market, enabling us to penetrate into wider market base. By marketing in high growth markets like European, North American and Asian region- where a CAGR growth of 5.5% is expected, the company can reach large consumer base and have enhanced revenues.

National/Societal relevance

The sugar products pave way for an exciting time for the food and beverage Industry, given the increasing pressure to reduce sugar and calories. The existing sweeteners are only half hearted attempt to address the need as they are artificial, have unpleasing sweetness and after taste. Furthermore, the intrinsic properties of the existing sweeteners restrict their scope of application.

Project achievements

a. **Progress vis-a vis objectives-** The progress made were as per the objectives of the project. The aim was to mature the technology to pre- commercial level.
b. **Technology/ Product developed** – The products are under commercialization stage. Aggressive global business development is ongoing. Time for commencement for large scale commercial operation is 18 months.
c. **IP generated/ Potential for IP generation** - Over 20 global patents covering critical aspects of the technology process, novel equipment and new product formulations have been awarded.
d. **Resources Generated -** Currently establishing a 5 ton per day test marketing facility near Hyderabad. Next plan is to commission a 100 tons per day plant to undertake fully fledged commercial operations.

Plans to take innovation further

Next step is to undertake global commercialization by engaging the local government and financial agencies of the targeted countries. Long term product off take agreement would be entered into with local food and beverage manufacturers.

Risks envisaged

Some of the risks envisaged pertains to market risk price/ volume, project and competition risk. However, a robust risk mitigation and management framework has been developed that factors in majority of scenarios.

Project Coordinator :
[illegible]

Team Members :
[illegible]

Contact :
Nagarjuna Fertilizer & Chemicals Ltd
[illegible]

National Chemical Laboratory

Collaborators : Auraphyll Innoventures Pvt. Ltd. & Greenvention Biotech Pvt. Ltd.

Title of the Proposal

Production of low molecular weight fungal chitosan for healthcare applications

Brief description

Chitosan is commercially produced from shellfish, crab, lobster and shrimp waste by using strong alkalis at high temperatures. Proposed product i.e. chitosan obtained from fungal sources will be a first-of-its-kind product in India which has lot of applications in healthcare and agriculture. This can open new area for bioprospecting in mycotechnology under three categories; such as, waste fungal biomass from Biotech industries, fungi containing high amounts of these polymers and value addition to existing mycotech-products.

Current Stage of development

Validation

Innovative Element(s)

Benjaminiella poitrasii is a dimorphic fungus with high chitin/chitosan contents, 35% of the cell wall in the mycelial form. Use of dimorphic character of *B. poitrasii* to produce high amount of mycelial biomass and subsequently use of chitin deacetylase to increase the deacetylation level for health care application.

Market potential

B. poitrasii is an important alternative to obtain chitosan with specific properties. Alternately, fungal waste from mycotech industries can be used. Increased low molecular weight chitosan use in healthcare necessitates fungal chitosan production.

National/Societal relevance

Technology for production of low molecular weight fungal chitosan for healthcare applications. Prototype ready with testing in factory environment with pilot scale chitosan production.

Project achievements

a. **Progress vis-a vis objectives:** Optimization for inoculum development, biomass and chitin deacetylase production from B. poitrasii was completed. Isolation, characterization and antifungal study of chitosan was done.

b. **Technology/ Product (to be) developed:** Technology for production of low molecular weight fungal chitosan for healthcare applications. Prototype ready with testing in factory environment with pilot scale chitosan production.

c. **IP generated/Potential for IP generation:** Organism *B. poitrasii* isolated and identified by NCL for chitosan production. IP possible for low molecular weight highly deacetylated chitosan production.

d. **Resources Generated:** One Post-doctoral researcher and two Junior Research Fellows employed and trained for the project work.

Plans to take innovation further

As per the guidelines of CSIR and DBT, NCL will transfer exclusive/non-exclusive rights to collaborating industries or all three may approach third party for technology transfer.

Risks envisaged

Cost of the product can be more for practical grade chitosan useful for industrial scale water treatment, etc than marine source. However, for purified chitosan, especially for health care, it would be lower than marine source.

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : National Chemical Laboratory, [illegible] Pashan, Pune, Maharashtra India-411008

REVY Environmental Solutions Pvt. Ltd.

Title of the Proposal

Mass production of anaerobic granulated sludge - An effective solution for organic water / waste water conversion to recover Biogas and reusable water

Brief description

The product is an anaerobic granulated sludge of 1.5 -2.0mm size and more than 650 bacteria. This consortium is proven to treat waste water and the treated water can directly be used for irrigation purposes. The product developed is highly economical as an industrial effluent is being used as feed material. This ready to use product will provide 26X faster start of Anaerobic digestor/ UASB reactors. It can withstand 10 X higher loading rate. It has a capability to reduce 1.5 X higher COD/BOD while giving 2 X higher biogas yield.

Current Stage of development

Validation

Innovative Element(s)

A case study of dairy ETP reflects that use of UASB with Granulated sludge will require less space, less pre-treatment; can handle 20% higher organic loads, will give 38% more energy as compared to conventional process, less maintenance and 81% lesser time for startup of UASB digester.

Market potential

It is estimated that the waste water treatment equipment market is worth approximately Rs. 220-367 million. One such report suggests that waste water treatment market in India is expected to reach USD 3600 Million by end of FY2018 growing at a CAGR of 18-20%.

National/Societal relevance

Fresh water bodies deteriorate due to untreated sewage and effluent discharge. 62,000 MLD sewage is generated in India but no more than 18,883 MLD of sewage is actually treated. Out of 816 STPs, only 522. Thus, there is an urgent need for efficient water resource management through enhanced water use efficiency and waste water recycling. Problem can be mitigated by adoption of cost effective eco-friendly technologies for waste water treatment.

Project achievements

a. **Progress vis-a vis objectives:** REVY has completed all legal formalities for acquisition of land for setting up pilot plant and now is in process of setting up the pilot unit for technology validation.

b. **Technology/Product (to be) developed:** Successfully completed the PoC development and now are in pilot scaling phase which will be over in next 18 months followed by commercial manufacturing by end of 24 months.

c. **IP generated/ Potential for IP generation:** IP Application submitted for the methodology developed of producing granular biomass with key operational and experimental parameters. Completed Trade mark registration of the product developed along with its content.

d. **Resources Generated:** Employed 7; Trained – 15; Waste water testing & Analysis facility Created; Fund Mobilised – Rs. 50 Lacks bootstrapped.

Plans to take innovation further

Scale up R & D unit and commercialization of technology developed

Risks envisaged

There are no major challenges in setting up the R & D part of the project. The commercialization steps are dependent on challenges of starting of any biotechnology company i.e. include raising capital for mass production, building strategic partnerships, recruiting, and retaining top scientific talent and compliance with regulatory bodies.

Project Coordinator : [illegible]

Team Members : [illegible]

Contact : REVY Environmental Solutions Pvt. Ltd. [illegible] Vadodara, GUJARAT India-[illegible]

Sankar Ganesh Palani (ALMAC Projects and Technology Pvt. Ltd.)

Title of the Proposal

Co-treatment of domestic septage and municipal solid waste landfill leachate using dry-thermophilic anaerobic digestion for the production of bioenergy and biofertilizer

Brief description

The project aims to address problems posed by improper disposal of domestic septage and municipal solid waste landfill leachate by their co-treatment using iSTAR® thermophilic anaerobic digestion process for production of bioenergy followed by composting of digestate for production of biofertilizer. iSTAR® is appended with remote monitoring system to measure those parameters that are critical for the digester's health. Ultimate outcome of the project was iSTAR® a low-cost yet modular biomethanation process and digester for the treatment of organic wastes.

Current Stage of development

Validation

Innovative Element(s)

iSTAR® is designed for treatment of domestic septage and municipal solid waste landfill leachate. However other substrates such as sewage sludge, organic municipal solid waste can be treated using iSTAR®. "Internet of Things" based remote monitoring system, helps in monitoring digester's health and restore any issue at the earliest.

Market Potential

Domestic septage and landfill leachate are generated from many cities in India and many countries in South-East Asia and Africa. iSTAR® has huge potential to treat septage and leachate in eco-friendly yet economic way. Revenue generated from biogas and compost biofertilizer is used to subsidize running cost of the digester.

National/Societal relevance

iSTAR® is simple to operate even by unlettered farmers and persons with minimum education. Hence it can be implemented in both rural and urban areas of our nation. In the absence of comprehensive sewerage network system, more than 50% of the households in India are dependent on conventional individual septic tanks located at the residences. Additionally, as part of Swachh Bharath Abhiyaan, nation is progressing towards achieving the target of having a toilet at every house. With this effort, huge quantities of domestic septage are going to be generated. iSTAR® could easily handle the septage in a safe and eco-friendly manner. The biogas and compost can be used to meet the energy and organic fertilizer requirements respectively, of Indian villages.

Project achievements

a) **Progress vis-a vis objectives-** Project was successfully completed in July, 2018.

b) **Technology/ Product (to be) developed –** During the next phase of the project, industrial scale iSTAR® digester will be demonstrated.

c) **IP generated/ Potential for IP generation -** The novel bioreactor design and process of iSTAR®, including remote monitoring system to monitor digester fitness is under the process of patenting.

d) **Resources Generated -** As part of this project, a private limited company ALMaC Pro Tech has been registered and incubated at the Technology Business Incubator at BITS Pilani, Hyderabad Campus. The main focus areas of the company are waste and wastewater treatment, bioprocess and environmental technologies, in addition to application of Internet of Things. In this project a post-doc fellow Research Associate, two junior research fellows and a lab assistant were trained to work in anaerobic digestion in general and to treat septage and leachate in specific.

Plans to take innovation further

The project coordinator is applying for the second phase of funding to BIRAC. iSTAR® would be commissioned to treat organic fraction of municipal solid waste generated in cities such as Kakhinada and Vijayawada at Andhra Pradesh. In collaboration with National Institute of Rural Development and Panchayati Raj, Hyderabad iSTAR® will be implemented in identified villages and rural areas adopted by the institute.

Risks envisaged

No major risks foreseen

Project Coordinator :
Dr Sankar Ganesh

Team Members :
Chennuru V. V.
Debasree Chowdhury
Jyoti Hosalgade
Mumtaz Sumel

Contact :
Sankar Ganesh Palani, Department of Biological Sciences, BITS Pilani, Hyderabad Campus, Jawahar Nagar, Shameerpet Mandal, RR District, Hyderabad - TELANGANA, India, 500078

Santosh Kumar Jha (KIIT)

Title of the Proposal

Process Development for the Production of UV-protective, Antioxidative and Antimicrobial Pigments from Bacterial Source Using Dairy Waste

Brief description

There is need of cheaper, safer and eco-friendly natural pigments with improved biological properties. Red pigment has been produced by bacterial source using dairy waste and/or agro waste residues to reduce the cost of final product. Red pigment having anti-microbial, anti-aging, anti-oxidative and UV-protective properties.

Current stage of development

Proof-of-Concept

Innovative Element(s)

Use of dairy waste to produce the pigment.

Market Potential

Pigment have immense potential and versatile application namely, antioxidative effect, anti-aging, anti-microbial and immunosuppressive effects. So, it can be used in Food, Pharma and cosmetic industries.

National/Societal relevance

It will be eco-friendly and safe pigment. Pigment will not have any harmful effect on environment and easily biodegradable.

Project achievements

a. **Progress vis-a vis objectives-** PoC has been developed

b. **Technology/Product (to be) developed –** Red pigment from bacterial source

c. **IP generated/ Potential for IP generation -** IP will be filled on upstream and downstream processing of pigment production by using dairy waste.

d. **Resources Generated -** Manpower recruited, Registered as the Star-up, Incorporation completed, Trademark registration filled.

Plans to take innovation further

Fundraising, Licensing

Risks envisaged

Regulatory Approvals

Project Coordinator :
Santosh Kumar Jha

Team Members :
Debasree Roy
Hariharan Parasu

Contact :
Santosh Kumar Jha
Department of Bio-Engineering, Kalinga Institute of Technology, Patia, Bhubaneswar, Khordha, Odisha, 751024

Sengathali Biofiber Pvt. Ltd.

Title of the Proposal

Novel process & Device to extract Banana sap and center core Dietary fiber

Brief description

After harvesting the banana bunch the remaining portion of the tree becomes agriculture waste. This waste contains valuable banana sap and banana dietary fiber. Our technology extracts the valuable things from the banana stem based wastes. Our technology extracts wealth from the waste.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

They have designed the innovative machine to extract the whole stem after cutting it. The banana sap is extracted then remain portion will be dietary fiber. They will develop the machine and process innovative to extract 90% of banana sap and banana dietary fiber.

Market potential

This banana sap is used as a bio fertilizer and if they spray the banana sap in the banana, mango and other vegetable plants it increase the production by 25%. It is rich in potassium. The banana dietary fiber is used as a food materials and to cure the stomach ailments.

National/Societal relevance

This innovative project will give additional income to the banana farmers and will provide nutrient fertilizer from the banana tree itself.

Project achievements

a. **Progress vis-a vis objectives-** Project recently sanctioned

b. **Technology/ Product (to be) developed –** This project is ongoing project. it will take another one year to enter in the market

c. **IP generated/ Potential for IP generation –** None till now

d. **Resources Generated –** Manpower hiring is ongoing

Plans to take innovation further

After completion of the project, immediately they will take this in to market.

Risks envisaged

The people come just like a buyer and simply copying the machine and fabricate in their own place. To safeguard the technology.

Project Coordinator :
Murugan

Team Members :
Lalitha Prakash

Contact :
Sengathali Biofiber Pvt. Ltd.
204/3, Nilam Nagar, 8th Street,
Tiruchirapalli (Dt), TN, INDIA
India-620008

Shaon Ray Chaudhuri (KIIT)

Title of the Proposal

Microbial consortium based biofertilizer for increased Ramie Fiber yield

Brief description

Technology for rapid selective conversion of dairy waste water into biofertilizer using an energy inexpensive method.

Current Stage of development

Proof-of-Concept

Innovative Element(s)

The innovation is in the novel microbial consortium for conversion of pollutants in dairy waste water into plant utilizable biofertilizer as well as the bioreactor design. The biofertilizer application would save use of fresh water and chemical fertilizer for irrigation while saving energy and time.

Market potential

These units will be preferred in the semi-urban areas closer to the farm land requiring irrigation. Typically these units would convert the waste into biofertilizer and use in the surrounding land for cultivation of fodder and food crops. This will establish the pay-back period with different cropping patterns and would be used by all dairy farms based on their requirement of biofertilizer production which would make ETP a profitable proposition.

National/Societal relevance

The conventional process of dairy effluent treatment is expensive and crippling for the middle and small scale dairy farms and an economic drain for the large dairy farms. This technology would make running a dairy ETP profitable, enhance the processing capacity of the plants being less time consuming, prevent the misuse of fresh water for irrigation and protect the environment from using excess chemical fertilizer for yield enhancement.

Project achievements

a. **Progress vis-a vis objectives-** The technology has been scaled up to 9 meter cube per day processing capacity with field trial carried out for mung bean and black gram.

b. **Technology/ Product (to be) developed –** A setup is functioning since April 2018 at Gomati Cooperative Milk Producers Union Limited at Agartala and another is about to be commissioned at OMFED, Bhubaneswar. These are the showcase for the clients to assess the technology.

c. **IP generated/ Potential for IP generation** - One Patent filed "201731003023 dated 27th January 2017". Another patent to be filed soon.

d. **Resources Generated** - Two industrial setup created, manpower trained 5, startup formation process initiated.

Plans to take innovation further

Attempts are on to showcase the technology to the potential clients.

Risks envisaged

Challenge involves preventing third party use of the technology without licensing.

Project Coordinator :
Shaon Ray Chaudhuri

Team Members :
Lalit Mohan Gantayat,
Ashwini Kumar Thakur,
Santanu Dutta

Contact :
Department of Microbiology
[illegible] University, Jaipur-Dehradun
West Bengal 729022

Shirdi Sai Nutraceuticals Pvt. Ltd.

Title of the Proposal

Manufacture of high performance immobilized lipases for production of (a) refined oils, (b) zero trans modified fats, (c) emulsifiers and (d) biodiesel

Brief description

Lipase enzymes are used for commercial processing of oils & fats. The existing commercial lipase enzyme products are expensive and have certain drawbacks, which limit their usage. The Technology address these issues by "Developing High Performance Immobilized Lipases on appropriate supports" so that these immobilized lipases can be used for a large number of cycles and this brings down the application cost of lipases and the appropriate support ensures robustness of the immobilized lipase.

Current stage of development

Validation

Innovative Element(s)

Novel approach to making a High Performance Immobilized Lipase that can be reused for a large number of batches or for a long run in a packed bed reactor.

Market Potential

The targeted applications for "High Performance Immobilized Lipases" are production of biodiesel, modified fats and refined vegetable oils. Market Potential for biodiesel is a few hundred tons world wide and about 75 tons in India. Market Potential for modified fats is a few hundred tons world wide and about 200 tons in India.

National/Societal relevance

Import Substitution; Production of healthy and safe zero trans modified fats in India, eliminating chemical catalysts; Use of range of raw materials for production of bio-diesel in India, which is difficult with chemical process; Development and growth of biotech industry in India and; Employment generation in India.

Project achievements

a. **Progress vis-a vis objectives**- Established the technology on 1 kg scale for making High Performance Immobilized Lipase and using the same for production of emulsifiers and biodiesel.
b. **Technology/Product (to be) developed** – High Performance Immobilized Lipases were developed and tested successfully and expected to enter the market during July 2020.
c. **IP generated/ Potential for IP generation** – A novel way to make High Performance Immobilized Lipases with appropriate supports to suit various applications were developed.
d. **Resources Generated** - Three employee positions hired; a basic R&D laboratory infrastructure with tables, analytical instruments including GC was created in a leased premises; BIG and BIPP grant received.

Plans to take innovation further

Work on productivity of immobilized Lipases with raw materials from customers will be done.
Angel/Venture/Private Equity funds will be sought.

Risks envisaged

Regulatory approvals for refined vegetable oil production using enzymes, though the same can be shown as modified fat without any hurdles. Investment required from Promoter's contribution. The project is based on imported raw materials viz: immobilization support as well as enzymes. Hence, any change in import regulations or cost escalation from suppliers will have an adverse impact on the project profitability.

Project Coordinator : [illegible] Jawadi

Team Members : [illegible]

Contact : Shirdi Sai Nutraceuticals Pvt. Ltd. [illegible] KARNATAKA, India [illegible]

Supriyo Sen (Venture Center)

Title of the Proposal

Novel fermentation process for fragrant agarwood oil production

Brief description

Agarwood is the costliest wood in the world from which fragrant essential oil is produced. The PI has set up the first R&D lab in the world with installed fermentation-distillation pipeline for agarwood oil production and are developing a technology that replaces the traditional soaking of agarwood chips. The results show that fermentation shortens the processing time as well as improves the yield without compromising the quality of the oil.

Current stage of development

Proof-of-Concept

Innovative Element(s)

The innovative element in the project is that it replaces the traditional method of Assam agarwood oil production by a Biotech intervention where a fungus-mediated fermentation is carried out inside specially designed bioreactors.

Market Potential

Agarwood is the costliest wood and is used as a premium fragrance component. Sold at exorbitant process, the global agarwood trade is estimated at 6-8 billion USD. Our technology has huge market potential as it is expected to bring in scientific R&D in Indian agarwood which is otherwise largely traditional.

National/Societal relevance

India is one of the centres of origin of agarwood. The NE part of India is the only region where agarwood resin forms naturally in India. Globally, the market for essential oils and extracts is predicted to grow the fastest in the flavour and fragrance sector. The challenges lie in the fact that the market here is not organised and the production lacks scientific R&D.

Project achievements

a. **Progress vis-a vis objectives**- Process at 5 L scale has been developed.
b. **Technology/Product (to be) developed** – Technology for alternate production of Agarwood oil
c. **IP generated/ Potential for IP generation** – Filed and assigned 2 Indian patents Application Nos. 1277/KOL/2014 and 201633016084A in consultation with Seenergi IPR, Kolkata under BIG project. One process patent filing is under preparation in consultation with IPFace, Venture Center, Pune.
d. **Resources Generated** – Manpower and Facility has been generated.

Plans to take innovation further

Applied for next phase funding

Risks envisaged

None

Project Coordinator : Supriyo Sen

Team Members : [illegible]

Contact : [illegible]

Grand Challenges India

Grand Challenges India

Grand Challenges India

Grand Challenges India (GCI) is the Indian arm of Global Grand Challenges, launched in 2012 and is the flagship program managed by the PMU at BIRAC and is collaboratively funded by Department of Biotechnology (DBT), Bill & Melinda Gates Foundation (BMGF), and the Wellcome Trust.

GCI was launched with the aim of directing funding and research to address some of the most daunting health and development challenges we face today. It does this by fostering Indian-led innovation to develop affordable and sustainable solutions to these challenges, both in the country and across the globe.

The ambit of GCI is intentionally diverse in an effort to include a wide range of research areas that have direct or indirect impacts on public health and development, in order to maximize benefits. GCI also funds projects at various stages in their lifecycle; from basic science research in laboratories, to proof-of-concept projects and potentially to scale-up to innovation projects. GCI is also mandated to work across different disciplines, such as maternal and child health, infectious diseases, vaccines, point-of-care diagnostics, agricultural development, food and nutrition, sanitation and hygiene among others.

GCI is committed to seeking and rewarding both established researchers, young entrepreneurs and other innovators, from academia and industry, with the ambition of expanding the pipeline of ideas for developing new preventive and curative therapies, piloting new technologies and exploring new ideas.

GCI is committed to harness the potential of young as well as established investigators by supporting projects through a series of thematic call announcements or specialised initiatives.

The Program Management Unit at BIRAC (PMU-BIRAC) was set up to execute, manage, and provide technical and financial oversight of this program as well as manage specialised programs on behalf of one or more of the partners.

In 2016, Wellcome Trust joined this partnership and PMU-BIRAC provides technical and management support to the Affordable Healthcare in India portfolio and the Innovators Awards of the Trust.

What began as a suite of 3 programs till 2015, is now a flourishing partnership which implements and manages nearly 15 programs, across 7 themes. Currently, Grand Challnges India and the PMU-BIRAC manage programs in the areas of agriculture and nutrition, sanitation, maternal and child health, immunizations and infectious disease, data integration and analysis, knowledge dissemination among others.

Grand Challenges India and PMU-BIRAC run open calls as well as specialised programs or initiatives on behalf of the partners.

Open calls

Grand Challenges India runs open calls, or calls that are open to the public to apply under various themes. Among these, there are current calls as well as graduated programs where projects under the programs have been completed.

Open calls are typically run as a time bound program, that provides a specific amount of funding for a specific time period. Most open calls are theme-based, i.e. each call is based around a 'Grand Challenge' with a specific mandate. The Grand Challenges Explorations India call is run twice a year on multiple mandates.

Specialised programs/Initiatives

Specialised programs or initiatives or programs that are run by PMU-BIRAC across variety of themes and support a specific research program.

Graduated Programs

These are programs whose projects have been completed and whose successful projects are under active consideration for next steps.

Grand Challenges Exploration-India

The Grand Challenges Exploration-India (GCE-India) is one of the path breaking program under Grand Challenges India (GCI) initiative. This fast-track program is aimed at identifying, nurturing and encouraging innovative ideas to create novel, indigenous technologies to improve the public health situation in India. Although, GCE-India mirrors global GCE program of the Bill & Melinda Gates Foundation (BMGF), however, being India-centric, it addresses challenges that are specific to the Indian health ecosystem. The program is being supported by the Department of Biotechnology, Government of India (DBT), and BMGF.

The program supports proof-of-concept or initial validation of ideas with seed grant that eventually lend themselves to be incubated in start-ups across India resulting in venture creation. As grantees are supported for 18 months to test their idea and generate initial evidence, the calls for application require only a two-page proposal on the basis of which ideas are chosen. The ultimate goal is the quest for new healthcare innovations in the form of medical technology devices, drug delivery systems, diagnostics, and technology enabled service models that can potentially be made available to people from all socio-economic strata. As healthcare innovation from within our nation will address the needs of our nation better; GCE-India is a supporting project that will enable to achieve the goal of equitable healthcare in country.

The GCE-India platform supports projects, keeping in view the public health challenges that continues to be social, economic and political threat to the country and impedes the development of human populations.

Since, Tuberculosis (TB) remains one of the most fatal infectious disease in India, one of the studies supported is aimed at identifying miRNA patterns and their correlation with the TB treatments response, treatment outcome and possible resistance generation. The program is also supporting a robust, cost-effective technology that will convert the existing simple bright-field microscope and fluorescent microscope to the total internal reflection fluorescence for rapid diagnosis of TB. One of the supported studies is also aimed at developing a novel aptamer based rapid electrochemical sensor for diagnoses of pulmonary TB.

In search of PoC test for infectious diseases the development of a glucometer like device and resistive Pulse Technique (RPT) technique that estimates HIV RNA (viral load) and detects malaria infected stiffer RBCs respectively are also in pipeline.

The GCE-India platform in also trying to bridge the existing gap in knowledge on antimicrobial resistance burden (AMR) by supporting studies that intends to develop a point of care (PoC) test combined with a phone-based surveillance system to detect and track AMR in primary care settings and develop Microfluidics-based pH sensors for AMR detection. One of the supported studies is also intending to develop a low-cost AST device accessible to Tier-2/grass root labs.

As maternal child health (MCH) is an important public health priority, the GCE-India platform is also supporting innovations in this area. Development of devices that will be able to auscultate the fetal heart to identify birth asphyxia and remote monitoring of cerebral hypoxia and seizures for early detection and management of HIE is underway. Through development of a nutrient loaded novel, cost-effective cosmeceuticals product novel, the GCE platform is encouraging development of an effective, transdermal multi-micronutrient delivery system, for pregnant women.

The GCE-India platform through network of highly qualified individuals leverage the mentorship, resources and technical consulting to the grantees to help refine their business strategy and other hurdles in the early stage of development. The successful projects also have the opportunity to apply for a follow-on funds from BIRAC through the BIPP, SBIRI and/or the GCE Phase II program of the Department of Biotechnology (DBT), Government of India (GoI), the Biotechnology Industry Research Assistance Council (BIRAC) and Bill & Melinda Gates Foundation (BMGF).

All Children Thriving

The well-being of mothers, infants and children is an important public health priority and addressing maternal infant and child health concerns not only minimizes public health challenges ensuing within families and communities, but consequently reduces the overall burden on health care system. Although, birth defects, adverse pregnancy outcomes and developmental disabilities in children are interrelated functions of several known determinants (such as maternal health, nutritional deficiencies, infectious diseases, genetics, enteric health, water and sanitation), incidentally, much remains unknown about the root cause.

It was to understand some of these factors that the All Children Thriving (ACT) call was launched under Grand Challenges India (GCI).

The program intends to investigate novel cost-effective measurement tools and mechanisms to combat unhealthy birth, growth and development and investigate novel cost-effective measurement tools and mechanisms to combat unhealthy birth, growth and development. The overall goal of the program is to ensure that not only all children survive, but also remain on the trajectory of healthy and productive lives and try to adequately alleviate the burden of birth defects, adverse pregnancy, outcomes and developmental disabilities in children.

Seven projects have been supported under this initiative and each of them projects is aimed at exploring a unique element of the problem with special emphasis on innovative, impactful research on maternal and child health and development.

Three are aimed at developing simple low-cost biomarkers that can be applied early in life to predict or identify possible adverse outcomes among mother and children. Three projects intend to validate/ develop interventions or packages of interventions for improvement in maternal and child health. Whereas one of the projects is aimed at development of biobanks for long term storage of biospecimens to reduce time and cost for future research in this area.

IMPRINT (Nutritional Interventions to improve Linear Growth during Infancy in India)

This is a sub-study under one the Grand Challenges India – All Children Thriving project, titled "Linear Growth Study of Children in Low Income Settings"and is being supported by BMGF with funding support of USD 2.82 Million to Society for Applied Studies, New Delhi, India.

This trial will run for a period of two years and is very critical to provide specific answers to nutritional interventions that would be most efficient and suitable for mothers and children enrolled under the larger Linear Growth trial.

The objectives of IMPRINT trial is

i) To test the efficacy of a daily nutritional supplement for lactating mothers, that provides 600 Kcal of energy, with 25-30% of energy from fats (150 Kcal) and 20 grams of protein (mix of animal and plant source protein) plus micronutrients (80 to 100% of RDA) during the first six months after birth, in improving linear growth of their infants during the first 6 months of life compared to standard of care

ii) To assess the effect of the above intervention on exclusive breastfeeding, breast milk volume and composition, maternal BMI, and anaemia and micronutrient status of mothers and their infants

Improving Immunization Data Systems: Innovating for Action (IDIA)

Grand Challenges India fourth thematic call was announced on 15th November, 2017 on 'Improving Immunization Data Systems', a program directed at addressing challenges faced in collecting, analyzing and using data on immunization and health. The call was open for 60 days with funding support from Department of Biotechnology, GoI and the Bill & Melinda Gates Foundation to support the set of projects aligned to the Indian strategy requirement and in technical partnership with the Ministry of Health and Family Welfare, Government of India, the Department of Health Research (DHR) and the Indian Council of Medical Research (ICMR), who will be providing their valuable technical and practical inputs in selecting and reviewing projects.

This program was launched in response to the challenge that India faces in collating and analysing all the data that it collects for immunizations, starting from supply of vaccines till the consumer. There is an unmet need for an immunization data system or a new way of thinking on data collection, analysis and use to harness the potential of the information that is being missed today. Reconciling coverage and consumption data on immunization is crucial to ensuring that government health and planning officials have an accurate picture of the immunization and disease burden landscape. Immunization is also long-term public health intervention in most cases; therefore there is need for a sustainable data collection and analysis system that is robust and dynamic to manage the demands of it in the future.

The program explicitly focuses on solutions that conceptualize and demonstrate innovations in data systems for immunization to aid in real-time visibility of correlation between consumption and coverage of immunizations. The best ideas would have the potential to be scaled up in multiple settings and would be translatable to practical interventions in India's immunization programme.

The funding of the program was designed such that the Phase I would support upto 10 projects for a limited funding to develop a viable proof-of-concept in 12-18 months for projects to provide an opportunity to develop, refine, and rigorously test approaches that have previously shown promise in controlled or limited settings. Phase II of this program would select the best of the projects from Phase II to scale their intervention and conduct limited field programs, with the ultimate aim being integration into the government programs.

9 projects were selected by the selection committee are being supported under the program.

Antimicrobial Resistance (AMR)

The fifth Grand Challenges India call on Antimicrobial Resistance was launched on 11th April 2018 as a program directed at addressing challenges that are being faced in tackling antimicrobial resistance in India and in comparable geographies.

This call is part of a global call on antimicrobial resistance, where Grand Challenges partners from Brazil, South Africa, Africa and India have come together and announced a call for proposals. Each partner country has run the call in their specific geographies with the understanding that there could be opportunities for cross-country collaborations during the course of the program.

This program aims at encouraging innovation in tackling AMR under three specific categories: solutions for better use of surveillance data to achieve actionable results; innovations in products and technologies to break infection cycles in healthcare settings and to remove antibiotics from effluents.

With the increased awareness on the threat of antimicrobial resistance in the last few years, this call was designed specifically to focus on certain areas that are particularly important for India or have had less research and funding.

Under the mandate of surveillance, the call focused on innovations in new data sources, analytical methods and new biomarkers for surveillance, given that the Government of India is heavily supporting the setting of traditional surveillance networks and systems through the Indian Council of Medical Research. There is a need to explore new data sources, analytical techniques and biomarkers, that may allow us to gather better and more accurate data about how resistance develops and moves in the community. This kind of data will be particularly useful for establishing algorithms that can predict trends in resistance development and its associated factors so that appropriate interventions could be planned.

Another area where research is particularly important, especially for India, given its high rates of infectious disease, is innovative low-cost products and technologies that can be used to break the cycle of infections especially in healthcare settings. Since the drug development pipeline takes a very long time, another alternative to tackle resistance is to break the chain of transmission of these resistant microbes.

The effect of antibiotics in the environment is still not well understood, but what is known is that there is a large outflow of antibiotics/antimicrobials from various sources such as industries that produce APIs for antimicrobials, the community, farms, industrial agricultural set ups among others. It is therefore important to arrest this flow of antibiotics into the environment through new technologies and products.

The call may fund up to nine proposals for a period of 12-18 months with a seed funding.

This call closed on 25th May 2018 and received a total of 293 applications. The review process is underway.

Knowledge Integration -"ki data Challenge for Maternal and Child health"

Data Science Approaches to Improve Maternal and Child Health in India

This is the 6th call under Grand Challenges India program, launched on 3rd July for 45 days with a goal to foster new data-driven approaches answer critical scientific questions related to maternal and child health and development outcomes, using innovative data analytics and modelling approaches.

To foster improvement in mother and child health, there remain key knowledge gaps in our understanding of how nutrition, prenatal and antenatal care, maternal support, and environmental and social factors contribute to an elevated risk of poor maternal and childhood health outcomes. Such an understanding is required to determine what interventions, including health policies, should be delivered to which group of individuals at what point in their lifecycle to ensure optimal outcomes.

Developing and validating approaches to foster maternal and child health is difficult due to the challenging interaction of biological, environmental, and social factors. Furthermore, policy recommendations for such approaches frequently lack sufficient supporting scientific evidence, while clinical trials are expensive, time-consuming, and increasingly difficult to implement. There is now a key opportunity to accelerate research in this area by analysing existing data arising from multiple sources in India and formulating public health recommendations that are data-driven and cost-effective.

Proposals for developing data analytics approaches would be funded at up to $100,000 USD per project for a period of 12-18 months. We have encouraged partnerships between researchers and data scientists from various parts of the country, especially where the opportunity exists to build on established collaborations.

The application process closed on 17th August, 2018. During the call duration robust outreach was done by digital, social, print mediums and mass emails on large scale. During the entire call duration, several roadshows were organized in various institutes across the country which included, IIT Delhi, IIT Chennai, NIRRH Mumbai, NCCS Pune, IGIB Delhi, ISI Kolkata, SJRI Bangalore, among many others. As a result of the efforts for rigorous outreach, we received 119 applications on the online portal by call close time. The applications submitted are under the review process.

Healthy Birth, Growth and Development knowledge integration (HBGDki)-India

The Bill & Melinda Gates Foundation initiated the Healthy Birth, Growth and Development knowledge integration (HBGDki) in India in 2014 with joint management and partnership with PMU-BIRAC. This initiative supports the rapid aggregation and comparison of data from various fragmented sources by providing a single platform for this data to be stored.

This initiative will essentially create a knowledge compendium that will allow researchers and others to access a variety of data from different parts of the world, to allow them to obtain a much clearer picture of global trends and analyses on factors that affect child birth and subsequent development. The three major areas of focus for this initiative are: Preterm birth, physical growth faltering and impaired neurocognitive development.Ten collaborators from India signed an agreement to share their Indian datasets and 23 datasets have been curated and uploaded on GHAP (Global Health Analytics Platform).

Several efforts have been taken for capacity building and grooming of existing data modelers and public health scientists in India, who are well trained to work on India specific problems. PMU-BIRAC consistantly plays an important role in leveraging such talent/expertise in India. As a part of capacity building, HBGDki-India Community Workshop was hosted by the Program Management Unit – BIRAC, in New Delhi in December, 2017. The meeting was attended by over 60 participants from India and abroad. The HBGDki sessions were designed to provide the audience with a detailed introduction to the working of the platform. The workshop also included 'Action Labs' where participants were provided the access to tools and were introduced to its working, and could follow it on their own laptops for hands-on experience. Along with the workshop, a Consultative meeting was organized with key stakeholders and HBGDki-India collaborators to discuss the current situation of HBGDki, how the insights from datasets will be used in country's context and next steps for HBGDki- India.

To provide more insight into the analysis of datasets on the GHAP platform, an online HBGDki-India webinar entitled: "Exploring aggregated HBGDki-India data: a descriptive epidemiology of stunting and wasting" was conducted on May 17, 2018. This webinar provided a detailed composite view of all of the India study data and initial findings of the analysis of datasets that were received from our current partnered community of HBGDki-India investigators. This analysis looked across the entire body of aggregated HBGDki-India data to characterize the epidemiology of moderate and severe wasting and stunting among Indian children from birth until age of 24 months.

PMU team conducted a series of outreach sessions/roadshows in several parts of India/major Indian institutes such as AIIMS, IIT-Delhi, ISI Kolkata, THSTI etc., to find new data scientists, data modellers and public health researchers. This strategy was particularly useful for inciting interest and promoting Indian data science capacity for the 6th Grand Challenges India call on 'ki Data challenge for Maternal and Child Health'.

Knowledge Integration and Translational Platform (KniT)

The Knowledge Integration and Translational Platform (KniT) is a unique platform that has been launched with the aim of collating and analyzing available evidence within India, to inform policymakers and health authorities and aid in the development of evidence-based policy to address the inequalities in the health outcomes in our country. The platform works by identifying gaps in our knowledge and policy, and synthesizing currently available evidence to improve our understanding of current or new interventions or packages of interventions to address the major health issues in our country.

This platform was launched in 2016 and specifically targets Indian policymakers as the end users of the knowledge synthesized, specifically at the State level. This is to ensure that the data and evidence collection is done with the overarching goal of developing and implementing cost-effective, sustainable interventions or packages of multi-sectoral health interventions that are appropriate to the context of different states.

The platform works by conducting extensive systematic reviews and workshops and other meetings to widely share the findings of these studies. Currently, KniT focuses on two tracks, maternal and child health issues and nutrition.

KniT- Nutrition Domain

Being vital to disease prevention, treatment and management, nutrition has emerged as the critical component of the health development agenda. As India accounts for an overwhelming majority of global undernutrition burden, adequate and sustained action and investment in nutrition is essential for achievement of several National and Global Sustainable Development Goals.

Acknowledging the relevance of nutrition, the Society for Applied Studies (SAS) as the KniT- Nutrition Domain Centre, is utilizing multidisciplinary approach to address issues which are of specific interest in the Indian context. The challenges being addressed by the nutrition domain is decided after deliberations among several subject matter specialist/experts.

Currently, the nutrition domain is examining public health and medical interventions to mitigate low birth weight (LBW), anaemia, diarrheal mortality, stunting, wasting and morbidity in reproductive age group women. The platform is also trying to make impact by conducting equity analysis of existing national nutrition and MCH program(s); and examining quality and coverage of home-based care to new born.

To summarise the existing evidence and knowledge integration for policy implications on all aforementioned issues, the platform is carrying out systematic reviews, and review of reviews. The secondary analysis of data from large intervention trials or cohorts, resources and reports of consultative groups are also being used. In addition to this, platform is also evaluating program reports and outputs of implementation research.

In line with the ideology of KniT, the nutrition domain has come out with five manuscripts and few more are in process of publication (submitted for publication). While working on these sub-projects of interests, the platform has identified several knowledge gaps that could provide valuable insights for a redesign of the national program. The platform is currently partnering/interacting with several states providing early implementation guidance/support to states. There is also increased focus on organizing National level consultation workshops/ consultative meetings to accelerate progress in anaemia, food fortification and LBW issues.

KniT – Maternal and Child Health Domain

The International AIDS Vaccine Initiative (IAVI) is the domain center for maternal and child health. This center is focused on providing a system level situation and analysis and diagnosis of the care of small and vulnerable babies at the district level in India.

The learning from this effort should guide the government on a rationale reform of the care system, a better model for analytical and impactful use of routinely collected data in the public and private system within the larger policy space.

The current system of neonatal care comprises of preparatory component in form of antenatal care, safe labour and early neonatal care including extended support and care to sick and vulnerable babies. The integrated care of sick and small neonates at district level will enable easy comparisons of neonatal health status across states and districts and will further aid in designing effective strategies/policy to improve neonatal health, particularly in areas of greatest need.

The overarching goal of present work is to assess the working of and redesign the district model of newborn care for small and sick neonates so as to maximize gains in newborn survival and health and reduce inequity in access and quality of care.

The Domain center, with its team of experts have decided on three questions on the care of sick and small newborns.

The first question aims at understanding the demand and supply of care for small and sick newborns at the district center. In essence, the question focuses on understanding the burden of sick and small newborns and whether facilities are able to cater to these demands in terms of manpower, hospital infrastructure etc. This is being done by a combination of methodologies, such as analysis of government data and published literature.

The second question is a deep-dive into the supply side of the first question and focuses on ascertaining the quality of care provided to these small and sick newborns in these facilities. Here the quality of infrastructure, protocol compliance and competency of the health worker will be conducted through direct observations and surveys as well as through analysis of secondary data. Data on the outcomes of care as well as the mothers' perspective on the in-patient care provided, will also be collected and analysed.

The third question focuses on assessing the level of care in the community as follow up to the discharge of these babies from facilities. This will be answered through home-based interviews of mothers and ASHAs to ascertain their level of knowledge, practices and care seeking behaviour for routine follow-up care and at the time of illness. This will also be supplemented by government data to assess outcomes in babies post-discharge in the district upto 6 months of age.

KniT support to States

The KniT program also provides support to states in India with on public health by analysing and studying relevant India-specific or state-specific data. So far, the program has assisted three states, Orissa, Himachal Pradesh and Rajasthan in answering public health questions specific to the states, and helped them redesign a policy or implementation practice. For Himachal Pradesh, the program analysed data from the state on anaemia and provided inputs that assisted the state in redesigning the anaemia program. The Rajasthan SAM program was assisted by the platform's analysis of SAM data in India.

The way forward

The first segment of KniT was run as an experiment to understand the working of such a platform and the gaps and challenges that it would face. It is clear that such a platform and mechanism are truly filling a hitherto unaddressed gap in the translation of qualitative and quantitative evidence to truly influence and impact public health in a positive manner.

The Sentinels Experiment

Sentinels Experiment in India intends to engage in a new experiment in India in sourcing innovation for global health and would help in catalysing innovation for the discovery and translation of transformative solutions to global health and development inequity. The overall goal is to support explicit innovation practitioners, new partners, new ideas and new opportunities that can either solve gaps in existing strategies or create completely new opportunities and pathways to the outcomes sought on the broader global health challenges.

The investment is to catalyze innovation for the discovery and translation of transformative solutions to global health and development inequity. The experiment focus is on creating and fostering the delivery of more appropriate (affordable, deliverable, scalable) versions of extant interventions, the contribution could be by way of a new product, service or process. The initiative seeks to drive the discovery and development of new transformational advances toward impact that cannot otherwise be achieved.

The experiment will be using some special 'administrative mechanisms' to ensure efficiencies, ideas are reviewed blind, selected by a champion based review and do not require preliminary data or clear demonstrated capacity of the applicant.

The supported projects would be mentored to deliver affordable deliverable, scalable versions of interventions which would have maximum access through public and private markets and fulfil a strong unmet societal need.

Twenty four application received under round I are under review to provide offers of grant agreement either onsite or within days after final selection.

Achieving Healthy Growth through Agriculture and Nutrition (AGN)

The Grand Challenges India (GCI) partnership announced the first call titled 'Achieving Healthy Growth through Agriculture and Nutrition' in August 2013 to target the linkage and relationship between agriculture, nutrition and health shape and structure agriculture and food systems in ways that improve the nutrition, incomes and productivity of smallholders farmers and the rural poor. The program was supported by DBT, BMGF and USAID for four years to implement 5 projects.

The supported five pilot studies brought together a multi-disciplinary consortium of interventions to evaluate innovations at the nexus of agriculture, nutrition, and health to reduce the high incidence of low birth weight, early stunting and wasting among Indian infants and empower women in their multiple family roles.

All the projects under this call, stand completed at their respective sites.

The Technical Advisory Group (TAG) held in October 2017, reviewed all five projects that were successfully completed or nearing completion by December 2017. TAG Noted that, the duration of the studies was very short to produce substantial results in terms of behavior change and deriving health impacts with diet diversities.

Therefore, consideration for a Transition to Scale Grant, recommended scaling up of the three successful interventions while adding more clusters to bring out a significant social impact.

Reinvent the Toilet Challenge

"Reinvent the Toilet Challenge - India", a program directed at addressing the problems in sanitation and especially needed in the rural and urban areas, where billions of people are only capturing and storing their waste, with no sustainable way to handle it once their on-site storage—such as a septic tank or latrine pit—fills up. Sustainable solutions supporting the entire value chain of sanitation from collection to treatment is the need of the hour.

Our ultimate goal is to help ensure clean cities in India with universal access to hygienic toilets as well as local solutions to contain, treat, and safely dispose of human waste. According to the World Health Organization and UNICEF, sanitation rated as "safe for people" increased by only three percent worldwide over the last five years.

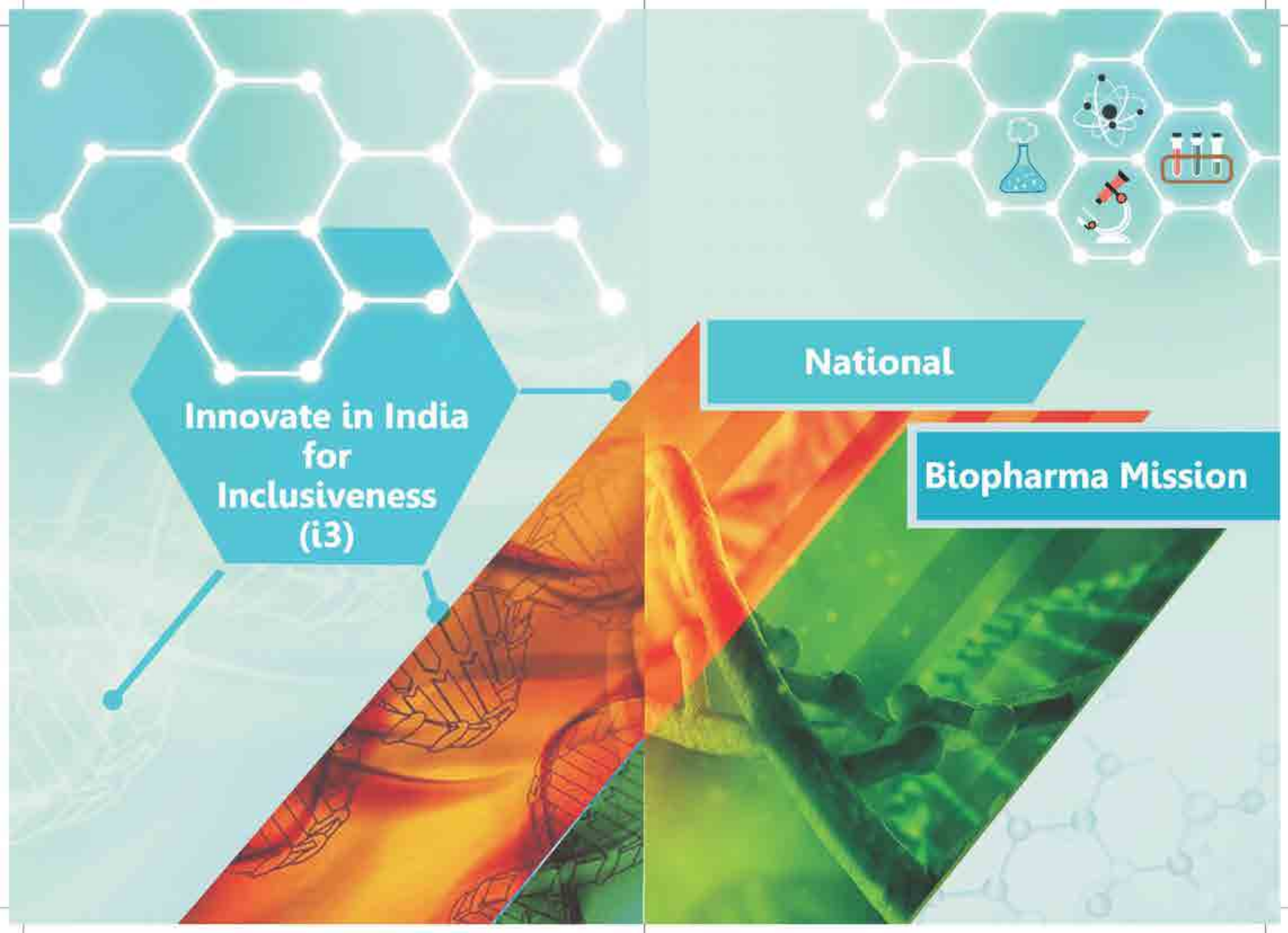
The objective of "Reinvent the Toilet Challenge – India" is to develop a portfolio of Indian-led pilot projects that seek to contribute innovations can be incorporated into a next- generation toilet that will reduce the burden of excreta-related disease and improve the lives. The aim is to expand the use of toilet and sanitation technologies that do not connect to a sewer, as this is by far the most common approach used by the poor. The first round of the RTTC program launched in 2013 and six projects funded under GCI. Out of six projects two technologies had successfully demonstrated proof of concept at a laboratory scale with experimental data. The developed technologies installed in some parts of Delhi for demonstration and greater visibility.

The two technologies that are simple, cost-effective, reliable and culturally acceptable would be supporting under innovation-to-scale. Decentralization of wastewater treatment is a sustainable solution to address this problem that locally treats the sewage and also reuses/recycle. One of the technologies such as the electrochemical, reactor that works on a novel electrochemical process in which the water to be treated is subjected to extremes of pH to kill the coliform and Helminth's.

The second technology is the completely solar powered eToilet is connected to the NEWGenerator this creating a unique model of sanitation recovery with a perfect back-end processing through which resource generation/recovery is made possible. The NEWgenerator harvests nutrient fertilizers (Nitrogen, Phosphorous, and Potassium), energy through biogas, and clean water from human wastes. The machine achieves a high level of waste treatment through the use of anaerobic membrane bioreactor technology (AnMBR). A high level of pathogen destruction is performed to ensure safe sanitation.

Innovate in India for Inclusiveness (i3)

National Biopharma Mission



National Biopharma Mission

Jointly Supported by

Department of Biotechnology (DBT)
Ministry of Science and Technology
Government of India

WORLD BANK GROUP

Implementation Agency

Biotechnology Industry Research Assistance Council (BIRAC)
A Government of India Enterprise

National Biopharma Mission

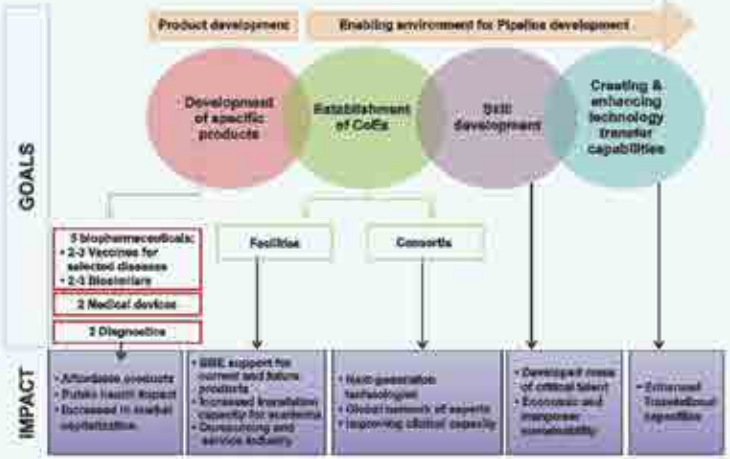
National Biopharma Mission

Industry-Academia Collaborative Mission For Accelerating Discovery Research To Early Development For Biopharmaceuticals - "Innovate in India for Inclusiveness (3)"

The National Biopharma Mission was approved by the Cabinet in May 2017 at a total cost of US$250 million for five years with 50% funding through World Bank loan. The Mission was formally launched by Hon'ble Minister for Science & Technology on 30th June, 2017. The loan agreement between the World Bank and Department of Economic Affairs for flexible financing arrangements for this Mission of DBT was executed on April 24, 2018. The global experience of the World Bank would be instrumental in building sustained global linkages, technical assistance and knowledge flow between public private partners for business promotion in biotech sector.

The Mission aims to make India a hub for design and development of novel, affordable and effective biopharmaceutical products for combating public health concerns. It would strengthen translational capability of academic researchers, empower bio-entrepreneurs and SMEs by decreasing the cost and risk during early stages of product development and also elevate the innovation quotient of the industry.

The Mission would aid in preparing India's technological and product development capabilities in the biopharmaceutical sector to a level that it is globally competitive over the next 10-15 years and will help transform the health standards of India's population through affordable product development. The Mission will provide a holistic and integrated approach to strengthen and support the entire product development value chain for accelerating the research leads to product development. This will help not only in immediate product development addressing public health needs, but will also help to create an ecosystem which will facilitate development of a continuous pipeline of products. The Mission is expected to bring a vast social impact through improved health care products and affordable solutions. It would also have a major economic impact by increasing the market capitalization of Biopharma. India which today occupies only 3% of the Biopharmaceuticals Global Market aims to reach 5% by 2022. This would also help in decreasing our dependency on imported biopharma products, reducing the out of pocket costs, enhancing outsourcing capabilities and ensuring an IP-driven bioeconomy, which will help us to achieve the target of USD 100 billion Biotechnology Industry by 2025.



National Biopharma Mission

In December 2017, BIRAC issued the first round of Request for Proposals (RFPs) under the Mission in alignment with its objectives soliciting proposals from academia and industry focusing on development of (i) Vaccines for Pneumococcus, Dengue, HPV and candidates for other diseases of high burden in India (ii) Biosimilars for cancer, diabetics and rheumatoid arthritis (iii) Medical devices and diagnostics (iv) Process Development Laboratory, GMP Manufacturing Units and GLP analytical characterization facility for Bio therapeutics. Through a tiered screening process, potential proposals have been shortlisted for receiving financial support under the mission.The Mission is expected to extend support to the eligible proposals from September 2018.

The Mission conducted a brainstorming session on June 1, 2018 at BIRAC office, New Delhi seeking inputs toward developing RFP of GCLP labs for vaccine clinical immunogenicity evaluation. Experts from Academia, Research Institutes, Not-for-profits, ICMR and Vaccine industry were invited so as to understand the need, existing capabilities, gaps and the possible operational models for GCLP labs and Clinical Trial Networks. A roundtable session entitled "Working Together Towards Affordable Indigenous Biosimilars' was organized on July 18, 2018 at BIRAC office, New Delhi. This was attended by industry representatives and academic researchers working in the field of biosimilars. The specific objectives of the session were to identify the key challenges faced by industry and academia in the development of biosimilars in India and to suggest possible collaborative pathways towards addressing these challenges.

The next RFP launched in July 2018, based on inputs from the brainstorming session, solicited proposals for establishment of GCLP labs to assess clinical immunogenicity of vaccine candidates in clinical trials. These labs would undertake evaluation of candidate vaccines to generate data for regulatory agencies. Another call was simultaneously launched for establishment of Translational Research Consortia that would help improve, standardize and provide support for advancing development and evaluation of vaccines and monoclonal antibodies for any of the 4 diseases - Dengue, Influenza, Chikungunya and Respiratory Syncytial Virus (RSV). In sequel there will be launch of series of RFPs in 2018-19 under the Mission to strengthen infrastructure, skill development and technology transfer capabilities.

It is envisaged that this Mission will help deliver 6-10 new products in the next five years, create several dedicated facilities for next-generation skills, and generate hundreds of jobs in the process.

WAY FORWARD

The last six years have been exceptionally impactful in the growth of biotech startup ecosystem in the country. Today, we have a well developed entrepreneurial ecosystem strongly backed by the government. An excellent foundation, world class infrastructure, receptivity to home-grown innovative biotech products and services, supportive national policy mandate etc. that have begun to reflect in instances of successful endeavours as commercialized products and technologies generating more than $120 Mn as secondary funding.

Recent initiatives of BIRAC and DBT, such as the launch of FIRST Hub and partnership with KIHT (Kalam's Institute of Health Technology) for facilitation of testing & standardization of medical devices demonstrates BIRAC's commitment to make India as a Global Innovation Hub in the biotech sector.

As we move forward, we will continue to build new capacities to nurture & sustain the Innovation Ecosystem. We intend to amplify our engagement with the community, understand the gaps that still exist and design new paradigms for enhancing the impact. Biotech innovation ecosystem is poised to catalyse a major transformation in the country and BIRAC remains committed to support it to grow and achieve the next level through our commitment to excellence.